

REVving UP RIDER SAFETY: REDUCING THE RISK OF HINDFOOT HYPER-ROTATION IN THE MOTOGP

TU Delft Faculty of Industrial Design Engineering

APPENDIX

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APPENDIX 1. KICK-OFF DOCUMENT

IDE Master Graduation

Project team, Procedural checks and personal Project brief

This document contains the agreements made between student and supervisory team about the student's IDE Master Graduation Project. This document can also include the involvement of an external organisation, however, it does not cover any legal employment relationship that the student and the client (might) agree upon. Next to that, this document facilitates the required procedural checks. In this document:

- The student defines the team, what he/she is going to do/deliver and how that will come about.
- SSC E&SA (Shared Service Center, Education & Student Affairs) reports on the student's registration and study progress.
- IDE's Board of Examiners confirms if the student is allowed to start the Graduation Project.

! USE ADOBE ACROBAT READER TO OPEN, EDIT AND SAVE THIS DOCUMENT

Download again and reopen in case you tried other software, such as Preview (Mac) or a webbrowser.

STUDENT DATA & MASTER PROGRAMME

Save this form according the format "IDE Master Graduation Project Brief_familyname_firstname_studentnumber_dd-mm-yyyy". Complete all blue parts of the form and include the approved Project Brief in your Graduation Report as Appendix 1 !



family name Guis
 initials R.N. given name Sanne
 student number 4353331
 street & no. _____
 zipcode & city _____
 country The Netherlands
 phone _____
 email _____

Your master programme (only select the options that apply to you):

IDE master(s): ☒ IPD ☐ Dfl ☐ SPD

2nd non-IDE master: -

individual programme: - - (give date of approval)

honours programme: ☐ Honours Programme Master

specialisation / annotation: ☐ Medisign

☐ Tech. in Sustainable Design

☐ Entrepreneurship

SUPERVISORY TEAM **

Fill in the required data for the supervisory team members. Please check the instructions on the right !

** chair Toon Huysmans dept. / section: HCD/AED
 ** mentor Lina Li dept. / section: HCD/DCC
 2nd mentor Jasper den Dekker
 organisation: REV'IT! Sport International B.V.
 city: Oss country: The Netherlands

comments (optional) Both supervisors are from HCD, yet they add great value through their different specializations as together they cover the ergonomic (Toon) and the user research side (Lina) of the project. Also, there is no hierarchical conflict.

Chair should request the IDE Board of Examiners for approval of a non-IDE mentor, including a motivation letter and c.v..



Second mentor only applies in case the assignment is hosted by an external organisation.



Ensure a heterogeneous team. In case you wish to include two team members from the same section, please explain why.

APPROVAL PROJECT BRIEF

To be filled in by the chair of the supervisory team.

chair _____ date 08 - 11 - 2021 signature _____**CHECK STUDY PROGRESS**

To be filled in by the SSC E&SA (Shared Service Center, Education & Student Affairs), after approval of the project brief by the Chair. The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total: _____ EC

Of which, taking the conditional requirements into account, can be part of the exam programme _____ EC

List of electives obtained before the third semester without approval of the BoE _____

☒ YES all 1st year master courses passed

☐ NO missing 1st year master courses are:

name _____ date ____ - ____ - ____ signature _____

FORMAL APPROVAL GRADUATION PROJECT

To be filled in by the Board of Examiners of IDE TU Delft. Please check the supervisory team and study the parts of the brief marked **. Next, please assess, (dis)approve and sign this Project Brief, by using the criteria below.

- Does the project fit within the (MSc)-programme of the student (taking into account, if described, the activities done next to the obligatory MSc specific courses)?
- Is the level of the project challenging enough for a MSc IDE graduating student?
- Is the project expected to be doable within 100 working days/20 weeks ?
- Does the composition of the supervisory team comply with the regulations and fit the assignment ?

Content: ☒ APPROVED ☐ NOT APPROVEDProcedure: ☒ APPROVED ☐ NOT APPROVED

comments

name _____ date ____ - ____ - ____ signature _____

The design of a subsystem of a MotoGP motorcycle racing boot

project title

Please state the title of your graduation project (above) and the start date and end date (below). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

start date 08 - 11 - 2021

27 - 06 - 2022

end date

INTRODUCTION **

Please describe, the context of your project, and address the main stakeholders (interests) within this context in a concise yet complete manner. Who are involved, what do they value and how do they currently operate within the given context? What are the main opportunities and limitations you are currently aware of (cultural- and social norms, resources (time, money,...), technology, ...).

The MotoGP Championship is the highest class of motorcycle road (circuit) racing events in the world. The motorcycles that are used in this championship are specifically built for this race and are unavailable for purchase by the general public and not allowed on the public road (Yamaha Racing, 2021). Riding on a circuit is different from riding on the public road. The high speeds and the specific design of the motorcycles call for different riding positions, tactics and movements. With racing at such high speeds also comes a higher risk of crashing (Tomida, et al., 2005). However, the circuits, motorcycles and the protective gear of the riders are specifically designed with this kept in mind, which makes road racing safer than driving on the road (Horner & O'Brien, 1986). In this context, performance and safety are the main design drivers for the gear. Many innovations come from the racing world, as price is less of an issue and people have to come up with smart solutions to outperform the competition (digitaltrends, 2019). The greatest limitations in this field are the safety norms that the designs need to comply with.

All stakeholders for this project can be found in the graph that can be seen in figure 1. They were rated and so positioned based on their level of interest and their influence regarding this project. The main stakeholders are the following ones:

- REV'IT!: A Dutch company that has been developing motorcycle gear since 1995 and specializes in developing a wide range of high-quality gear for a wide range of riders. In 2008 they joined the MotoGP as a sponsor of riding gear for its riders. A few iterations of their racing suits and gloves have come out throughout the years, but now they are looking to expand their design scope by adding motorcycle racing boots to it. They plan to bring these boots to market in a few years. Making a name for yourself at big racing events is a smart way to attract the attention of consumers and to show the company's worth. This increases sales in general and as these boots will, afterwards, become available for the consumer, it's a good way to advertise them.

- MotoGP racers sponsored by REV'IT!: The direct users of the motorcycle racing boots are the MotoGP participants that have a sponsor deal with REV'IT!. Having a pair of good racing boots is important for their performance and safety on the racing track and so for their careers and their physical health. Depending on the rider, aesthetics, comfort and price could also be attributes they value.

- The team surrounding the rider: They are concerned with getting sponsor deals and with the logistics and research behind finding the right gear for their rider. On top of that, the performance and physical health of their rider is in their best interest as it influences their career and probably care about their rider.

- Amateur motorcycle riders: New technical innovations from the racing world often bleed into the consumer market. On top of that, consumer versions of the gear used in the races often eventually end up in the stores for people that are more into the sports look or like to do races on amateur level. They also value performance and safety but for this segment price, comfort and aesthetics are of greater importance.

- Me: A student Integrated Product Design from the faculty of Industrial Design Engineering of the TU Delft who will do research and develop a concept within the context and scope of the described graduation project at REV'IT!.

space available for images / figures on next page



introduction (continued): space for images

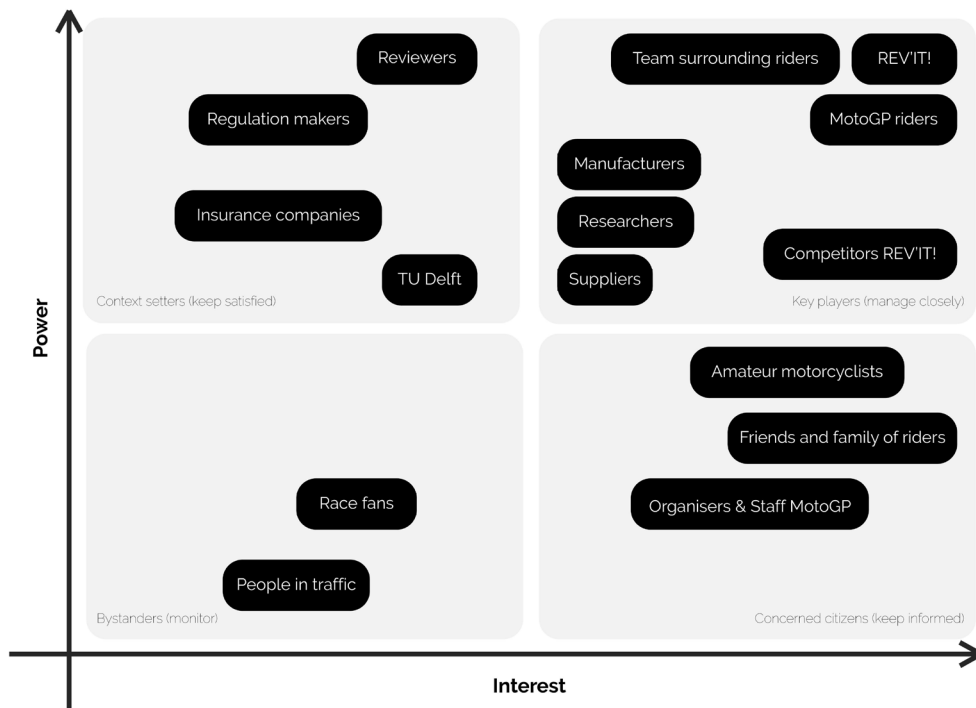


image / figure 1: An overview of the stakeholder and their influence and interest regarding the project.



image / figure 2: Examples of currently available motorcycle racing boots suitable for the MotoGP.

PROBLEM DEFINITION **

Limit and define the scope and solution space of your project to one that is manageable within one Master Graduation Project of 30 EC (= 20 full time weeks or 100 working days) and clearly indicate what issue(s) should be addressed in this project.

REV'IT! is aiming to have their MotoGP riders wear REV'IT! motorcycle racing boots on the racetrack in a few years, instead of the ones of their competitors, so that they are covered in REV'IT! gear from neck to toe. They currently have experience with the development of adventure bike boots, race gloves and race suits, as these are already in their product portfolio, but in terms of motorcycle racing boots, they are at the start of the analysis phase. To get from this point to a race-ready product a lot of research, designing and testing is required. For this project, the scope is limited to the development of a concept design of the selected subsystem of the boot. The research and the design within this scope should serve as a base for REV'IT!'s development of their full and race-ready boots.

As mentioned, performance and safety are the main design drivers for MotoGP level gear and so also for the racing boots. For the rider to perform well, the gear should be comfortable, aerodynamic and lightweight. Furthermore, it should allow for freedom of motion in the right directions, and the grip and tactile feel of the footpegs, brake and shift lever must be optimal. How these aspects combined with the safety regulations exactly influence the design of the boot and whether there are any other influential factors specific for this context will have to be explored. The ergonomics including the safety, comfort on and off the bike, freedom of motion and tactile feel will be the focus of this project. The MotoGP riders are the considered target group, so the amateur market is left outside the scope. As the batch size of the product for this target group is small, the option of personalisation should be considered.

The boot should fit the brand identity of REV'IT!; high-quality, safe, innovative and aesthetic. The market of racing footwear is relatively traditional and so REV'IT!'s goal is to implement innovative technology into their design. Additionally, other ways to differentiate from the competition should be investigated, while considering current patents.

ASSIGNMENT **

State in 2 or 3 sentences what you are going to research, design, create and / or generate, that will solve (part of) the issue(s) pointed out in "problem definition". Then illustrate this assignment by indicating what kind of solution you expect and / or aim to deliver, for instance: a product, a product-service combination, a strategy illustrated through product or product-service combination ideas, ... In case of a Specialisation and/or Annotation, make sure the assignment reflects this/these.

Analyse the factors that influence the design of a MotoGP level motorcycle racing boot that fits the brand identity of REV'IT! with a focus on the ergonomics, and summarize this research into a list of requirements. Then, select the subsystem of the boot that, based on the results of the analysis, turns out to be most relevant and fitting with the project and design this part so that it balances performance, safety, technological innovation, aesthetics and price.

The kind of solution that I expect to deliver by the end of this project is both a list of requirements for the design of a MotoGP level motorcycle racing boot and the concept design of a subsystem of the motorcycle boot that is taken up to the technology readiness level 4 (TRL 4). This means that the core mechanisms and functions are tested in a laboratory environment with the use of a prototype. The results of this test will be an update of the LoR, an iteration of the conceptual design and recommendations.

The analysis that will be the base for the list of requirements will consist of research regarding the target group, user context, fit, tactile feel, comfort, anatomy and biomechanics of the lower leg, current market supply (competitors of REV'IT!), current patents, production processes, relevant technological developments and other trends, safety regulations, brand identity and the possibility for personalisation of the boot for the riders.

Examples of subsystems of the racing boot are (a) the anti-torsion system that prevents damage caused by overstretching the ankle joint, while it should allow for freedom of motion in the right directions, (b) the sole of the boot that protects the foot from being crushed from the side and provides grip and tactile feel, (c) the fitting system that could ensure an optimal fit and so comfort for the rider or (d) the ankle, heel and toe protection system that protect these parts from impact and from being crushed.



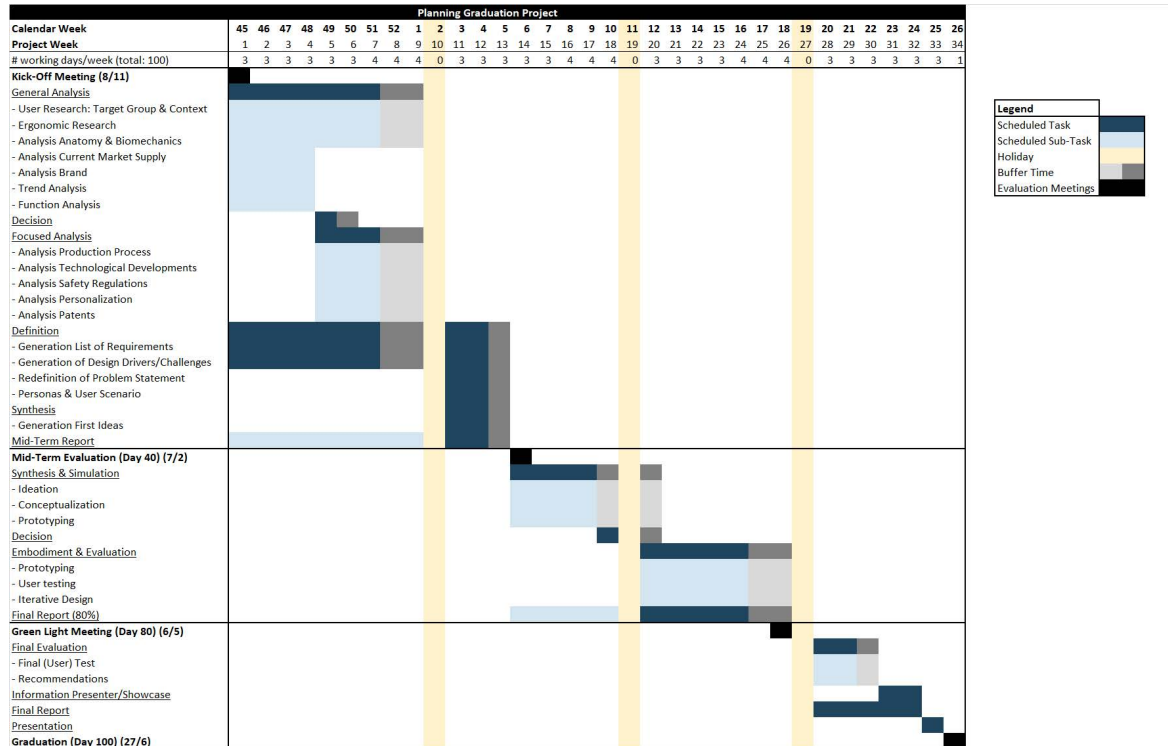
PLANNING AND APPROACH **

Include a Gantt Chart (replace the example below - more examples can be found in Manual 2) that shows the different phases of your project, deliverables you have in mind, meetings, and how you plan to spend your time. Please note that all activities should fit within the given net time of 30 EC = 20 full time weeks or 100 working days, and your planning should include a kick-off meeting, mid-term meeting, green light meeting and graduation ceremony. Illustrate your Gantt Chart by, for instance, explaining your approach, and please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any, for instance because of holidays or parallel activities.

start date 8 - 11 - 2021

27 - 6 - 2022

end date



Due to the passing of my little sister half a year ago and because of my new job as Operations Manager of the D: DREAM Hall, I decided to spread the required 100 working days so that, in general, three days a week are designated to my graduation project. Some weeks this will be four days, to be able to schedule a week of vacation without extending the graduation too far into the summer holiday. Combining this reduced workload with the variation that my job brings, should allow me to execute this project in a healthier and more sustainable manner.

During the analysis phase, the goal is to gather the information that can be summarized into a list of requirements, design drivers, personas, user scenario and a redefinition of the problem statement. The data will be gathered through literature reviews, interviewing experts and the target group, physical testing for objective data and user research. First a general analysis will be done that applies to the whole boot (diverging) to determine which subsystem to focus on (converging). After this, a subsystem is chosen which will be the focus of further analyses. By the end of this phase, a design goal will be stated that fits the project and findings, and first ideas will be presented at the Mid-Term Evaluation. From there, more ideation methods are used, and the chosen ideas are turned into concepts. Within the synthesis phase research will be done to support design decisions (Research through Design). Prototyping and (user) testing will support this process. From these concepts, one will be brought along into the embodiment phase, in which iterations will be generated and tested. The final concept is presented at the Green Light Meeting. The final evaluation of a prototype of this concept is done in the weeks to follow and will be the basis for recommendations.

The idea is to start off with meetings with both the chair and mentor on a biweekly basis. Depending on the phase and the emphasis in the research or design phase, the frequency, the nature of the meeting and who is present will be altered accordingly. Updating the client will be done when relevant and more continuously.

MOTIVATION AND PERSONAL AMBITIONS

Explain why you set up this project, what competences you want to prove and learn. For example: acquired competences from your MSc programme, the elective semester, extra-curricular activities (etc.) and point out the competences you have yet developed. Optionally, describe which personal learning ambitions you explicitly want to address in this project, on top of the learning objectives of the Graduation Project, such as: in depth knowledge a on specific subject, broadening your competences or experimenting with a specific tool and/or methodology, Stick to no more than five ambitions.

In 2017 I joined the D:DREAM Team Nova Electric Racing which is a student team that spends a year designing, building and racing an electric racing motorcycle. I joined the team fulltime for two years and learned a lot about motorcycles in general and about racing them. I got to work with our riders for the ergonomic side of the bodywork that I designed, which I enjoyed a lot. I joined this team as I had recently started my motorcycle driving lessons around that time and that's when I started to develop my love for motorcycles. As REV'IT! is my go-to in terms of motorcycle gear, I'm excited to work with them on this project. My goal is to learn more in-depth about protective gear and with that about the safety, design and ergonomics behind it. Throughout the courses of my master, it became apparent that my interests lie in user research, ergonomics, prototyping, electronics, CAD modelling, ideation, video editing and project management. These are competences I would enjoy developing further and hope to be able to use during this project, but there are a few ambitions I specifically have for this project:

- Time Management

A great challenge for me this project will be the time management. I tend to be too optimistic when it comes to estimating how much time something will take and I generally want to do things too well, which often leads me to overwork. My goal is to maintain a healthy work/life balance throughout this project.

- Use Tools from the IDE Physical and Ergonomics Lab

If I get the chance, I would like to become familiar with 3D scanning and/or motion capture. I've used 3D scanning before to adapt the bodywork of the motorcycle to our rider, but I'm far from experienced with it. That's why I would either like to get more acquainted with this or would like to learn a new skill by exploring motion capture.

- Applying Ideation Methodologies

With courses like Design Theory & Methodology and Creative Facilitation I learned new ideation techniques that I would like to put to practice during this project. This way I would like to get more familiar with these methods and learn my preferences in this area.

- Talking to Experts

Talking to experts is my preferred way of retrieving information. My pitfall, however, is often that I want to be too well prepared before entering set meeting and postpone it too long because of that. This is the reason why I strive to talk to the relevant experts early on into the project and continue to work with them throughout the project, to force myself to get over this.

- Visual Communication

Through MSc projects I've been able to practice my visual communication skills, but I want to become more experienced. Especially in terms of computer-generated visuals in reports and presentations. That's why my ambition is to create a visual report instead of a thesis that resembles a paper.

FINAL COMMENTS

In case your project brief needs final comments, please add any information you think is relevant.



APPENDIX 2. ANALYSIS BRAND IMAGE REV'IT!

The brand identity of REV'IT! is designed by REV'IT! itself. The portray themselves the way they would like to be seen by the outside world. Interesting to investigate, however, is whether this identity matches the way the way the outside world sees them. And if not, what the reason behind this is. In this situation REV'IT! could decide to change something in their product design or portfolio or to change their marketing strategy. For this analysis the Facebook, Instagram, and LinkedIn of REV'IT! (REV'IT!, 2022b, 2022c, 2022d, 2022e) and other channels reviewing REV'IT!'s products were looked at. All the comments in which people expressed an opinion, good or bad, were screenshots and can be found below.

Conclusion

In general people think of REV'IT! as a high-end brand, that delivers very good looking, high-quality products that make people feel safe and comfortable. Most of the comments were positive and enthusiastic about the brand. Many comments about products were saying that this was the best product in this category they ever owned. On their communication channels REV'IT! mostly represents people in their 30's, but their customers seem to range greatly in age (16-60 years old (REV'IT!, n.d.)). People seem to really appreciate the diversity of the models and the high-production value of the photos and videos they output. This fits with the way they want to portray themselves. As their gear is rather pricey, which is pointed out from time to time, they are mostly selling to riders from the middle and high class.

There were a few remarks, however. The most frequently mentioned is the one that women don't feel like REV'IT! tailors to their needs in terms of aesthetics and available options. They state that the gear is rather stereotypical, as there is always some pink or an animal print on it, which is something they don't want. Of course, there will be women that do appreciate this, but seeing the comments, there seems to be a lot of frustration in the group of women that don't. They feel these design decisions were made by smallminded men that feel like women are only on a motorcycle when they are sitting on the back of their men's bike. This image does not match REV'IT!'s identity of being user oriented, young/modern and inclusive. REV'IT! says to be working on it, but they will have to show it in practice to change this image. This complaint is not specific to REV'IT!, however, but they could be a good example to other brands and use this to promote the brand identity of REV'IT! while making users happy. Generally, racing boots are unisex, even though they are mostly targeted towards men. There are a few brands making women's racing boots, but these are never the top-segment boots with the best protection and usually feminine in design (Motorcycle Gearhub, n.d.-a; n.d.-b). As fit is an important factor in the efficacy of the protection of the boot, focussing on a racing boot with the safety, sizing and the aesthetic preferences of women in mind could be an interesting step to explore for REV'IT! and to maybe even sponsor a female rider, like Moto3 rider Carrasco (Motorsport, 2022), at some point. Of course, at this point the market is small, but it's growing and there is the potential that more representation results in the growth of a market. Also, REV'IT! says to be a challenger in the sport segment, so it could be a good marketing strategy to communicate this status. A few comments on the videos about the women adventure team were already very positive, as they appreciate the attention REV'IT! is paying to it.

Another comment was about the range of sizes. People felt left out as they were either too big or too small for the REV'IT! products. However, this comes down to a trade-off as at some point the investments required to accommodate for these sizes probably will not be compensated by the revenue that is generated by them. There were a few (very few) complaints that were gear related. But a downfall of being known for being so high-quality and for being in the higher price segment, is that people get nit-picky and are quick to point out something is wrong with the items they bought. This will also be something to consider for the high-end racing boots REV'IT! plans to bring to the consumer market. But REV'IT! handles these comments in a kind, helpful and understanding manner. Which only contributes to the good image people have of the brand.



I have one. I love it! Everyone always asks me about it. I like that it isn't logo heavy or look like I'm headed off to racing.

Leuk Beantwoorden 30 w Bewerkt



1

...



Rev'it Leathers are great but don't bother looking if you are not small and slim they don't make leathers for larger people

Leuk Beantwoorden 28 w

...



Got them, best boots I ever owned. And perfect fit on the Sand3 trousers.
Grats REV'IT!

Leuk Beantwoorden 33 w



1

...



I tried it on, it looks great and the color is very nice. A bit pricey I'd say 😊

Leuk Beantwoorden 33 w

...



Bought a pair of gloves from you a couple of months ago and now today one of them already goes apart — should I be questioning the quality of your products now?

Leuk Beantwoorden 34 w

...



REV'IT! Maybe you should start. MANY adult women have "child" sized hands. We are completely left out. I have zero protective gloves and I ride my motorcycle almost every day.

Leuk Beantwoorden 41 w

...



Please take a look at your current team before deciding on your next two team members. I've been riding for 23 years and the women I've ridden with over the years come in all shapes, sizes, ages, and colors. Let's see some diversity, REV'IT!

Leuk Beantwoorden 33 w Bewerkt



1

...



Neon yellow or teal instead of pink, please

Leuk Beantwoorden 41 w

...



Auteur

Working on that for the future!

Leuk Beantwoorden 41 w

...



well they do have to apply, cant prick them out of thin air

Leuk Beantwoorden 33 w



1

...



Take a look at KLIM, for reference. I love my Revit jackets and gloves but recently purchased a KLIM jacket with neon yellow..

Leuk Beantwoorden 41 w Bewerkt



1

...



More color options OTHER THAN PINK would be lovely. Idk how many times, how many ways your LADY customers gotta scream it...guess we will just keep trying. At least this is LESS pink?

Leuk Beantwoorden 41 w



...



That is one stunning mobile lab! Innovative way of developing the best gear.
Vertaling weergeven

7 mnd ...

Interessant | Reageren



Hearing you loud and clear. Unfortunately pink sells, but we are definately looking into adding more color options in the future.

Leuk Beantwoorden 41 w

...



As usual very nice design from Rev'it

Leuk Beantwoorden 21 w



...



REV'IT! I am guessing pink sells because we women still don't have other options. (When the ONLY two options are black or pink, we still have to have gear, so it will have to be one of those two.) I don't think the men in charge quite understand. We. Don't. Like. Pink. We keep buying it because we are forced to. 😞

Leuk Beantwoorden 41 w



...



Fingers crossed for better womens gear 🙏

Leuk Beantwoorden 1 w

...



REV'IT! I'm glad you're listening- but perhaps pink sells bc its all that offered in female fit? I know ALL the ladies pages im a part of, from dirt, to track, and especially ADV- they are all begging for more colors then pink. We like blue. We like yellow. Companies like yours and the other big names are taking steps to improve ladies fit and color-and we thank you-just keep pushing even harder! The sooner the better- the # of lady riders has DOUBLED in the last few years.

Leuk Beantwoorden 41 w



...



Excellent. He's certainly wearing the best in my opinion.

Leuk Beantwoorden 27 w



...

The best motorcycle riding gear I ever bought, love it 🙏

Leuk Beantwoorden 29 w



...



Yes!!! Congrats and
!!! The #REV'IT! women's team is awesome!

1 w. 3 vind-ik-leuks Reageren





What an epic collab! 🤖

4 w. 1 vind-ik-leuk Reageren



I love all my Revit! Gear. High quality gear

4 w. Reageren ...



I wish this bag had more rugged features, i've used it for several months now for daily commuting anf light adventure but it could definitely use some upgrades to prevent wear/tear. Overall user experience could be very easily upgraded for this pricepoint.

6 w. Reageren



I got my first Revit gear and I love the way it makes me feel, safe and comfortable. I always thought that it needed to be leather to feel that way, but now the Sand 4 H20 is giving me everything. And my daughter said I look really fancy. ❤️🔥❤️

4 w. 1 vind-ik-leuk Reageren



The very best protective and stylish clothing for a motorcycle enthusiast 🏍️

4 w. 1 vind-ik-leuk Reageren



One of my best everyday jacket 🤖

5 w. Reageren



Your's products are very best 🐾

6 w. Reageren ...



I bought a revit jacket, i hope it doesn't kill my bike too 🤖

6 w. 1 vind-ik-leuk Reageren ...



A Legend in Legendary Clothes 🌟🐾

6 w. Reageren



To bad he broke his ankle @revit_official

8 w. Reageren



Shut up n take my money

10 w. 1 vind-ik-leuk Reageren



Woman's Moto gear exists.....Moto companies: "Make It PINK Or AnImAl Print" 🤖

12 w. 3 vind-ik-leuks Reageren



That's how you do a team-up/collab two awesome brands working on great products. @officialtriumph you may want to take some notes

9 w. 1 vind-ik-leuk Reageren ...



the dark pink or with a lovely flower detail are the worst for me

11 w. 2 vind-ik-leuks Reageren ...



Okaaaaayyyy... we see you @revit_official 🧑🏽

15 w. Reageren ***

Can we have something like this for woman? 🤔

17 w. Reageren

Congrats. Keep up developing great motorcycle wear.

18 w. 1 vind-ik-leuk Reageren ***

I own it, good stuff 👍

19 w. Reageren

This jacket has saved my ass numerous times in motorcycle accidents

21 w. Reageren ***

My favorite mens jacket ever!!!

21 w. 1 vind-ik-leuk Reageren

I love your photography, great style and fantastic models. Just saying! 🤔👍

22 w. Reageren

Love your gear; can you call us women instead of ladies please?

22 w. Reageren

Could you not with the pink though?

22 w. Reageren

Why rose for the girls? 🤔 why not orange? 🤔

19 w. Reageren

The women's suits are 🤔🤔

23 w. Reageren

More for the ladies please

24 w. 1 vind-ik-leuk Reageren ***

revit is my favorite brand of motorcycle equipments, but these shoes i dont like them, sry

26 w. Reageren

I love all of your other shoes.

26 w. Reageren

Loving the womenswear range

27 w. Reageren

Super fijn pak. Top kwaliteit! 👍👍

30 w. 1 vind-ik-leuk Reageren ***

Best jacked I ever have

30 w. Reageren





Great looking jacket!

30 w. Reageren



Best suit i've owned so far 🍑

33 w. 1 vind-ik-leuk Reageren



Way out of my price range 😬

35 w. Reageren



Love the Revit Gear. You guys are just amazing!
Every product I have is superb!

35 w. 1 vind-ik-leuk Reageren



Easiest boots to put on and take off, nice work on
that closure system REV'IT! team.

34 w. Reageren



No offense, for I truly love my Revit jacket and the
quality of your gear, but this lanky model has basically no hips
or butt so she isn't exactly the most representative human for
women's gear.

37 w. 1 vind-ik-leuk Reageren



If we can please stop putting only pink, white,
and black on all the ladies gear that would be great. This
happens across multiple brands and it's tiresome. I'm a lady
rider, but I don't need to wear pink all the time to remind
myself of it.

24 w. 2 vind-ik-leuks Reageren



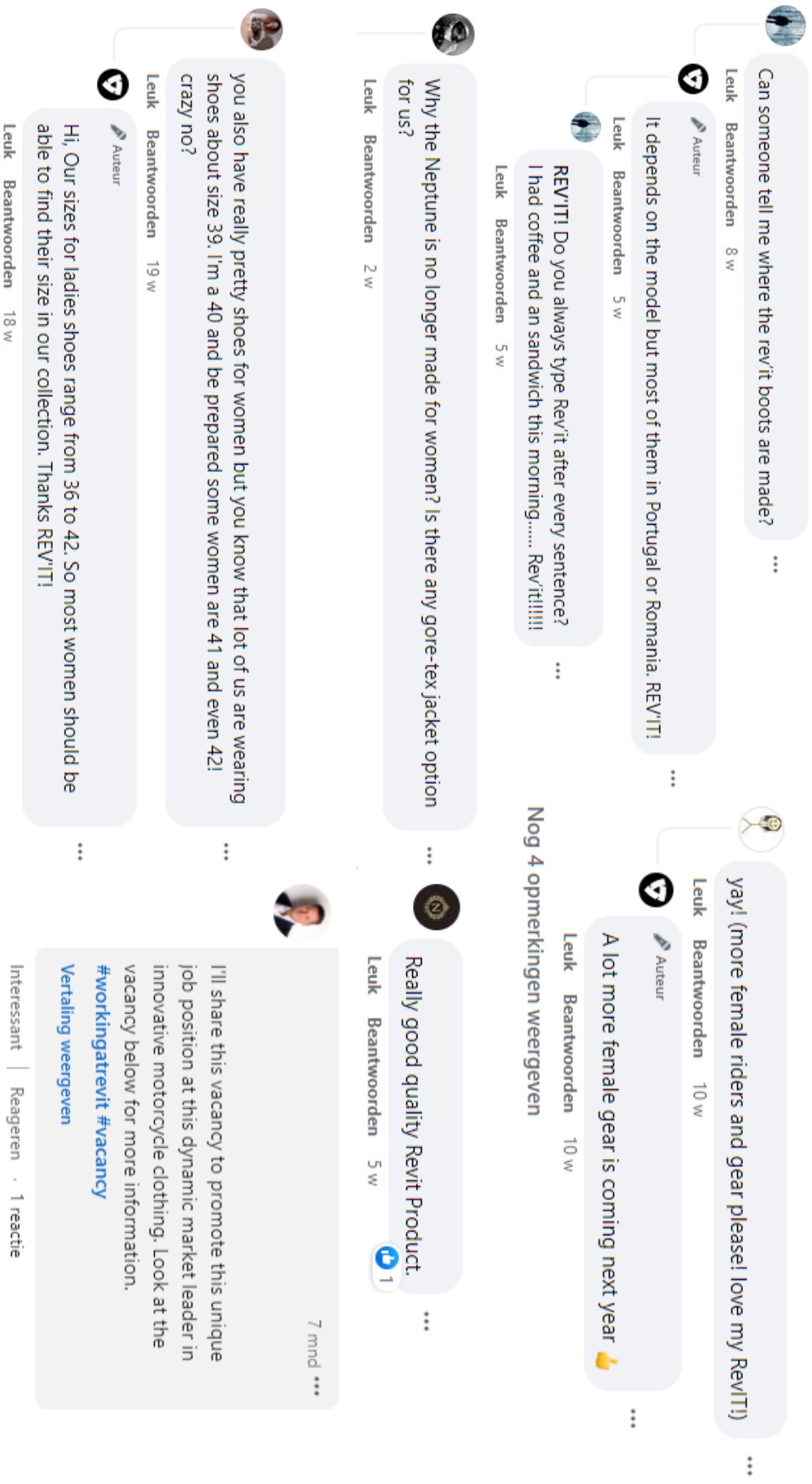
What samantha is saying. More for the ladies.
Let's be real.. We love shopping more anyway. 😂 And for
someone who's a woman, with an orange bike it's impossible
to find a black leather jacket with some orange in it. Why. Not
one single brand has black with orange. 🤔 Guess I'll be
buying leather dye to paint over the whites haha

24 w. Reageren



I 100% support adv gear companies using real
riders on their personal bikes to showcase new gear. Stickers,
imperfections, and all. Love it 🍑🍑

35 w. 3 vind-ik-leuks Reageren ***





11 maanden geleden

Love it! Amelia is an inspiration to all of us. Self care through the pandemic is so important and even better when you can do it with friends while giving back to the community. Rockstar!

👍 4 🔄 BEANTWOORDEN



4 maanden geleden

About to ditch my Klim Latitude for this setup it looks so much more refined.

👍 🔄 BEANTWOORDEN



2 jaar geleden

I am saving money to buy me a Rev'it race suit and rev'it glove

👍 🔄 BEANTWOORDEN



11 maanden geleden

My Rev'it jacket is stunning all-time ...

👍 🔄 BEANTWOORDEN



1 jaar geleden

Thanks to all the amazing ladies who made this possible.

Thanks also to Rev'it for recognizing the need in the moto community to have this incredible resource of inspiration for other women riders, and bringing this team together.

👍 7 🔄 BEANTWOORDEN



11 maanden geleden

hey Rev'it! really appreciate the diversity of all your models in your videos

👍 1 🔄 BEANTWOORDEN



3 jaar geleden

This was Awesome!! Thanks for representing Women Riders Rev'IT!

👍 1 🔄 BEANTWOORDEN



3 jaar geleden

I really enjoy these snippets REV'IT, I really admire your brand and how you choose to market yourself. Would love to see more snippet videos like this with your Women Adventure Team.

👍 5 🔄 BEANTWOORDEN



1 jaar geleden

hello, I am very happy with your products, I have an undergarment and a quantum fluor, last week a car hit me hard and they hit my left knee brace, very happy because Revit saved my leg, my question is, is there any solution to fix this knee brace? Thank you

👍 🔄 BEANTWOORDEN



1 jaar geleden

Ive had the original Poseidon suit for over 5 years excellent suit, I do a lot of touring in all weathers . what I really like is the all in one waterproofing ,no zip out waterproofing .which when the garment gets wet gets really heavy . not with the Poseidon . I'm saving up for this replacement ,which I know will be worth the money .Best I've ever worn .ps washes and reproofs easily and comes up like new.





4 jaar geleden

Big fan of Revit's gear. I've reviewed their Tornado 2 jacket and pants on our Youtube channel and website; the consensus is that their gear is top of the line and is even getting better every year. The Tornado 2 jackets and pants are a big upgrade from the original Tornado saga. Revit is now among the brands that we trust by their name alone (which is an award that we've given to very-few brands like A* or Held). I love how Revit continues to push the limits with every new line of products.

⋮

Meer tonen

👍 1 🗨️ BEANTWOORDEN



4 jaar geleden

Big fan of Revit's gear. I've reviewed their Tornado 2 jacket and pants on our Youtube channel and website; the consensus is that their gear is top of the line and is even getting better every year. The Tornado 2 jackets and pants are a big upgrade from the original Tornado saga. Revit is now among the brands that we trust by their name alone (which is an award that we've given to very-few brands like A* or Held). I love how Revit continues to push the limits with every new line of products...

Meer tonen

👍 1 🗨️ BEANTWOORDEN



2 jaar geleden

Great Video, guys... Makes one want to ride, and to visit and ride the many wonderful roads of Europe... Thanks!

👍 1 🗨️ BEANTWOORDEN



4 jaar geleden

I like mine, but not waterproof, 3 hours of heavy rain in Poland, and my feet was all soaked.

👍 1 🗨️ BEANTWOORDEN

▼ 3 antwoorden bekijken



4 jaar geleden

I brought the mine back, both left and right were leaking

👍 🗨️ BEANTWOORDEN



5 jaar geleden

Great looking boot, love REV'IT gear!

👍 1 🗨️ BEANTWOORDEN



3 maanden geleden

Really good boot worth the money

👍 🗨️ BEANTWOORDEN





5 jaar geleden

Just got these... It is great all the way around except for one thing - if you walk wearing it, the gear shifter protector... whatever it's called... cuts right into your foot. Not sure if it will go away or not, may just return it because of that. That sucks - other than that the boots are great!

👍 2 🔄 BEANTWOORDEN



1 jaar geleden

It's designed backwards - all the light parts where you get dirty and all the black bits that face the sun. It's supposed to be a summer or warm weather jacket, have light colours only. If it's for cooler months, then go dark or black. Pretty simple physics or has Rev'it moved away from logical design?

👍 2 🔄 BEANTWOORDEN



7 mnd ***

Yes!! Really happy to see that there is more and more focus on woman in the motor industry. 🙌 there is always such a limited section of woman clothes and gear in the shops..
[Vertaling weergeven](#)

Interessant · 🔄 2 | Reageren



16 uur geleden

WTH are Rev'it doing? these jackets are terrible compared to the previous generation. Very feminine, colours are terrible and the quality has even taken a dive. tried a few of their jackets recently, this is how they kept the price the same, downgraded the quality.

Gutted. 🙄

Love this suit!

Let me just say when ordering this suit I really was sad that there was a lead time but it got here way sooner than anticipated and I literally drove home on a lunch break just to try it on. It fits like a glove!

When deciding on sizing I simply measured myself and compared that to the sizing chart and it's true to size. I'm 5'4" around 130 lbs and I got the size 36, it fits like a glove! Rev'it makes high quality products and I'm very loyal to their brand. Love the color option on this as well; the pink pinstripe is so clean. I've gotten so many complements and "Ilikes" on this suit.

APPENDIX 3. COMPETITION ANALYSIS



To create an understanding about what the current consumer market deems important when it comes to motorcycle boots an analysis was done of the reviews that people leave on websites like Revzilla.com and under reviews on YouTube (SidiSport, 2018; MKC Moto, 2019; AtSpeed, 2020; Champion Helmets, 2018a-b, 2019; Count Greffi, 2020a-b, 2021; Silly Side Down, 2017; Sportbike Track Gear, 2015, 2019a-c, 2021; RevZilla, 2015, 2017, 2018, 2019a-b, 2021 2022a-i; MotoGeo, 2021; RSFinch, 2020). This helps REV'IT! understand the aspects the different consumers like and dislike and so what to consider in their own design. The selection of boots was made based on the market that REV'IT! is planning on entering, which is the one of professional level road racing boots. The companies that REV'IT! will directly be competing against are Dainese, Alpinestars, TCX, Sidi, Forma Boots, Gaerne, Füsport and XPD. A selection of these boots was made for the analysis based on their presence in the championship, their level of quality and the availability of information. The boots of XPD are high-end and worn by quite a few Moto2 & Moto3 riders, but there is barely any information available regarding these boots. So, if this is deemed necessary, a recommendation would be to wait a few years until these reviews will be available. The conclusions per pair of boots were noted in the results. An overview of all the analysed reviews can be found below.

Results

The Dainese Axial D1 Air

- On RevZilla they score a 4.9 out of 5.0 stars (19 + 7 (non-perforated) ratings).
- You need to get a size bigger than your actual size.
- They are available in size 40-47.
- They cost \$ 529.95.
- They run on the narrower side.
- Scores:
 - Bang for the buck: 4.5
 - Protection & Durability: 4.8
 - Features: 4.8
 - Comfort: 4.9
 - Style: 4.8
 - Airflow: 4.3

Strengths

- No break-in period is needed, they are comfortable right out of the box, but they become even more comfortable over time.
- They are very comfortable even to walk around in all day.

- People experience them as one of the safest boots (even though the CE levels don't indicate this).
- The longevity of these boots is great. Even with the necessary crashes these boots last very long for consumers.
- It's the lightest pair of boots there is.
- The freedom of movement and the range of motion are great in the dorsi- and plantarflexion direction.
- Because of the small profile they are less likely to grip the road while cornering and they are more aerodynamic.
- They allow for big calves, due to the elastic Velcro straps and the zipper in the back.
- The back entry is much appreciated. It's easy to get them on and off.
- The suit to boot fastening system is good for aerodynamics, the protection of the ankle joint, the comfort, the adherence of the rider's leg to the vehicle and the likelihood to get caught in the motorcycle during a fall or in general to get hooked behind certain parts.
- The ankle distortion control system is lightweight, very strong and it distributes impacts over a larger area and stops objects from entering the boot.
- The soles became more resistant to damage by the sharp foot pegs, with the new model.
- Great grip, shifter feel, feel on the bike and great feel on the bottom of the foot.
- They are easy to combine with pairs of pants and more discrete.
- No issues with the laces.
- No forced riding position.
- The titanium sliders don't grip the asphalt.
- People like the style of the boots.
- They are very breathable.
- The toe box is very comfortable.

Complaints

- Even the perforated version barely flows air, so the ventilation isn't that good.
- The toe box can be insufficient in the protection of the toes against crushing and impact. However, according to RevZilla (2019), race boots need to balance impact and flex protection while also giving a slim profile and a good feel for shifting, so you won't have super-armoured toes on road-race boots.
- They are a bit expensive, but overall people think it's worth the money.
- The toe area is a little narrow (but some say this improves gear shifting).
- They are less high without much of a shin protector, which makes some people feel like they are less protective than the Supertech R's.

- Having the ankle distortion system be kept in place by Velcro straps and having this flexible of a system makes it feel less trustworthy.
- They can't be worn with short socks as the zipper seam in the back rubs and because the upper liner is itchy to the bare skin.
- People would like some more colour options.
- Not available for women with small to normal sized feet.
- They become looser over time, so going up a size is not always recommended.
- No 360-degree ankle protection against impact.
- More tightening support on the inside would have been nice.
- The heel seems a little too loose in some cases.
- They are not that wide ranging in their fit and not very adjustable. People with a high instep, won't fit them that well.
- The zipper can be difficult to zip up.

The Alpinestars Supertech R Vented

- On RevZilla they score a 4.6 out of 5.0 stars (7 + 3 (non-perforated) ratings).
- You need to get a size smaller than your actual size.
- They are available in size 39-48.
- They cost \$ 499.95.
- They run on the narrower side.
- Scores:

- Bang for the buck: 3.9
- Protection & Durability: 4.9
- Features: 4.7
- Comfort: 4.7
- Style: 4.6
- Airflow: 4.8

Strengths

- They are very comfortable, even right out of the box.
- They give great confidence in feet, ankle, and shin protection.
- Great freedom of movement.
- The closure system is easy to use.

- They are well made boots.
- People feel very protected, and people have good experiences with them reducing the damage during a crash.
- They look great.
- Great ankle support.
- Sufficient ventilation.
- No squeaking when walking around.
- A lot of grip on the pegs.
- You barely notice the protection.
- Having the ankle support structure on the inside of the boot results in a big contact area which makes it nicer to interact with the heel guards of the bike on the medial side of the foot. You could otherwise also latch onto the heel guards, which is dangerous and takes away focus.
- The microfiber panel on the medial side creates a better feeling in contact with the bike.

Complaints

- They are tight on people's calves!
- The inner lacing system is too frail, and the laces rip the stitching of the inner boot!
- The top is difficult to tighten sufficiently for a good fit when you have slimmer legs.
- If during a crash, you slide on the side of the boots, you will most likely damage the zipper, which makes the whole boot unusable.
- Someone wishes they would stop making symmetrical boots and that they would remove the shift pad, but others say this is for special cases in which shifting is done by the other foot (this is quite rare though, so it could be something to consider).
- People still break their bones, but overall, the people are very happy with the protection and injury reduction.
- Not that
- A bit pricey

The Forma Ice Pro Flow

- On RevZilla they score a 4.1 out of 5.0 stars (7 + 5 (non-perforated) ratings).
- You need to get a size smaller than your actual size.
- They are available in size 38-47.
- They cost \$ 349.00.
- Scores:

- Bang for the buck: 4.3
- Protection & Durability: 4.7
- Features: 4.1
- Comfort: 4.6
- Style: 4.4
- Airflow: 4.7

Strengths

- They are quite comfortable right out of the box.
- Great ventilation.
- They look great.
- A lot of replaceable parts.
- The toes curve up a bit to avoid touching the asphalt with the toes, this makes them a little uncomfortable to walk in though.
- More affordable than the rest of the boots.
- They don't interfere with shifting/the gear shifting is precise.
- The soles sit on and grip the pegs just right.
- The zipper works quite smoothly.
- The ratchet buckle on the calf increases the ease of the adjustment of the boot.
- People feel well protected in them.
- Good mobility.
- Good moisture management.
- Antibacterial liner, but people don't mention this in their reviews.
- An air pump system in the memory foam sole (no comments about this).
- Rubberized panels on the medial side for great grip on the bike.
- Achilles heel protection.

Complaints

- The ankle cage pivots can rub against the ankle after a while.
- They squeak a little.
- The toe box can be a little too tight.
- Some people had difficulty operating their bike with them.
- They are quite bulky and heavy.

The Sidi Rex Air

- On RevZilla they score a 4.5 out of 5.0 stars (10 (non-perforated) + 3 ratings).
- You need to get a size larger than your actual size.
- They are available in size 39-48.
- They cost \$ 499.99.
- They run narrower than the other boots.
- Its predecessor had a replaceable sole and many people want that back. However, the sales did not indicate this. On top of that, from a tactile response/flexibility standpoint without it, it's much more ergonomic and easier to use and you get more feel out of the peg. The replaceable part made it beefier and stiffer, which meant less feedback to your foot (RevZilla, 2021).
- Scores:
 - Bang for the buck: 4.4
 - Protection & Durability: 4.9
 - Features: 4.8
 - Comfort: 4.1
 - Style: 4.8
 - Airflow: 4.8

Strengths

- Many replaceable parts, which increases the longevity of the boots and allows for the users to wear them in much better, which increases the comfort.
- The fit is customizable and allow for a snug fit for different types of users.
- The closure system is very easy to use, quick and intuitive.
- Very effective vents that can be opened and closed.
- They fit around larger calves.
- Very flexible so great freedom of movement.
- Reflective pieces for on the road.
- The lower adjuster allows for the heel to get well secured into the heel cup for better protection.
- Comfortable to walk around in, but not too special. They are more comfortable on the bike.
- People like the style.
- No pinching or hot spots.

Complaints

- The top-entry isn't ideal. The predecessors of this boot allowed side-entry which made it much less painful take off and put on after an injury and much easier to adjust your socks.
- The soles wear quickly.
- They need some breaking in time, they are a little stiff at the beginning.
- They are quite heavy.
- They look a bit clunky.
- Very expensive.
- The exoskeleton could get caught on the bike.
- People have the feeling the neoprene part in the flex zone is dangerous.
- The side support piece is constantly pushing your suit zipper into your skin.
- The hard mounting post/point, for the inner ankle braces, are only secured by the leather and are subject to tearing. This is not a replaceable part and is not covered by warranty. This is a point the boots fail on.
- They are not subtle, so they are not that suitable for commuting, if this is something that bothers you.

The TCX RT-Race Pro Air

- On RevZilla they score a 4.6 out of 5.0 stars (10 ratings).
- They fit true to size.
- They are available in size 38-49.
- They cost \$ 499.99.
- Scores:
 - Bang for the buck: 4.1
 - Protection & Durability: 4.3
 - Features: 4.1
 - Comfort: 4.4
 - Style: 4.7
 - Airflow: 4.0

Strengths

- The feel and the break in of this boot is great directly: this comes from the motion panels in the front, the stretch area around the zipper and the stretch area in the back (more motion panels)

- The soles are great of the box, no break in needed and no slipping.
- They are comfortable to walk around in.
- The ventilation quite good.
- The grip and feel of the Michelin soles are amazing.
- The tactile feel of the boots is great as there are less layers (no inner boot).
- They are considered very safe.
- The heel and sole are more durable for riding and walking.
- They are lightweight, yet rather sturdy.
- They seem to fit some people that couldn't fit comfortably in any other boots.
- Easy to get in and out of.
- Cool colour schemes.
- They are non-bulky.
- Great mobility/freedom of movement.
- They come with a carrying back.
- They are good for people with bigger calves.
- The lasting board is strong, yet flexible in the toe area, it becomes thinner there.
- They are produced in Romania, which means a more refined product.

Complaints

- Someone had the lower piece of the torsion control system that slots in at the heel would come out of its channel.
- People would like to see an easier way to close the boots; the closing system on top gets in the way of attaching the Velcro at the top of the zipper.
- People feel the ankle support might limit the plantarflexion a little too much.
- Not a really good shifter feel.
- They can be a bit squeaky.
- They are less protective and comfortable than the Supertech R.
- They are considered a little difficult to put on by some with the inner lacing system and tongue. A lot of wiggling is required to get in.
- They have a low foot bridge, so that can be too tight for some people.
- They feel flimsy, so some people question the safety of the boots.

Conclusion

All the findings were summarized in an overview of scores from 1 to 5, with 1 being good and 5 being bad:

	Alpinestars		Dainese Axial D1 Air		TCX RT-Race PRO Air	Sidi Rex Air	Forma Ice Pro Flow
	Supertech R Vented						
Overall Review	4,6		4,9		4,6	4,5	4,3
Consumer							
Worth the Money	3,9		4,5		4,1	4,4	4,3
Comfort	4,7		4,9		4,4	4,1	4,4
Protection & Durability	4,9		4,8		4,3	4,9	4,6
Features	4,7		4,8		4,1	4,8	4,2
Style	4,6		4,8		4,7	4,8	4,5
Airflow	4,8		4,3		4,0	4,8	4,7
Donning/Doffing Ease	4		4		3	5	2
Customization (Fit)	3		2		3	5	3
Aerodynamics	4		4		4	3	2
Bulkiness	4		4		5	3	1
Stiffness Ankle Brace	4		5		2	3	3
Repairability	3		1		3	5	4
Longevity	4		4		3	5	3
Sliding Capabilities	4		3		3	3	4
Quality Materials	5		5		4	4	3
Fit (True to Size)	2		4		5	3	4
Innovativeness	3		4		2	4	2
Technicality solutions	3		4		2	5	2
Freedom of Movement	4		5		4	5	3
Inclusiveness of Size	2		1		4	2	3
Range							
Donning/Doffing time	27 seconds		20 seconds		35 seconds	28 seconds	41 seconds
Protection Level (CE)	2017: 2-2-2-1		2017: 2-1-1-1 (WAD)		2015:2-2-2 (SRA)	2017:2-2-2-2	2017:2-1-2-1 (WAD)
Price	\$499,95		\$529,95		\$499,99	\$499,99	\$349
Weight (per boot)	1168 g		910 g		965 g	1166 g	1167 g



8 maanden geleden

S

-SIZING: Ignore when he says "reference the sizing chart". The Alpinestars boot chart is junk; don't even look at it. The A* chart says 47 is a US 12...NO! Just figure out what euro size you typically are and they should fit similar. For reference, if you wear 13 US shoes, D width, a 46 is a snug race fit and 47 is a bit loose and comfy, same as Dainese.

-SHIN PROTECTION: seems to be a bit lower profile at the peak.

-VENTING: Even though they're asking for more airflow with the standard version, as he mentioned, there is a vented version. The newest vented actually has perforation in the back to help get the air out, which the old version did not. The standard version is better for cold weather. If it's cool enough that you're wearing non-perf leathers and not sweating then you probably also want the non vent boots.

-ZIPPER: Not sure if it's mentioned, but A* improved the bellows on the zipper so it stretches more and hopefully has better zipper life.

Minder tonen

👍 1 🗨️ BEANTWOORDEN

8 maanden geleden

X

I use the Supertech R and I have a very wide foot! I am wearing a size 42 boot (should probably go with the 41) and the boot is not wide enough for me. it leads to discomfort and even pain (because the shoe is building up pressure on the outside of my foot where the plastic reinforcement of the inner shoe sits and meets the fabric). Can u recommend a top of the line race boot for people like me? thanks in advance :)

ps. taking the sole out doesn't fix the problem

3 maanden geleden

t

between Supertech R and sidi Rex what would you recommend if riding in location that got temperature 35 or more celsius

👍 1 🗨️ BEANTWOORDEN

▶️ [Antwoord verbergen](#)



3 maanden geleden

While they are both good boots I prefer the Supertech R. Max and I both wear the Astars boots. - Van

👍 🗨️ BEANTWOORDEN

1 maand geleden



I have the Supertech R from 2015 and the inner booty tie-cord thing ripped through after a few years. Alpinestars sent replacement ones for free!

Great boot and service :)

1 maand geleden



This is not a boot you would want to wear off the bike and walking around. Its built and meant for track/days and racing/canyon riding. If you want something better for walking around in but with similar features, either the SMX Plus v2 or the SMX 6 v2 should be your options

👍 1 🗨️ BEANTWOORDEN

8 maanden geleden



These things haven't changed in like 10 years.

👍 🗨️ BEANTWOORDEN



Z

5 jaar geleden

I wish they would stop putting shift panels on the right boot. I think the asymmetrical look would be cool.

👍 21 BEANTWOORDEN

3 antwoorden verbergen



3 jaar geleden

They can't do that. If a person lose the left leg in an accident, put the shift on the right, and the back brake on left hand.

👍 1 BEANTWOORDEN



2 jaar geleden

There are right shift bikes, not much race replicas, but they exist

👍 BEANTWOORDEN



1 jaar geleden

Useless if you're racing classic bikes with right foot gear changes ;)

👍 BEANTWOORDEN



19 maanden geleden

I feel like you're personally attacking me with the inner lace "don't go yanking on it" comments. I break those laces so quickly and was hoping the V2 had made them a bit more yank safe. Looks like they have also weakened the lace holder parts on the inner boot. Older Supertechs had the lace looped through metal rings, now it is fabric/leather.

👍 2 BEANTWOORDEN

2 antwoorden van Sportbike Track Gear en anderen bekijken



7 maanden geleden

How substantial is the toe protection on this boot? Is it reinforced on the outer canvas and then has some light protection on the inner "bootie"? Or is there only light reinforcement on the toe area on the inner bootie? I ruptured recently on my old wearing alpine pros and the shoe landed on my left foot. No broken bones/twisted since however my big toe got severely jammed and my foot is still swollen and I need a foot brace to walk around comfortably. Was curious to see if these boots would feel any protecting level to an even lighter extent if I was to get in a similar accident. Thanks ;)

Minder tonen

👍 BEANTWOORDEN



3 jaar geleden

3 antwoorden verbergen

The toe protection is similar to the Axal Pro in boots. There is hard but flexible toe reinforcement built into the outer boot. The inner bootie does not have any hard protection at the toe. Race boots need to balance impact and flex protection while also giving a slim profile and good feel for sitting so you won't have super-armored toes on road-race boots. -DrewZilla

👍 BEANTWOORDEN

★★★★★☆☆

Jul 16, 2021

Tim G.

VERIFIED PURCHASER

Fit issues

All I've done is wear these boots around the house. I was suspicious of the Alpinestars conversion chart from US sizes to European sizes but ordered what was recommended. I'm a 10 and 1/2 to 11 in almost every shoe

and boot. A 45 was recommended. It's just too large. The other problem is I have skinny legs and there's no way you can tighten the top of these boots sufficiently for a good fit.

There is a thin flimsy fabric extension on the top of these boots that seems kind of pointless. The boots feels comfortable, the inner bootie is easy to use and like most Alpinestars gear seems well made.

Was this helpful? 🍷 🍷 🍷

★★★★★☆☆

Jul 15, 2021

Anonymous S.

VERIFIED PURCHASER

Substantial but flexible

These boots are substantial and give great confidence in feet, ankle and shin protection. The focus is on protection, but these are also ok to talk around in - they are more flexible than I thought they would be. Fast shipping too.

Was this helpful? 🍷 🍷 🍷

★★★★★☆☆

Jul 9, 2021

Matt M.

VERIFIED PURCHASER

Supertech R Vented

Much more comfortable than my Sidis were

Was this helpful? 🍷 🍷 🍷



★★★★★☆☆

Aug 14, 2021

Anonymous S.

VERIFIED PURCHASER

Supertech-R

They are the best boots I have ever purchased. I have massive calves and the Supertech-R's are the only boots to ever fit them. I would recommend going down a size then what the size chart recommends. I am a 44 euro in other alpinestars boots, but I should have went 43 with the Supertech-R since I do have more room than what I prefer, but at the same time I'm not sure if I would have been able to zip them up due to calf issues.

Was this helpful? 🍷 🍷 🍷

7 Ratings

4.9
out of 5 stars

WRITE A REVIEW

7 Ratings



4 Customer Photos



Bang For The Buck: 4.0 / 5.0

Protection & Durability: 5.0 / 5.0

Features: 4.9 / 5.0

Comfort: 5.0 / 5.0

Style: 4.9 / 5.0

Fit

Small Large

Footbed

Narrow Wide

Air Flow: 4.8 / 5.0

1 jaar geleden

id prefer to try on before buying.. locally i cant find any atm.. i wanted supertech r.. but 42 my foot was swimming.. also even a 43 couldnt even zip over my suit and leg.. supertech r is made for Italian midggets

BEANTWOORDEN



1 jaar geleden

100% the Alpinestars Supertech R are the most comfortable race boots on the market. Thanks for watching and the kind words! - Van

BEANTWOORDEN



<https://www.revzilla.com/motorcycle/alpinestars-supertech-r-vented-boots>
<https://www.revzilla.com/motorcycle/alpinestars-supertech-r-boots>

https://www.youtube.com/watch?v=NKYIFU_jz4Q&t=45
<https://www.youtube.com/watch?v=jzyRZ1Omrvw>
<https://www.youtube.com/watch?v=IMPP5GD2jM&t=45>
<https://www.youtube.com/watch?v=5vSegTCY9Xk>
<https://www.youtube.com/watch?v=cFKLTOWp18>
<https://www.youtube.com/watch?v=GxCDgqdd40SY>



6 jaar geleden

this is a top notch poser boot . the more you make your ankle and foot stiff , the more forces will be directed to your knee . i rather have a broken ankle then my knee messed up . and the guy is now telling us how terrible the 2015 model is , in 12 months he will do the same to the 16 model .

BEANTWOORDEN

4 antwoorden verbergen

0

6 jaar geleden

+wasnt me it's not quite a direct transfer of forces like you're making things out to be. it's not "broken ankle vs. messed up knee". Also, by your rationale, MX boots are contributing to more leg damage than they're helping avoid. Unless you can come up with some kind of actual data to support your claim, I'm more willing to think you're talking out your butt.

Every professional racing series I can think of has the ENTIRE field in pretty stiff boots. Why do you think this would be the case if they did nothing but increase the likelihood of knee damage which, as you say, can be a more complicated injury?

Minder tonen

BEANTWOORDEN





5 maanden geleden

Im not brand loyal in any way - but I do love my Alpinestars boots - they just do what they are made to do properly !

Beantwoorden



1 jaar geleden

: (I crashed in mine and my boots came off

Beantwoorden

Antwoord verbergen



1 jaar geleden

If they came off they were either too large or not done up properly. My Son Max had a big crash this past weekend and they performed great again. After he puts the boots on there is on way in hell I could pull them off without undoing them. - Van

Beantwoorden



1 jaar geleden

Is it comfort?

Beantwoorden

Antwoord verbergen



1 jaar geleden

Feels super comfy mate. Grip to the pegs is insane tho, its something I had to get used to. I dont feel like Im having this much protection on my feet. Those boots feel like a slippers you wear at home :D

Beantwoorden



2 jaar geleden

I love the Alpinestars Supertech R boots, I have ridden with them for close to 15 years, crash tested and no injuries. However i was finally able to get my hands on a pair of Daytona Security Evo G3 racing boots and they are on another level protection wise. The inner boot is non twisting and the material that is made of is way tougher than the Alpinestars. I wish you guys can start carrying them so people dont have to buy them from Ebay or European sites since they dont have a distributor in the United States

Minder tonen

Beantwoorden



2 jaar geleden

had a highsider with those boots on 13.06. this year only few scuffs - toe sliders were scratched anyway cause of my not so perfect body position. Held Leather only needed a few stitches. Only my helmet (Xlite x803) is damaged beyoned repair. the outer shell has a few cracks cause i landed on the back of my head.

Minder tonen

but after all the gear did it's job and i know i can trust those manufacturers!

Beantwoorden



Jul 1, 2021

Less Vents than I anticipated from the picture

Jeff M.

VERIFIED PURCHASER

Judging from the picture I thought these boots had the whole front with ventilatory holes so disappointed. wanted these for NC Summer riding

Was this helpful?

0 21



Oct 10, 2021

I am extremely happy with my decision to purchas a more expensive boot. they really comfortable to walk around in while still feel really safe without the rigidity and squeaking when you walk around.

VERIFIED PURCHASER

my prevolus boots were the SMX plus and the supertechs are loads better.

Was this helpful?

2 0



Nov 2, 2021

Great boots

Really quality product. They fit well and offer great protection while allowing a reasonable amount of mobility.

Anonymous S.

VERIFIED PURCHASER

Was this helpful?

0 0



Oct 19, 2021

Best track boots I've ever had

Love love love these boots! Glad I got these instead of the Stellias. Went from the dainese women's boots to these. thank goodness

Brianna O.

VERIFIED PURCHASER

Was this helpful?

0 1



Nov 6, 2021

Boots

Havent used these yet, but they are a serious step up from the SMX Plus that I had. These run big. I wear a size 9 shoe, and a 41 in the SMX Plus, but the 41 in these are at least a full size to a size and a half big. No clue on that...

Patrick L.

VERIFIED PURCHASER

Was this helpful?

2 0



maanden geleden

Are these more protective than the Dainese Axial D1?

Beantwoorden

Antwoord verbergen



4 maanden geleden

Roughly the same. They go up a bit higher, so more shin protection.





Why I chose this:

"Most expensive one money can buy."

4 months ago

"I already have bad ankles so I wanted the best protection I could get"

4 months ago

"my last pair was a bit too large"

5 months ago

"Because 'go slow, look pro'."

5 months ago

"I wanted an upgrade from my SMX-6's and these are the best on the market."

6 months ago

"They are the best! Extremely comfortable! The best protection!"

7 months ago

Why I chose this:

"Helping me a lot with my ankle."

1 month ago

"Protection riding street and motor."

1 month ago

"I like the protection, but not so much the help with it."

2 months ago

"I've been wearing them for a while."

3 months ago

"They're like a warm and soft blanket for my ankles."

3 months ago

"I've been wearing them for a while, but they're not my favorite."

3 months ago

Why I chose this:

"I've been wearing them for a while, but they're not my favorite."

3 months ago

"Another great product, I wanted to be sure I had the best protection for my ankles, but they're not my favorite."

6 months ago

"I've been wearing them for a while, but they're not my favorite."

6 months ago

"I've been wearing them for a while, but they're not my favorite."

7 months ago

"I've been wearing them for a while, but they're not my favorite."

7 months ago

"I've been wearing them for a while, but they're not my favorite."

7 months ago

Why I chose this:

"I need new boots to replace my old ST's."

7 months ago

"Wanted good boots for street city riding in congested areas and possibly a track day or two."

7 months ago

"Like the brand and like the features."

7 months ago

"Needed new pair and happy with previous pair of same model"

8 months ago

"I wanted them to finish my set. But they're great boots."

8 months ago

"Superior R Boots saved my foot in a crash. Still had a compound fracture at the ankle and multiple breaks in the foot along with tons of tendon and ligament damage but I have my foot and will have a full recovery. -@treedustiny"

8 months ago





Why I chose this:

"Love Alpinestars Supertech R boots. Great protection learned from past experience. 🙏"	7 months ago
"For comfort while riding in hot weather"	7 months ago
"Saidly the only boots in my size available... I hate looking for boots anymore as NOTHING is in stock"	8 months ago
"Everyone says these are the best racing boots and I also have massive calves and the SMX Plus V2's don't fit"	8 months ago
"The Supertech R V2 were reviewed as the Alpine's best."	8 months ago
"Because they are the best boots period Not to mention they look fantastic"	8 months ago
"Comfort and protection in one nice design"	8 months ago
"Because this is the ultimate riding boot. And I am was the ultimate salesperson. Thank you guys..."	8 months ago
"My old SMX Plus boots saved my ankle from a low side crash. With the updated technology, I hope these boots may save me the next time :)"	8 months ago
"Love Alpinestars gear. This website was the only one that had them in stock and also had several delivery options."	8 months ago
"These boots are extremely comfortable. They have style and protection, the whole 9 yards. Definitely a good buy"	9 months ago
"It's a really comfortable race boot with great support."	9 months ago

Why I chose this:

"alpinestars fit me well"	9 months ago
— Thomas J.	
"comfort and safety for club racing"	9 months ago
— Matt M.	
"I've ridden with Sidi boots and former ice pros. I tried my brother's super tech r's on and it never ride in anything else. Top flexibility and protection. Love the removable inside boot"	9 months ago
— Anonymous S.	
"Previously used and happy with that choice. NB, although not specified I wish to purchase the boots that are described as Color: Black/Red FluoWhite/Gray"	10 months ago
— Anonymous S.	
"I hate my dainese boots and needed to replace them. I wanted women's boots, but the pickings are slim for women's gear, so I ordered these since they were my favorite. Just wish they make superfects..." Read More	4 months ago
— Bri O.	
"Ran the sidi race boot forever. I want to try the alpinestars"	5 months ago
— BMFP	
"Only the most expensive offering for me"	5 months ago
— doomoon K.	
"Best truck boots I've ever had Gone through 3 pairs."	5 months ago
— Vane (Vince) M.	
"Fit very well for people with wide feet"	5 months ago
— Tom K.	



Why I chose this:

"Alpine stars are to be the best race boot on the market if ur looking at safety, comfort and quality ! Climbing"

— Anonymous S.

2 days ago

"Read good reviews and wanted better boots for riding. These have more protection then current boots and they are vented which is important for me."

— Anonymous S.

1 month ago

"Needed a step up from the V2"

— Justin S.

1 month ago

"Big calf problem.. will see if it fits."

— Commodore G.

2 months ago

"Son has same boot and loves them !"

— Stephen H.

2 months ago

"Because the black/red/white superfecta i wanted boots in my size were out of stock until August 2022 and cant race without boots"

— A.C.

2 months ago

Why I chose this:

"The look and reviews"

— Jouxne L.

3 months ago

"My Son had these on his Christmas wish list. :)"

— Anonymous S.

3 months ago

"It has the most air vent holes more than any other brand"

— Jacky I.

3 months ago

"Absolutely amazing Boots, Alpinestar always delivers and the fit is snug and comfortable."

— Luke W.

3 months ago

"seems like the top of the line, good quality, but pricey."

— GTP

4 months ago

"old ones broke k after extensive street / track use for well over 7 years :X"

— Wojciech J.

4 months ago

Why I chose this:

"Alpinestars makes a good product. I liked the design"

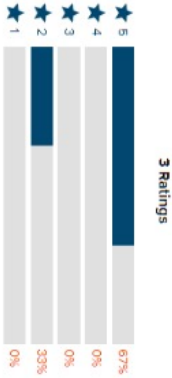
— S.T.

10 months ago

3 Ratings



WRITE A REVIEW





2 jaar geleden

These boots fit perfectly under a pair of jeans as well. All I do is attach a strip of female-side velcro to the necessary areas and it slides right under my pants without snagging :)

👍 14 🔄 BEANTWOORDEN



1 jaar geleden

how much do the new ones weigh out of curiosity

👍 1 🔄 BEANTWOORDEN

▶ Antwoord verbergen



1 jaar geleden

The Dainese Axial D1 boots weigh about 875 grams, though this may vary according to the shoe size. Thanks for the question!

What do you think of the Axial D1s?



2 jaar geleden

Just bought these today. They fit like a glove. I was originally going for the Torque D1 Air's, but it felt uncomfortable with the shape of my foot. These Axial D1 Air's are so freakin comfy. Definitely give them a big thumbs up! Worth every penny if it prevents an injury from a crash too. Did I mention the fit and finish?? Good god! I'm sitting here just holding these things. They're an incredible piece of engineering!

👍 3 🔄 BEANTWOORDEN



3 jaar geleden

Love the way they look never had a Dainese pair of boots always worn Sidi will give them a shot next time I need Boots

👍 2 🔄 BEANTWOORDEN



Dainese axial D1 Air Boots

Purchased on Dec 19, 2019

Jan 8, 2020

Michael L.



Great boot, definitely top notch protection and style. Order next size up. These run on the smaller size. I wear 12 us shoe and size 46 boot with thin socks work well.

Was this helpful? 🍷 2 🍷 1



2 maanden geleden

The sliders are Magesium aren't they? Not Titanium.

👍 1 🔄 BEANTWOORDEN

▶ Antwoord verbergen



2 maanden geleden

Yes you are correct- sorry did I say titanium?

👍 1 🔄 BEANTWOORDEN



2 jaar geleden

Princess, Yow I've got the Women's Torque D1 boots. I dropped a Hypermotard (= on my Achilles/ankle in a high side incident and they saved my \$\$\$ from real damage. The bike was fine! But besides a nasty bruise, nothing was broken, torn, or crushed and I learned the importance of wearing real boots. Since these are meant to go under a race suit, do you still feel like the upper part of the boot provides solid reinforcement without the extra layer of a track suit? I like these and plan to buy but will use mainly for day to day riding = jeans. Thanks-Rachel

Minder tonen

👍 1 🔄 BEANTWOORDEN



1 jaar geleden

I have heard they run half size small, is it true or should I buy the same size as my other dainese boots?

👍 1 🔄 BEANTWOORDEN

▶ 2 antwoorden verbergen



1 jaar geleden

For the Axial D1 boots, the best thing to do is to make sure to measure and find your size according to Dainese's size chart for these boots. Though the boots should fit the same as most other Dainese boots, it may still be a good idea to size up since Dainese does usually run small. Thanks for the question! What do you think of the Dainese boots?

👍 1 🔄 BEANTWOORDEN



11 maanden geleden

I find they run slightly larger, I normally wear size 45, sometimes 46. In these, 45 fits, but it is tiny bit looser than I would expect. Torque D1 of the same size is a bit more snug. This can be regulated by putting in a thicker insole from Decathlon, or wearing warmer socks.

👍 1 🔄 BEANTWOORDEN



2 jaar geleden

There doesn't appear to be a women's version offered and the smallest size is 40. Revzilla- can you please tell me if Dainese's sizing is universal or differs from men's to women's sizes? I've got the women's Torque D1's in a 40 so I want to know if a men's 40 would fit. Thanks!

👍 1 🔄 BEANTWOORDEN

▶ Antwoord verbergen



2 jaar geleden

Mens and women's Euro sizes are exactly the same length, but women's boots tend to be just slightly narrower in the foot and ankle compared to men's boots. The Axials are pretty slim, though, so you should be able to wear the men's version in size 40. -DrewJilla
*http://bit.ly/AxialD1



2 jaar geleden



1 jaar geleden

AMAZING BOOTS FANTASTIC EXELEN'T MAGICAL THE BEST EVER

👍 1 🔄 BEANTWOORDEN

👍 2 🔄 BEANTWOORDEN



2 jaar geleden

Just bought these today. They fit like a glove. I was originally going for the Torque D1 Air's, but they were really uncomfortable with my foot. These Axial D1 Air's are so freakin comfy. Worth every penny if it prevents an injury from a crash too. Did I mention the fit and finish?? Good god! I'm sitting here just holding these things. They're an incredible piece of engineering!

👍 2 🔄 BEANTWOORDEN

▶ 2 antwoorden van Champion Helmeis en anderen bekijken

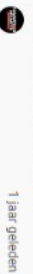


1 jaar geleden

Will they work wit non Dainese suits???

👍 1 🔄 BEANTWOORDEN

▶ 3 antwoorden verbergen



1 jaar geleden

While it may depend on what suit you have in mind, as a general rule these types of suit to boot and jacket to pants compatibilities are brand specific. Thanks for the question! What are your thoughts on the Axial D1s?

👍 1 🔄 BEANTWOORDEN

W

1 jaar geleden

How do they fit?

d5 1

BEANTWOORDEN

2 antwoorden verbergen

1 jaar geleden

As a European brand, Dainese boots generally fit on the slimmer side with a narrow foot bed. So, the best course of action is to check the boot size chart and (if possible) try them on in a local store. Thanks for the question!

What are your thoughts on the Dainese Axial boots?

d5 1

BEANTWOORDEN

1 jaar geleden

They fit really well. I wouldn't go one size up because the leather will expand after the first summer. Buy them in your tennis shoe size and wear thin cotton socks. It should be alright. FYI use the size of your tennis shoes in centimeters because UK and US sizes changes between brands.

d5

BEANTWOORDEN

25

2 jaar geleden

Do these offer more protection than the Torque D1 in boot?

d5 1

BEANTWOORDEN

Antwoord verbergen

2 jaar geleden

The amount of protection the Axial D1 Boot provides will be very similar considering that both of these boots offer a number of the same functional features as one another. The main difference will be in the cost of the materials used in the Axial D1, mainly the D-Axial system in carbon and aramid fiber. -Luke

d5 2

BEANTWOORDEN

5

5

5

5

5

Oct 15, 2019

V.O.

VERIFIED PURCHASER

Totally worth every penny

Great product fits and looks great too. The more I wear even more comfortable they become.

Purchased on Sep 23, 2019

5

5

5

5

5

Dec 12, 2021

Adam T.

VERIFIED PURCHASER

Another excellent Dainese product

Typical Dainese 5-star quality product. These boots are awesome, they are really well designed and made and very comfortable on and off the bike. The perforation works well on warm days. I have 3 other pair of Dainese boots and these fit true to size. Yes they are expensive, but they are the best protection you can buy.

Purchased on Nov 25, 2021

5

5

5

5

5

Jul 28, 2019

JR

VERIFIED PURCHASER

Best boot for me

I tried on several boot brands and needed a boot that zipped in the back due to cyclist calves. There were not available locally to try on and no I didn't get the sizing right at first. I had to go 2 sizes bigger than normal.. Revzilla has great customer service to work out the size exchange. I had to call in and discuss the sizing issue and work out the return. They were great. Boots fit great. Great feel on the bike. The level of protection these boots offer is amazing.

Purchased on Jul 6, 2019

5

5

5

5

5

Mar 21, 2021

Leo G.

VERIFIED PURCHASER

Comfortable & Quality

Very high quality boots, comfortable, and works great with or without a race suit. Long socks are required because the upper liner can be itchy to bare skin and the Perforated version barely flows air.

Purchased on Jul 24, 2019

5

5

5

5

5

Was this helpful?

0

5

0

Flag

5

5

5

5

5

Sep 4, 2019

Nate C.

VERIFIED PURCHASER

First race boot

This is my first hi end boot. It's pretty nice. Pretty easy to put on looks good and lots of protection. Fit true to size. Air flow is only ok. Also the red ones are a bright pink red. Would recommend getting the Black is my only complaint

Purchased on Aug 13, 2019

5

5

5

5

5

Aug 7, 2019

A. C.

VERIFIED PURCHASER

Highly Recommend

If you have a Dainese race suit or Dainese pants, these are a must buy. The Axial D1 Air Boots are the most comfortable boots I have ever worn, and they fit seamlessly with the Dainese "suit to boot" fastening system. I highly recommend them--no complaints.

Was this helpful?

2

0

Flag

5

5

5

5

5

Jan 31, 2022

Oscar D.

VERIFIED PURCHASER

AMAZING STYLE

amazing boots I had my envy racing apparel suit tailored to these boots and I love the clean look of the boot inside

Was this helpful?

1

0

Flag

5

5

5

5

5

Nov 26, 2021

Meimn E.

VERIFIED PURCHASER

Excellent quality, protection, fit, comfort, and true safety built in.

Dainese makes the best motorcycle boots money can buy. They fit true to size and offer real protection. They breathe. I wear them at work.

Was this helpful?

0

0

Flag

TU Delft

40 | Competition Analysis

19 Ratings

4.8
out of 5 stars

★★★★★

WRITE A REVIEW

19 Ratings



Bang For The Buck: **4.5 / 5.0**

Protection & Durability: **4.8 / 5.0**

Features: **4.7 / 5.0**

Comfort: **5.0 / 5.0**

Style: **4.8 / 5.0**

Fit



Footbed



Air Flow: **4.3 / 5.0**

1 jaar geleden

2 years ago a had a bad crash and broke my leg. After that when I was looking for better gear I compared all the top boots and the best feeling for me was Sidi Rex. Dainese was fitting me as they were too flexible.

1 jaar geleden BEANTWOORDEN

1 jaar geleden

My only is crushing protection. Like from having the bike fall on top of the leg (for example from a low side slide) and impact the side of the ankle. The old stiffer boots have a rigid ankle protector around the whole ankle, giving a 360 degree angle protection. I don't know how common that kind of injury is though.

1 jaar geleden BEANTWOORDEN

Sources

- <https://www.youtube.com/watch?v=dhoy0BOb8mU>
- <https://www.youtube.com/watch?v=Uxio9RD5YA>
- <https://www.championhelmet.com/nl/magazine/post/dainese-axial-d1-and-d1-all-clarzen-review>
- <https://www.youtube.com/watch?v=oaivocOxwI>
- https://www.youtube.com/watch?v=_F82baI3Xg
- <https://www.youtube.com/watch?v=z1kyZmKcOM>
- <https://www.revvilla.com/motorcycle/dainese-axial-d1-all-boots>
- https://www.youtube.com/watch?v=W2dyvC3_MPA&t=15

Why I chose this:

"Not happy with the current selection from Sidi for Street/Track boots. If Sidi had a Street model with replaceable soles I'd consider purchasing them instead. Reviews on the lower quality of materials..." *David Lopez*
1 month ago

"For the best performance and protection..." *Anonymous S.*
1 month ago

"Coordinates with my business..." *Orlando H.*
1 month ago

"The best boots for Racing and Dainese Suits Top Brand. Air because I do track days in hot days..." *Anonymous S.*
3 months ago

"Great online reviews and personal reviews from friends who have them..." *Robert F.*
5 months ago

"I saw a current pair in 45, think the 46 will fit just right..." *Thomas F.*
5 months ago

Why I chose this:

"Stellar fit and finish, excellent design, excellent quality materials..." *Marion B.*
1 year ago

"All reviews say that these offer excellent articulation and are light weight which is very important to me, I'm hopeful that the perforation allows some air flow. Will update after I receive them..." *Ben A.*
1 year ago

1 jaar geleden

I think Dainese developed a great boot. But the boot is very slim, so for people with wider feet it is too slim. Also the upper part of the feet is not able to adapt. So if you have a high spanned(upper part of your feet) the boot will not fit you. It would be great if Dainese would offer a personal fit.

1 jaar geleden BEANTWOORDEN

8 maanden geleden

I have not been used the vented model, but I ride with these boots in over 100 degrees Fahrenheit and I don't have any issues with my feet getting too warm especially while riding. Certainly more vents would help improve any overheating concerns, but I can't speak from experience and I can't say whether or not they have any draw backs. Perhaps Dainese will send me a set so I can try them out and make a new video.

1 jaar geleden

I actually wear soccer sox with them because you will need the barrier between your skin and the boot. I have worn them with short sox and while they don't bother me while I use them at the end of the day I do have a bit of discomfort. But tall sox fix it.

1 jaar geleden BEANTWOORDEN





Best Boots Ever

Purchased on Mar 29, 2020

Oct 4, 2021

Cris C.

VERIFIED PURCHASER

I tried SMX plus and several iterations of the Supertech R boots, a pair of Sidi Mag 3s (these just didn't fit me, but seemed fine boots), and a couple others to get to my forever favorite in these Axials. The Supertech inner bootie and to a lesser extent the SMX plus lacing system seemed like the play, but did not work out. A weird sizing aside, once I got my closest fit, the lacing system failed numerous times on the Supertech R or just didn't work that well for the SMX plus. When I first tried these on at a Dainese store in Chicago, they were quite stiff and the carbon arm for shin/kne protection seemed like a clunky gimmick. I was terribly wrong and wasted a lot of time and money before I circled back to them. I still think the Sidi boot is a quality product, but my feet are too wide for them (I'm not wide, they are narrow), but am happy I've found my match in these boots. They are proper racing boots, so don't expect tennis shoe like comfort, but the ankle pivot works and the boots loosen up to make walking around comfortable enough for the protection they offer. In vs Out makes me a little jealous of some boots having even better shin impact protection, but the tradeoff for being able to wear solid, not baggy, riding jeans to work is worth it. On the weekend, I have a pair of Dainese leather pants that interface perfectly and have a beefy shin protector that's likely better than what I felt I was missing by giving up some large plastic shellpad that stops normal out boots from going under proper fitting/quasi stylish straight leg riding jeans as mentioned before. These absolutely rock, and I can't think of anything bad to say about them. I once broke laces (for the fifth time) after sending my Supertech bootie back for repair on the first ride when I got them back. The Dainese system just keeps on going, and the velcro system for marrying the front and back shin arm/rear pad is quick and effective with no signs of wear either. I just wish I had gotten them years ago. I should have trusted Rossi.

1 jaar geleden

I'm in search of a boot that I can wear daily and I have narrowed the list to either Supertech R or Axial because of fitment issues. Do you think Axials would offer good protection with a proper riding jean on the street? My main concern is the shin protection as Axials are a bit shorter as you stated.

BEANTWOORDEN

Antwoord verbergen

1 jaar geleden

I wear my Axial Pro in boots with jeans all the time. They are the best looking boots to wear with jeans. And if you measure it against a Supertech R, it's only short by maybe an inch or two. If the plan is to wear just with jeans, I'd go Dainese as they are better for walking around. You'll be plenty protected, so don't worry. Hope that helps.

2 BEANTWOORDEN



Jun 16, 2020

Yong Y.

VERIFIED PURCHASER

It would have been awesome if \$100 cheaper, but I am still a very and very good boots

Purchased on May 23, 2020

(Background) I have been wearing only TCX boots (Duplier GTX & Hero WP) with size 41. I was a bit concerned about the size since some reviewers said it is a big snug. So, I contact Revzilla and talked to Khos from Revzilla. His suggestion was to stick to the size 41 and it is near perfect fit for me. (-_-)

((Comfort & Break-in Time)) It is very very comfortable. I can wear it for a quite a long time (The longest duration for me was 6.5 hrs). No problem walking around. Break-in time was like... well... almost immediate.. Maybe 15 mins to 1 hr ??

((Airtflow)) At least, no issue at 86 F (30 C). I think it will be just fine up to 92 degree F (32 degree C) as long as you are moving. Very very comfy from 55 F - 86 F (13-30 C).

((Some minor issue))

1. When I tried the boots for the first time in my room, it was a bit too tight at my left ankle. I felt a pressure at specific spot on my left ankle which disappeared in few hours of riding.

2. It is hard to fully close the zipper. It seems it is easier fully zip it if put the velcros lower part of your calf. But, still I wish the the zipper area is a bit more elastic so that I can fully zip it more easily.

((Overall)) I wish it is a bit cheaper, but I am very very happy with this boots. I strongly recommend to anyone who wishes to buy motorcycle boots for a full protection while being comfortable.

Was this helpful? 1 0

Flag





These are beautiful boots

Jun 18, 2020

Travers J.

VERIFIED PURCHASER

I am happy with these boots and I would suggest them.

Although, my foot is a size 10.5 in adidas and a size 42 in

European shoes (weird I know), I first got these in a 42 and my toes were smashed up front and quite frankly they were

bone crushing. No way I could do a 3 hour ride in them. So I sent them back for the 43. And, they fit but are roomie. I

WISH THEY MADE THESE IN HALF SIZES, the size

difference for one size up or down is MASSIVE. I also wish they had more tightening support in the inside. But other

than that these have a carbon fiber ankle brace in them which is awesome! I will probably put a thick footbed in

them if they pack out, but so far they have not packed out at all, and other reviews have said they will not. Other than

that these are just a beautiful, cool, simple boot. I like them.

I assume when these are worn out I will get another pair.

Was this helpful?



You get what you pay for

Jun 25, 2020

Anh-Viet T.

VERIFIED PURCHASER

I was actually a little peeved I had to buy innie boots for my Mugello R-D-Air suit as I had just gotten a pair of Sidi Mag 1 Air. I've raced and tracked with the Magis for years and have several pairs.

In comparison I feel the Axial look more premium and the

build quality is top notch. I have both size 43 in Mag 1 and

Axial and the Axial heel seems a little looser than I would

like, though the toe box is very comfy.

Protection wise I'm 100% confident they provide excellent

protection as there is substantial support around the ankles

for nearly every angle of movement.

If you're in a Dainese suit that requires an innie boot, just

bite the bullet and grab these. Excellent product at a steep

price. But worth it.

Was this helpful?



Extremely user friendly | comfortable | great range of

Jul 4, 2019

Theo R.

VERIFIED PURCHASER

motion

Was this helpful?



Comfortable, stylish and functional.

Jul 26, 2021

Richard H.

VERIFIED PURCHASER

Took a few rides to brake in, wear them all day at the track with no issue. Fantastic.

Was this helpful?



Most comfortable full boot ever

Aug 21, 2020

Ben A.

VERIFIED PURCHASER

These boots are much lighter than you'd think and the

comfort is something that I've never experienced in a full length boot. They allow so much more articulation while

your moving around on the bike than traditional boots. I'm a size 12 US and I ordered a 45 that fits spot on, and I have

a narrow foot. They are well worth the money, you won't

regret it.

Was this helpful?



Soles are more resistant to sharp

Mar 14, 2019

W E.

VERIFIED PURCHASER

Besides looking great and being very comfortable, the

soles now seem to be more resistant to damage by sharp footpegs, at least compared to the Airwalk soles on the

older models of this boot. 4 stars out of 5 because of the high MSRP.

Was this helpful?



Perfect

Mar 18, 2019

Damon N.

VERIFIED PURCHASER

Perfect sport bike boot. Have tried many others but no

comparison.

Was this helpful?



Why I chose this:

<p>"The best Motorcycle Boots on Earth" </p> <p>— Mevin E.</p> <p>1 year ago</p>	
<p>"Because it's Dainese"</p> <p>— Anonymous S.</p> <p>1 year ago</p>	
<p>"It's Dainese, protection and comfort."</p> <p>— Anonymous S.</p> <p>1 year ago</p>	
<p>"To prevent heel and toe fracture during falls."</p> <p>— David L.</p> <p>1 year ago</p>	
<p>"the best boots ever this will be my 4 pair"</p> <p>— Juan G.</p> <p>1 year ago</p>	
<p>"I chose these because I own two pairs of Dainese Alpha parts (in boots)."</p> <p>— Dylan H.</p> <p>1 year ago</p>	
<p>"Safety, Comfort and Quality."</p> <p>— Raminda A.</p> <p>9 months ago</p>	
<p>"Safety, Comfort and Quality boot."</p> <p>— Raminda A.</p> <p>9 months ago</p>	
<p>"It works with my race suit as well as my moto jeans"</p> <p>— Chris R.</p> <p>9 months ago</p>	
<p>"Need inside the suit boot"</p> <p>— Michael L.</p> <p>9 months ago</p>	
<p>"Liked the safety features displayed on the video"</p> <p>— Pedro C.</p> <p>10 months ago</p>	
<p>"To use for summer ride"</p> <p>— Raul D.</p> <p>10 months ago</p>	

Why I chose this:

<p>"Brand Reputation, Positive reviews, and detailed breakdown/review by Revzilla."</p> <p>— Jonathan Y.</p> <p>5 months ago</p>	
<p>"I seek max racetrack protection"</p> <p>— Wlo G.</p> <p>6 months ago</p>	
<p>"Thank you! I need color red"</p> <p>— Xiaoxin Y.</p> <p>7 months ago</p>	
<p>"because its the best"</p> <p>— Jared I.</p> <p>8 months ago</p>	
<p>"I ride on the track, and I can't put a value on my feet in case of a track. It's best to have good quality, highly safety-rated boots. I also have Dainese track leathers that will work with these boots."</p> <p>— Mark B.</p> <p>8 months ago</p>	
<p>"For my grandson, and all TCX boots we looked at were out of stock."</p> <p>— Bluesjamer2</p> <p>9 months ago</p>	
<p>"Will work with my Dainese suit."</p> <p>— Christopher W F.</p> <p>11 months ago</p>	
<p>"Wanted the best of the best."</p> <p>— Carlos C.</p> <p>1 year ago</p>	
<p>"I WAS LOOKING FOR THE BEST !!! JUST LIKE THAT"</p> <p>— Anonymous S.</p> <p>1 year ago</p>	
<p>"Cause I want in boots"</p> <p>— Mark G.</p> <p>1 year ago</p>	
<p>"Very good quality dainese"</p> <p>— Omar V.</p> <p>1 year ago</p>	
<p>"Because it looks like it'll save my feet from being wrecked."</p> <p>— Mario D.</p> <p>1 year ago</p>	





5 jaar geleden

Great overall review. My opinion, Van hit it all. I own this boot, it is a very high quality boot with exceptional style, great ventilation, awesome protection. The adjustments only add increased comfort from the elastic bar, ankle pocket, as well as the ratcheting shin adjuster. I own a Diasee DT, and of course Levi's 501's. Completes the suit and looks amazing with your street apparel. I get lots of compliments on my look with these.

d5 2 BEANTWOORDEN



4 jaar geleden (bewerkt)

My usual size for shoes is 43 (Europe). I ordered Forma Ice Pro in 44, do you think it will suit to me?

d5 BEANTWOORDEN

Antwoord verbergen

4 jaar geleden

kinda late with the answer, but you may have already noticed it feels like a boat. I normally wear 43 and the same 43 size of this boot is almost big for me, but at least my feet can get the blood going through, so it's comfortable to wear all day long

d5 BEANTWOORDEN



11 maanden geleden

Hello mate, During the colder weather I've been breaking my Sid's in, they're becoming more and more comfortable. They need a LOT of work to break them in, and they're pretty much solid for me in terms of warmth and being water proof (I don't ride in crazy downpours). Becoming more comfortable the more I wear them.

The Formas I've worn as few times since last year and they're still very comfy even though they're pretty much brand new still. I gripe I have with the Formas, the ankle cage pivots on my right foot rub my ankle a bit after a while, but they're still much better if you are going to be doing any walking.

I'm now on the fence, but that's only because my Sid's are becoming more supple, so no doubt once the Formas are broken in they will be my Go To summer boot, being perforated too gives you that nice air flow on the feet. They squeak a bit, also, I now like them both equally.

An additional point, The Sid's offer way more protection in my opinion, they are solid! But agility, comfort and summer riding, the Formas all day! I just need some gloves and a new lid to go with my Formas (Fluo yellow / White / Black), all my leathers, are black / red, helm is Carbon, sid's are black / red, so I got an excuse to buy some new gloves and a lid (Bell Race Star DLX Flex - Velocity Matt / Gloss Black / Hi-Viz).

Minder tonen

d5 1 BEANTWOORDEN



3 jaar geleden

The toe up concept is purposeful. You want to ride, inside foot, way up on the peg. It has little to do with protection, and more to do with avoiding scraping your toe. If you don't track much, then these boots are wayyyy overkill.

d5 1 BEANTWOORDEN

Antwoord verbergen

2 jaar geleden

501 Speeding ohh now that you explained it, it makes sense to why curved up words

d5 BEANTWOORDEN



1 jaar geleden

Just bought these and I prefer these 10x over than my Sid's ST boots. I only ride street on a ZX10R and I love 'em. My Sid's ST boots are so bloody wooden and stiff you get no feel and you feel like your wearing clogs when you have to walk in them.

These Formas are fantastic!



3 jaar geleden

Its weird that you say only the side heel vent is actually a vent because on the FORMA website that rear vent is real and so is the one in the toe slider you don't even mention are you sure all those are just for show?

d5 1 BEANTWOORDEN

Antwoord verbergen

3 jaar geleden

On the FLOW version, the shin vent and the toe slider vent function as real vents, because the leather beneath is perforated. On the regular, non-perforated version, those shin and toe slider vents aren't fully functional. -DrewZilla

d5 3 BEANTWOORDEN



4 maanden geleden

How good are these boots for touring? Just wanted to understand the practicality and comfort... Though safety is the top priority.

d5 1 BEANTWOORDEN

2 antwoorden verbergen



4 maanden geleden

This is more of a racing boot than a touring boot. - Van

d5 1 BEANTWOORDEN



11 maanden geleden

yes I was surprised that the sid boots are made of some sort of synthetic leather type material, but it is very durable.

I like both my boots and each have a use.



5 maanden geleden

Which of Alpinestars models is most comparable to this model, and why would this one be better or worse compared to it?

d5 1 BEANTWOORDEN

2 antwoorden verbergen



5 maanden geleden

IMO the Alpinestars Supertech R Boots are the most comfortable sport boot on the market. - Van

d5 1 BEANTWOORDEN



1 jaar geleden

Which do you prefer this or Sid's Vertigo 2? Thank you.

d5 BEANTWOORDEN

Antwoord verbergen



1 jaar geleden

The Vertigo 2 is a less technical boot IMO. This boot will offer a little more protection for racing / track riding. - Van



1 jaar geleden
Just got a pair of these in the Flow / White / Fluro for £100 and I prefer these waaaaay more than my Sidi ST boots. Less wooden and way more comfy. I know they're 2 different sorts of boots, but I'd use them both for the same thing and I'd pick these anyday over my Sidis!

ds 1 5P BEANTWOORDEN

1 jaar geleden
Would you choose these or de sidi vertigo 2? Thank you!

ds 1 5P BEANTWOORDEN

Antwoord verbergen

1 jaar geleden
It would really come down to fit, as they are similar in features. Forma typically run wider in the foot and calf, while Sidi have a very narrow footbed and a tighter leg opening.

I hope that helps!
-Zack

About
Forma Ice Pro
Flow Replica
Boots

Great boots. Very vibrant colors, comfortable, easy to put on, great for a days worth of riding.

Apr 23, 2020

5 stars

Jodi F.

5 stars
Jun 5, 2021
Great price, protection and style. These boots have good air flow to keep feet cool. The only bad thing is they are bulky.

VERIFIED PURCHASER

Was this helpful? 0 0

P Flag

Purchased on Apr 20, 2021

3 stars
Jun 9, 2021
I had issues with how the boots felt once on the bike and it was too late to return them. They felt great off the bike but when I put them in to ride I could not operate my motorcycle with them on.

VERIFIED PURCHASER

Was this helpful? 0 1 3

P Flag

Purchased on Apr 22, 2021

5 stars
Sep 3, 2021
These boots are just amazing and loading with features. Notes about them though since they don't have half sizes you have to go to the next size up. I wear 10.5 normally but had to go with the 11 or 45 with these boots, the only neg thing about them is the toe box section is a bit on the tighter side, so if your feet are wider its going be a bit tight, but still great boots and its not overly tight.

VERIFIED PURCHASER

Was this helpful? 0 1 0

P Flag

Purchased on Aug 29, 2021

5 stars
Jun 7, 2021
Awesome boots make me feel like Iron man with them on. They fit a bit on the tight side, hopefully they break in after awhile.

VERIFIED PURCHASER

Was this helpful? 0 0 3

P Flag

Purchased on Apr 23, 2021

4 stars
Sep 2, 2017
Fit is great. Airflow excellent, almost too cool sometimes. Securing mechanism is a bit 'gadgety'. Overall - good!

Ken D.
VERIFIED PURCHASER

Was this helpful? 0 10 1

P Flag

Purchased on Aug 8, 2017



Why I chose this:



<p>"Boots # 42 yellow neon and white."</p> <p>— Gabriel S.</p> <p>4 months ago</p>	<p>"Love the color and the design. It's the style of my bike, and I love Euro stuff"</p> <p>— Anonymous S.</p> <p>1 year ago</p>
<p>"Few boots are in my size"</p> <p>— Anonymous S.</p> <p>5 months ago</p>	<p>"I haven't heard of these boots but this is an upgrade to my current boots. I'm going to give them a try"</p> <p>— Anonymous S.</p> <p>1 year ago</p>
<p>"Appears to have all the race protection and quality of higher priced boots. The company established 1999 and is Italian background."</p> <p>— A. C.</p> <p>6 months ago</p>	<p>"Highly recommended by other racing apparel sites."</p> <p>— Anthony B.</p> <p>1 year ago</p>
<p>"color and nice looking boot"</p> <p>— Anonymous S.</p> <p>6 months ago</p>	<p>"I have a pair of these and needed backup for AIRMA races. Comfortable boots"</p> <p>— alan D.</p> <p>1 year ago</p>
<p>"Because there is a worldwide gear shortage and thus was my best option before the track on August 16th."</p> <p>— Ryan C.</p> <p>7 months ago</p>	<p>"I liked the style. They're very very well made and instill confidence in my riding. Awesome boot, a bit squeaky, but overall great."</p> <p>— Devin S.</p> <p>over 4 years ago</p>
<p>"Professional quality for a reasonable price."</p> <p>— Anonymous S.</p> <p>9 months ago</p>	<p>"Excellent ankle protection. Easy to tighten and release ratchet clasp."</p> <p>— David M.</p> <p>3 weeks ago</p>
<p>"For my safety and they are Italian"</p> <p>— Anonymous S.</p> <p>11 months ago</p>	<p>"I like my Forma Adventure boots for their fit and comfort along with their ruggedness and quite frankly, good looks, too. I'm hoping it equates to these Sport boots, as well."</p> <p>— Yujin S.</p> <p>4 weeks ago</p>
<p>"Recommended by a friend"</p> <p>— Anonymous S.</p> <p>11 months ago</p>	<p>"Color design and technical boot"</p> <p>— Anonymous S.</p> <p>2 months ago</p>
<p>"Because I am unhappy with my Alpinestars boots and am trying something different."</p> <p>— Andrew D.</p> <p>11 months ago</p>	<p>"I like the style, match the race suit I have."</p> <p>— James</p> <p>3 months ago</p>
<p>"Best protection for the money"</p> <p>— Anonymous S.</p> <p>11 months ago</p>	<p>"Is the perfect boots"</p> <p>— David I.</p> <p>3 months ago</p>
<p>"Because motorsport usa kept dropping my orders."</p> <p>— David G.</p> <p>1 year ago</p>	<p>"Best Race boots for the money"</p> <p>— Jerry W.</p> <p>4 months ago</p>
<p>"Because they are Italian...and so am I"</p> <p>— Justin D.</p> <p>1 year ago</p>	

★★★★★

5

0

Was this helpful?

Flag

★★★★★

5

0

Was this helpful?

Flag

★★★★★

31

4

Was this helpful?

Flag

★★★★★

31

4

Was this helpful?

Flag

7 Ratings

4.1
out of 5 stars

WRITE A REVIEW



Perforated

<https://www.youtube.com/watch?v=yxGSC9aVwI>
<https://www.youtube.com/watch?v=wILlseGDIA>
<https://www.youtube.com/watch?v=SMkUOC2LUw>
<https://www.revzilla.com/motorcycle/forma-ice-pro-flow-boots>

Bang For The Buck: 4.3 / 5.0

Protection & Durability: 4.7 / 5.0

Features: 4.1 / 5.0

Comfort: 4.6 / 5.0

Style: 4.4 / 5.0

Fit

Footbed

Air Flow: 4.7 / 5.0

Why I chose this:

"Style and color scheme"

— Anonymous S.

9 months ago

"I'm hoping they're not made in China, if they aren't, and the fit is comfy, I'll return them and order from FC-Moto in Germany and save \$80, even paying an extra \$50 in shipping. Ain't international..." Read More

— Gabie E.

9 months ago

"Liked the cooling, comfort, and protection this boot brings to the table. Trying to stay safe best I can on my Turbo BUSA"

— Anonymous S.

10 months ago

"According to the video and specs they had the easy wear and safety features I wanted at a good price point. It does help I really like the way they look."

— Corrado B.

10 months ago

"Recommended from some friends."

— Theresa N.

10 months ago

"Looks, Performance, Ratings."

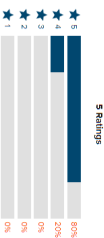
— Anonymous S.

10 months ago

5 Ratings

4.8
out of 5 stars

WRITE A REVIEW



4 Customer Photos



Bang For The Buck: 4.2 / 5.0

Protection & Durability: 4.4 / 5.0

Features: 4.4 / 5.0

Comfort: 4.0 / 5.0

Style: 4.8 / 5.0

Fit

Footbed

Air Flow: 2.8 / 5.0

FORMING
PERFORMING BOOTS



1 jaar geleden

Finally my vortice have given out after nearly 5 years. Not keen on the sole not being replaceable anymore (very very soft rubber wears quickly and also major problem with pulling the boot on. Stepping in sideways was so much easier to adjust your socks underneath and would be much less painful to remove them if you break your ankle. Just unzip the side rather than having to yank or cut them off. Big no no.

Was hoping to pickup another set of vortice but they are not avail in my size left anywhere now.

Why sidi why?

Minder tonen

2

👍

BEANTWOORDEN



3 maanden geleden

1. I don't have any issues, with figment or the design of the boot. I think you should be aware that the boots always vent air through the mesh/padded area in the front & back. So this boot isn't the most ideal for cold weather.

2. I think, without track use, the Vertigo 2 would be perfectly fine for your use. I personally like the aesthetics of the Rex more, and I like how easy they are to put on with a race suit.

Either way you go, you'll have the protection you want. Vertigo 2 will be able to be worn in colder weather, and they are also cheaper.



3 maanden geleden

yes, the Rex flows more air than the Vertigo 2. Both boots have vents on the side of the boot. But the Rex has a vent on the toe, and the Rex also has a mesh area front/back that vents air. The Rex comes in a perforated Rex Air version as well which may be best.

I have owned my SIDI Rex for a couple years now, and the synthetic leather upper is in great shape with no issues. But I have a lot of boots, so I don't wear any single pair that frequently.

Minder tonen



2 jaar geleden

Seems like you're getting quite some quality for that price, thanks for the review.



3 jaar geleden

Easy to use

2

👍

BEANTWOORDEN



3 jaar geleden

Much faster to get into... Looks way smarter than the vortice. I hope they also addressed the issue with the Achilles too. Is the sole replaceable?

1

👍

BEANTWOORDEN



1 jaar geleden

These boot hold up very well, and I've never had any issues with the. The ratchet system allows you to customize your fit really, so a little loose or more snug.

1

👍

BEANTWOORDEN



2 jaar geleden

I'm very happy with my Sidi rex 🙌🏻

1

👍

BEANTWOORDEN



2 jaar geleden

3 antwoorden verbergen


2 jaar geleden

That's great to hear! Have you been able to try them on your bike?

1

👍

BEANTWOORDEN



2 jaar geleden

Champion Helmets yes, at the beginning they were a bit stiff that was strange for me, but after the weekend I was used to it and convinced!

The fluo red looks stunning on my bik 🙌🏻

May I will get a second pair of them 🙌🏻

1

👍

BEANTWOORDEN



1 jaar geleden

I hope so... I love my vortice.. Jus dont like how exoskeleton gets caught on rearset sometimes.. Is that a factor w the rex?

1

👍

BEANTWOORDEN



1 jaar geleden

I personally haven't had that issue with these boots. If I were you, I'd be sure to try them out. Try them on while on your bike, without going for a ride, just to make sure. If you don't like how they fit on you or the bike, you can always return them I'm sure.

1

👍

BEANTWOORDEN



2 jaar geleden

What makes Sidi good but cheaper than danese?

1

👍

BEANTWOORDEN



2 jaar geleden

Antiwoord verbergen

1

👍

BEANTWOORDEN



1 jaar geleden

The rex is most comfortable boot to walk in top tier raceboot category. So you can use them sporting with them. I used mein on a 4500 mile road trip. They are comfortable for 7hrs of wear. The ball of the foot area flex well. And the mesh panel makes ankle flex easy.

1

👍

BEANTWOORDEN



1 jaar geleden (bewert)

I just ordered a pair. They are my street boots. I also have the SuperTechs which I absolutely love. Thanks for review.

1

👍

BEANTWOORDEN



1 maand geleden

I have two pairs of Sidi Rex black/black - one Air, and one non-Air. I wear them on track and for multi-day country rides and they are extremely comfortable. I've crashed in them twice (once on track and once on the street) and they offer amazing protection. Highly recommended.

1

👍

BEANTWOORDEN

The Rex Air is a great boot overall. It is extremely well made, and offers amazing levels of protection. One of the nice things about the Rex Air is the amount of replaceable parts it offers, if you were to go down on the road/track. One thing it lacks compared to its predecessor, is a replaceable sole. So you'd need to get the soles completely replaced if you were to wear through them.

Looks wise, the Rex Air is pretty boss. Yes it looks big and clunky, but that's the whole point. This boot is supposed to look like it can withstand a crash and keep you safe. And that's exactly what it's designed to do. The Rex Air boots look great with jeans, and you can wear them on the road easily as they have a reflective area on the heel. Overkill for the road? Depends where you live, and what level of protection you want. Do they beat the same old black boots everyone has? Yes. Beats wearing sneakers, thats for sure.

One thing I love about the brand SIDI is they make pretty much only boots. They make great cycling and motorcycle boots. That singular focus, to me, is the difference between SIDI and a company that makes all different types of gear. If you are in the market for a track boot, or all around motorcycle boot, and you want the most protective boot around...SIDI Rex Air. It's good to be the king.



13 dagen geleden (bevekt)

The soft neoprene below the shin guard is ridiculous. A foot peg will slice through that without issue. I've had this type of thing happen but successfully avoided my foot being amputated by wearing the best boots, which are Security Evos...

👤 1 BEANTWOORDEN

2 jaar geleden

Thanks for the video, my question to everyone is: How does this compare to the Mag 1 boot? Which offers more protection? Comfort? Looks better (subjective)? Please let me know what you suggest. Be as detailed as you can. Thanks in advance 🙏

👤 1 BEANTWOORDEN

Antwoord verbergen

2 jaar geleden

I have both and have ridden in both. The Mag 1 offers a little less lateral ankle support than the Rex does, this would be the only difference in protection between the 2 with the Rex on top. Comfort between the 2 is very close with the Rex offering less resistance in the ankle area fore and aft. The Mag 1 is easier to get in and out of and the Rex is easier to lace up (tighten the adjusters). The top entry of the Rex takes a little getting used to, once you have that dialed in they are super easy to use. Hope this helps! - Van

Minder tonen

👤 3 BEANTWOORDEN

1 jaar geleden

Great fix, great ankle flexibility which I need due to a major leg injury, however the getting it on is a bit tough (not bad, it's a trade out).

👤 1 BEANTWOORDEN

Antwoord van Sportbike Track Gear bekijken

4 maanden geleden

I bought a pair of the rex air last year. Awesome boots. So much protection and adjustment.

👤 1 BEANTWOORDEN

3 jaar geleden

Sidi has discontinued the replaceable sole with the Vortice. Looking at our sales history we have sold more Vortice Boots than replacement sole inserts. My bet is this is the reason why they did not move that feature forward. - Van

👤 1 BEANTWOORDEN

★★★★★

Great protection

May 25, 2020

Peter D.

They are expensive, but totally worth it.

Was this helpful? 🍏 0 🍏 0

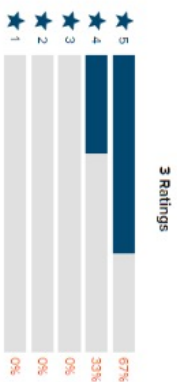
3 Ratings

4.7

out of 5 stars

★★★★★

WRITE A REVIEW



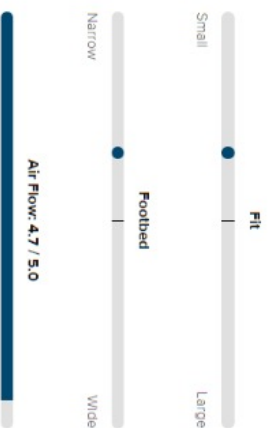
Bang For The Buck: 4.7 / 5.0

Protection & Durability: 5.0 / 5.0

Features: 4.7 / 5.0

Comfort: 3.7 / 5.0

Style: 4.3 / 5.0



Good Boots But..

Jun 29, 2019

Juan C.

Solid boots, the protection is there but do run a bit small. I wear 10.5 shoes, I bought 11 boots and fit perfect in length but bit narrow in width. So if you got a wide foot, may feel uncomfortable. Also the color is bright. It is a more a florescent red. For example, if you want these to match your Ducati Red, it will not but still a solid boot. I honestly gave it 4/5 stars maybe because pricing and color but that's really it.

Was this helpful? 🍏 2 🍏 2



10 Ratings

4.4

out of 5 stars



WRITE A REVIEW

10 Ratings



1 Customer Photo



Bang For The Buck: 4.3 / 5.0

Protection & Durability: 4.8 / 5.0

Features: 4.9 / 5.0

Comfort: 4.3 / 5.0

Style: 5.0 / 5.0

Fit

Small

Large

Footbed

Narrow

Wide

Air Flow: 4.1 / 5.0

Sidi Boots

Mar 1, 2020

Awesome product money well spent in my eyes. They look nice in online photos but I gotta say in person the boots look and feel amazing.

VERIFIED PURCHASER

Was this helpful? 0 0



Jul 13, 2020

Really dig those BOA buttons.

A. C.

Good but could be better

Pros: The boots are of good quality overall.Good airflow.

Cons: The side support piece is constantly pushing your

suit zipper into your skin. If you wearing Alpinestars suit

there's a good chance you'll run into the same problems as me



May 27, 2020

Onene G.

VERIFIED PURCHASER

Great fit; but you need to be moving on your bike

Must say, they are a bit warm, but that changes when I'm moving with them on my bike. SIDI boots are notorious for being uncomfortable / stiff, and though I'm not planning on window-shopping through the mall with them, they are not bad at all when it comes to comfort ... not quite slippers, but not bad. NOTE: I'm solidly a Euro 48 with w-d-e U.S. feet. I tried these because though I have a Dainese Laguna Seca 4 suit, Dainese won't make a 48 for their Torque3 Out Air nor their Torque D1 Out Air. TCX is also a good-fitting boot for me, but I believe the features on the Rex are better. I am not anywhere close to being a pro racer, but I don't mess around when it comes to my feet, and these boots work well for me. NOTE 2: I did not try the Rex Air, so I do not know if the Rex Air boots are much better in terms of ventilation when not moving.

Was this helpful? 1 0



Aug 27, 2021

William B.

Design Flaw - Ankle Brace Mounting

Love the boots! However, there is a design flaw. The hard mounting post/point, for the inner ankle braces, are only secured by the leather and subject to tearing. Since this is not a replaceable part, the boots are useless if the mounting post/point fails. Mine failed! After only 7 Track days. Sadly, Motionation, the Sidi Representative in the United States, will not cover this failure under the SIDI Warranty. It is either buy a new pair of Sidi's, or in the alternative move on to Alpinestars. I purchased my boots direct from Motionation and I am also a customer of Revzilla. I think its important to know the facts about a product ...



Was this helpful? 6 0



Jun 9, 2020

Michael H.

VERIFIED PURCHASER

So far, so good...

Returning SIDI customer. So far, these are definitely the cream of the crop. I have a 2500 ride coming up and will update this review if I notice anything that drops the rating. If you don't hear back from me, they remain a 10/10!

Was this helpful? 0 1





For first time Sidi buyers

Dec 11, 2018

John H.
VERIFIED
PURCHASER

This review is for those who have never tried Sidi before. As a reference, I currently only wear Dainese for the past few years. As far as my sizing goes, I am ever so slightly wider than normal, but D sized shoes fit me much better than EE sized shoes.

This off season, I wanted to upgrade to a Sidi from my current Dainese Torque RS which I've been wearing at the track. I was worried about sizing, because even within Dainese, the same sized boots between models are not the same size. For example, the Torque RS is the correct length by my size, but the JRC-Tour is too short and needs to be one Euro size higher.

The good news is that the Sidi's length is true. The size I ordered was the right length as with all my other boots and running shoes. However, the width of the footbed was on the narrower side, reminding me of the couple Puma boots I've owned years ago.

The Sidi boots look and feel like they offer much sturdier and better ankle roll protection than the Dainese boots with Axial Pro. The closure system provided even better fit.

But unfortunately, despite all the positives, I have to return the Sidi boots. I'm one of those people who easily get bothered by the zipper or my track suit around the legs that sits close to my Achilles tendon. It would dig into my skin that I would get blisters.

One of the benefits of the Dainese boots is the way the boots open up, zipping down the middle of the back side. This provides a wide entry and allows me to tuck the rear tongue (whatever that plastic thing is called that is in the rear side of the inner boot) between my skin and the suit, so the zipper rests on the tongue instead of my skin.

The Sidi has a similar tongue on the rear, but because I can't open up the Sidi boots wide enough at the top, it was really hard for me to zip down my suit over the rear tongue. It certainly is achievable, but I got it done with great difficulty in shoving my thumb and index finger down the boot to zip my suit down around my lower leg. I can only imagine how much harder it would be at the track, when you're hot and sweaty and flustered trying to get ready for your session.

So there you have it, I'm sad to have to return these nice pair of Sidi boots, if only they would allow the top of the boot to open up just another inch wider in circumference, that would've made all the difference for me. Do not hesitate to buy these boots if you don't have my blister problem.



Badass looking boots

Mar 26, 2020

Andrew M.
VERIFIED
PURCHASER

I was looking for a track boot and I was stuck between these boots, Alpinestars Supertech R and TCX RT-Race Pro Air. Ended up getting these Bad boys because they were on sale.

Love the look of this boot and I knew that they run narrow compared to other boots. I usually wear vans, adidas and new balance because they are a bit wider compared to nikes.

Initial fit, it was very tight and narrow. I find it best to put these boots while standing and using your weight to slide your foot in. Walking around with them is definitely uncomfortable and stiff like how it suppose to be. But while riding, it seems to fit just race and comfortable enough. In my opinion, the air flow is good. I usually have all the vent wide open. I rode on them during a chilly day (48F-55F) and my feet was getting a bit cold. Can't really test the durability since I haven't crashed with them yet. Overall, badass boots and definitely eye catching. I would say if you could get them on sale, don't pass on them and give them a try. But for the original price, I probably would go for Supertech R or RT Race Pro.

Was this helpful?



Feels great. Controls slightly quirky.

Mar 27, 2020

Tian N.
VERIFIED
PURCHASER

Previous boot: Sidi Vertigo Corsa Air. Typical of Euro boots, sizing runs true and VERY narrow. They feel great pivoting on toepegs, but not so much when walking around on flat ground with the rollerblade soles. I prefer the controls on the Vertigo Corsa much more. The new Rex Air pushbuttons take a little of getting used to, especially to release tension. My old Vertigo Corsa was much easier to get in and out of. But when you're in them, the Rex Air offers top notch ankle protection while... [Read More](#)

Was this helpful?



Nice boot, looks good with full protection, feels good, love them

Erby C.

VERIFIED
PURCHASER

Purchased on Mar 5, 2020



Was this helpful?





Apr 21, 2020

Giuseppe C.

Great on the bike but don't walk in them.

Getting back into riding after a long break. My last pair of boots were Sidi's and they lasted 18 years. These are much better. The ratchet system allow you to dial in a great fit and the protection is great. When I first put them on I thought they were really uncomfortable and they are if you're standing or walking. On the motorcycle, I don't notice I am wearing them. No pinching or hot spots and great airflow. However, I would bring shoes to change into if I was going to spend any real time off the bike.

Was this helpful?



- <https://www.youtube.com/watch?v=Oj8x-WfzPzI>
- <https://www.youtube.com/watch?v=Pb2nCAfE7VI>
- <https://www.youtube.com/watch?v=rzd9D5P-z0E>
- <https://www.youtube.com/watch?v=rXwgr0H1P1>
- <https://www.youtube.com/watch?v=e1UjH1CF9Uo>
- <https://www.revzilla.com/motorcycle/sidi-rex-air-boots>
- <https://www.revzilla.com/motorcycle/sidi-rex-boots>



May 28, 2020

Ahmar

Sidi T-Rex

Overall thoughts...

Phenomenal boot, sure the price is absurd but this is one heck of a boot. In my personal opinion this is one of those boots that have so much going on when you look at it but is just a part of it's simplicity. The finish and quality is simply amazing for what you pay.

SIZING (please read)

Now the most important part... the sizing. My true foot size is 8. I have narrow feet (if need be, use this as a reference). I have a pair of Dainese DI Torque out and also a pair of Alpinestars Smx Plus, both of those boots are in size 7.5. My feet are odd when it comes to motorcycle boots and can go half a size down or half a size up. For the Sidi Rex's I recommend trying to stay true to size. I purchased the Euro size 42 or 8.5 US and am positive it was the right call after all. Always remember folks, your feet will feel different in terms of fit in different brands, for instance, both my Dainese and Alpinestars boots fit like a size 8 despite them being size 7.5 boots. It may be the width of the boots rather than the length and have little to no room in terms of length (also don't forget that boots have a different break in time). For where as the Sidi's fit as if they are my running shoes, they are a bit more generous in terms of length compensation. That wraps up my 2 cents for these boots, again, very phenomenal and well constructed and will outlive you before you outlive them.



<div> <div> </div> <div> <div>jaar geleden</div> <div> <div>I normally wear us9, should i buy one size down?</div> <div> <div>7</div> <div>BEANTWOORDEN</div> </div> </div> </div> </div>	<div> <div> </div> <div> <div>1 jaar geleden</div> <div> <div>H. Can you tell me what's the difference between it race and race pro</div> <div> <div>5</div> <div>BEANTWOORDEN</div> </div> </div> </div> </div>	<div> <div> </div> <div> <div>1 jaar geleden</div> <div> <div>Antwoord verbergen</div> <div> <div>1 jaar geleden</div> <div> <div>Magnesium sliders, michelin sole</div> <div> <div>5</div> <div>BEANTWOORDEN</div> </div> </div> </div> </div> </div> </div>	<div> <div> </div> <div> <div>7 maanden geleden</div> <div> <div>Hi boss</div> <div> <div>I got a pair but when home the calf tightening came off what you do</div> <div> <div>5</div> <div>1</div> <div>BEANTWOORDEN</div> </div> </div> </div> </div> </div>	<div> <div> </div> <div> <div>2 maanden geleden</div> <div> <div>How do these compare with the Supertech R for comfort and tactile feel?</div> <div> <div>5</div> <div>BEANTWOORDEN</div> </div> </div> </div> </div>	<div> <div> </div> <div> <div>1 maand geleden</div> <div> <div>Antwoord verbergen</div> <div> <div>Both are very comparable when it comes to comfort and feel while riding. The Supertech R's do add an inner bootie system so there are more layers though. But most professional racers prefer and wear the Supertech R's so you can take that for what its worth.</div> <div> <div>5</div> <div>1</div> <div>BEANTWOORDEN</div> </div> </div> </div> </div></div>	<div> <div> </div> <div> <div>3 jaar geleden (bewerkt)</div> <div> <div>Are they good for touring long drives? Also will they harm in water?</div> <div> <div>5</div> <div>BEANTWOORDEN</div> </div> </div> </div> </div>	<div> <div> </div> <div> <div>3 jaar geleden</div> <div> <div>2 antwoorden verbergen</div> <div> <div>They're designed for racing, so they aren't good for touring or really long rides. Also, they are not waterproof, so your feet will get very wet in the rain. Instead, I recommend you look at waterproof sport touring boots. -DrewZilla</div> </div> </div> </div> </div>	<div> <div> </div> <div> <div>2 jaar geleden</div> <div> <div>I have to say, I am a HUGE fan of TCX boots. I had "Oakley" race boots before my current TCX's boots. I am still wearing the prior version. I purchased a pair of the current version when they went on a killer sale through my distributor (I use be a parts manager at a large multi-line dealership). I found the older versions to be a bit superior in build quality. I had issue out of the box with the current versions torsion control system. Specifically the lower piece that slots in at the heel would come out of its channel as if it was too short. Do you know if this has been addressed? I'd love to have the new version but this design flaw concerns me a bit. thanks in advance Van!</div> <div> <div>Minder tonen</div> </div> </div> </div> </div>	<div> <div> </div> <div> <div>jaar geleden</div> <div> <div>Just got mine! Love em.</div> <div> <div>5</div> <div>3</div> <div>BEANTWOORDEN</div> </div> </div> </div> </div>	<div> <div> </div> <div> <div>1 jaar geleden</div> <div> <div>I have worn Alpinestars race boots for almost 20 years. I tried this exact same pair of TCX last year and will never look back. The protection and fit is by far superior to the Supertech. The sole and heel are more durable for riding and also walking down the pitlane, so far I had 8 crashes in them and they did their job superbly.</div> <div> <div>5</div> <div>6</div> <div>BEANTWOORDEN</div> </div> </div> </div> </div>	<div> <div> </div> <div> <div>2 jaar geleden</div> <div> <div>Absolutely love those boots, the only thing I'd like to see is an easier way to close them, I find the ratchet system gets in the way of attaching the Velcro at the top of the zip. Other than that, very comfortable and sturdy enough for racing</div> <div> <div>5</div> <div>1</div> <div>BEANTWOORDEN</div> </div> </div> </div> </div>	<div> <div> </div> <div> <div>6 maanden geleden</div> <div> <div>How's the toe box width compared to Alpinestars?</div> <div> <div>5</div> <div>BEANTWOORDEN</div> </div> </div> </div> </div>	<div> <div> </div> <div> <div>6 maanden geleden</div> <div> <div>actually this is a very good question. I never ever had any bunion issue with my feet but recently I have swollen toes and bottom of my feet and it lasted a few weeks. I started to have sore feet a lot more last year and this year I noticed I seem to have a bunion problem on both feet. I don't wear dress shoes and the shoes I normally wear everyday is Nike and DC. Skater shoes so they are fairly roomy. Then I realized my TCX has a much narrower fit then my old Alpinestars and that might be the reason I can sore feet a lot more since last year. By NO means I am saying TCX is bad or anything but if you have "wider" feet (actually mine is not even that wide) you should try it before you buy it. But again I do ride on the track a lot more than most ppl as I have a free pass on a local circuit so I am there every week for a few days most of the time.</div> <div> <div>Minder tonen</div> </div> </div> </div> </div>	<div> <div> </div> <div> <div>6 maanden geleden</div> <div> <div>so basically no bunion or sore feet with Alpinestars boot before switching to these TCX? What Alpinestars boot did you wear? Thanks</div> <div> <div>5</div> <div>BEANTWOORDEN</div> </div> </div> </div> </div>	<div> <div> </div> <div> <div>1 jaar geleden</div> <div> <div>I have these but they felt so weird im 5'6 and not so tall for a sport bike so I ride with the tips of my toes and I felt like I couldn't reach the floor cuss of the ankle support and the I couldn't feel my shifter but I think they just need to really break in to get the feel and used to them besides that great quality boots and feel very safe to ride with.</div> <div> <div>5</div> <div>1</div> <div>BEANTWOORDEN</div> </div> </div> </div> </div>	<div> <div> </div> <div> <div>jaar geleden</div> <div> <div>I'm a big fan of TCX boots. I have several pairs now. My first pair was a closeout special I bought from STG without even trying them on. They were the Jupiter2 boots and with the STG return policy I figured I'd take a chance. Low and behold, they fit me spot on. I was so happy with them, I ended up trying a set of S-Race Air, again a closeout special from STG and again fit me perfectly. I actually wore out the sole on the Jupiter2 boots but recently had them re-soled at a local leather repair shop and now are my go-to.</div> <div> <div>Meer tonen</div> </div> </div> </div> </div>	<div> <div> </div> <div> <div>2 jaar geleden</div> <div> <div>This is a great pair of boots, IMO the Supertech R are significantly better. The Supertech R requires next to no break in, has excellent feel and offers what I rate as the highest level of protection on the market today. Considering the price difference they should be better to be fair. - Van</div> <div> <div>5</div> <div>BEANTWOORDEN</div> </div> </div> </div> </div>	<div> <div> </div> <div> <div>2 jaar geleden</div> <div> <div>Btw. They can be squeaky to walk in. But getting quieter..</div> <div> <div>5</div> <div>3</div> <div>BEANTWOORDEN</div> </div> </div> </div> </div>
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★★★★★ 49 run large enough :)

Dec 27, 2021
Bikramjy K.
super tech r 48 dont fit. tcx race 49 fit just fine. I wear a 15 normal in all brands except chucks.

Was this helpful?  1  0

 Flag

★★★★★ The best for me

Dec 3, 2020
Nick C.
These are the only track boots for me. Others didn't fit right, were hard to get on, or were painfully uncomfortable. The protection seems great, wearing them all day on track and my feet feel great.

VERIFIED PURCHASER

Purchased on Mar 25, 2019

Ride:
2016 BMW K1600GT

Was this helpful?  1  0

 Flag

★★★★★
Mar 1, 2021
Finish is good. Seem to be a little more protection than the Diabese Torque D1.

Purchased on Feb 8, 2021

Vaughn B.

VERIFIED PURCHASER

Was this helpful?  0  0

 Flag

★★★★★ Beautiful but returned

Jun 12, 2019
Curtis J.
I have wide feet. So I have been struggling with buying boots online. These were pretty comfortable for my feet. But I had to return these. As the top of the foot was too tight. Width was fine.
If you have a tall top of your foot. Be wary as these may not work for you.
Otherwise. One of the best boots I have seen in person and tried on.

Purchased on Jun 4, 2019

VERIFIED PURCHASER

Was this helpful?  6  2

 Flag

★★★★★ Another great pair of TCX Boots

Aug 3, 2018
Eric G.
I just bought these perforated boots for street and track riding, they are my third pair of TCX boots. Having tried Dainese, Alpinestars and Sidi, I much prefer the comfort and practicality of these boots. Beyond that, they are well built and safe with great protection.

Highly recommend these boots over competitors.

Was this helpful?  5  0

 Flag

★★★★★ Great Boot!

Jul 28, 2018
A. C.
2nd purchase from RevZilla after the Sidi Mag was too narrow. Easy to get in & out of, excellent adjustment controls for comfort, unbelievable feel on the pegs, if you have a wide foot, you can't go wrong with TCX.
Also, RevZilla is an amazing distributor for motorcycle gear. Customer service on the phone, & their shipping policies are top notch. Every staffer I spoke with, over the course of several purchases, was extremely knowledgeable and willingly offered their expertise. Great customer experience...huge shoutout to RevZilla

Was this helpful?  2  0

 Flag

★★★★★ Great boots (blue in color)

Jul 26, 2018
Rob S.
Very happy with the purchase however these boots are a bold blue (like most gear that is blue). To the pictures that are on the Revzilla site the boots look like they might be brighter blue but don't let the photo trick you (I am glad they are as blue as they are).

The boots feel amazing and did not take long to break into.

Would purchase again.

Was this helpful?  1  0

 Flag



6 maanden geleden (bewert1)

How's the toe box width compared to a SMX-6 V2 and in general between both brands? I read someone saying TCX is slightly wider.

👤 1 📌 BEANTWOORDEN

👤 1 📌 Antwoord verbergen

6 maanden geleden

I feel like the Alpinestars and TCX boots offer a similar width. - Van

👤 1 📌 BEANTWOORDEN

1 jaar geleden

What I want to know is what is available for people with wide feet? I cannot find any good options. I have really wide feet and want some good protection but it seems like the market has forgotten about us folks

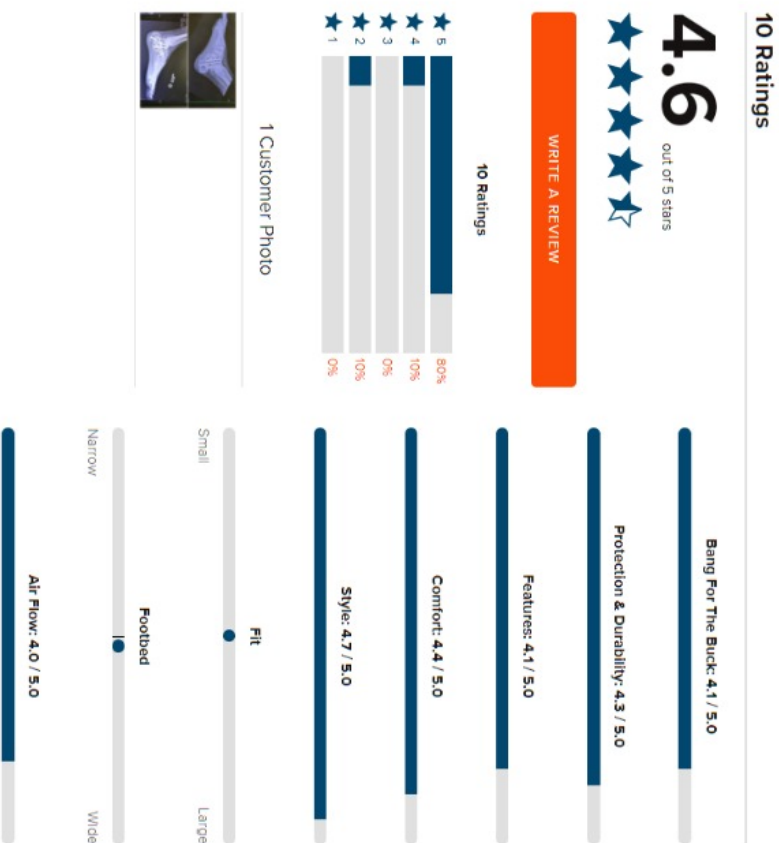
👤 1 📌 BEANTWOORDEN

👤 1 📌 2 antwoorden verbergen

1 jaar geleden

Both TCX and Alpinestars offer boots that typically work well for riders with feet that are a little wider. Unfortunately there are no boot produced specifically for riders with wide feet as we see in shoes. - Van

👤 1 📌 BEANTWOORDEN



Why I chose this:

"I chose these boots because some riders use them in MotoGP and I want that level of protection. Reading reviews, I chose these over the Dainese D1 (too narrow) and Alpinestars Supertech (too expensive)."

— Anonymous S.

1 month ago

"It is an excellent boot, very comfortable"

— Sime G.

3 months ago

"TCX makes very reliable and comfortable race boots. My last pair is 10 years old. Time for an upgrade."

— David T.

4 months ago

"Looking for a protective boot for both street and track that has some hi-vis"

— Andrew A.

11 months ago

"Recommended for wider feet"

— Vaughn B.

1 year ago

"I wanted to try something new."

— Darrin G.

1 year ago

Difficult to put on

Three stars

May 27, 2020

Purchased on Mar 2, 2020

Michael A.
Verified Purchaser

say? I've had many different brand/style boots over the years and these have been disappointing. Getting your foot through the upper area and into the footbed is a struggle by pulling on on the tongue, wriggling around, wriggling the boot, tightening the strap etc...its actually painful, same for removing them. Once in, they're comfortable. But then you have to deal with the zippers. Getting them to the top is impossible...if you rip the tab off, your in trouble...I have a pair of TCX wet weather boots that are great...I like the brand, but for \$500, I expected better design/quality





Extremely happy with boots!

May 26, 2018

A. C.

I bought these boots online without ever trying them on, and they fit better than expected! They fit identical to the alpinestars supertech 1, so great boot if your feet are on the wide side.

Hard to rate on protection but the boots feel very sturdy but light at the same time, airflow is also hard to rate but since my old boots had no ventilation my new boots will be a great improvement.

Easy to put on and off and after a full day at the track my feet felt great. I was even tempted to drive home in them, which says a lot because I couldn't wait to take my old boots off as they were not the right width for my feet.

I was tossing up between these and the supertech 1 boots but the blue colourway won me over. I love them. I have no regrets with my choice and after trying the supertechs on at a shop after my purchase, I am extremely happy with my new TCX track boots.

Was this helpful?



<https://www.revzilla.com/motorcycle/tcx-track-boots-all-boots>
<https://www.youtube.com/watch?v=BHzgU1L30>
<https://www.youtube.com/watch?v=h55Quaaeg8I>
<https://www.youtube.com/watch?v=kC0nB-wKXJg>



They feel good!

May 2, 2018

Eric T.

First off, these boots are not worth \$500. I ended getting these for \$350 shipped to my door from another vendor which made them a great deal. They are extremely light and non-bulky to an extent that I have never felt. My previous boots that I wore were a pair of 2009 Alpinestars plus air, Dainese Torque RS out air, and Sidi Mag-1.

By far these boots feel the thinnest and most flexible out. I don't know how they well hold up in a crash since they feel flimsy, but walking around and riding with them felt great. Shifter and brake feel are second to none since the TCX aren't bulky in any way. Getting in and out of the boot also requires less effort since the inner bootie is much like a snowboard shoe. The Dainese Torque RS required less work, but the zipper failed on me twice. The other boots that I have used were bulky with long tight zippers and extra ratcheting systems.

My only concern is what I consider lack of protection/support. These boots really feel almost flimsy compared to other high end boots I have used. As a note, my Sidi Mag-1 felt twice as heavy as these TCX, but felt almost like MX boots compared to these.

An added bonus is that these boots come with a carrying bag. No other manufacturer has included a bag with the purchase. I can easily throw the boots in the bag for storage or transportation.



1. RACE BOOTS ★★★★★

Posted by on 7th Oct 2021

Very comfortable boot. Light weight. I haven't went down in them yet but seems to have enough protection around the ankles and shin for track days. I wear a 10.5-11. Ordered the 45 but was a little to big. So I sent those back and reordereed a size 44. Fit like a glove.

2. XP9R BOOTS ★★★★★

Posted by on 30th Apr 2021

These are the most comfortable boots I've ever worn and I've tried pretty much everything due to having somewhat wide feet! I think I'm EE. So if your toes are going numb from grinding neuroma (Morton's) then these are for you. Also the sole seems rigid comparatively so it gives good support for pushing on the pegs all day. Lastly, no sizing discrepancies, your normal size is what you are in these.

★★★★★ Superb boot! (12/07/2021)

I used Forma Ice Pro before XP9-R, this is more flexible and comfortable than Forma. This will be compared with the Alpinestars SUPERTECH R, but there are in close.

FCMoto is very fast shipping and competitive price!

Niks op
RevZilla



Spidi XP9-R Boots -
RevZilla

Shop RevZilla for your Spidi XP9-R Boots today! Free Shipping. Lowest Price Guaranteed & Top of the Line Expert Service.

Good fit, it has a good width	High performance sport boots	Not really the best option for people with big calves	A little extra impact protection in the outer side of the boot
Ankle protection on the inner boot	High quality materials	Enough string area	The ankle brace is adjustable in terms of placement
Smooth on the medial side	Aerodynamics are great	Vents in the heel cup	Well ventilated
Small stretch panel next to the zipper	No issues zipping up		

https://www.fc-moto.de/pages/fcm_sifen_GB?ObjectPath=Shops/10207048P-Products/XP9-R-Motorcycle-Boots/SUP-Products/XP9-R-Motorcycle-Boots-0019&?viewAction=ViewProduct&lang=https://www.youtube.com/watch?v=gmuYUcP2LY&t=13s

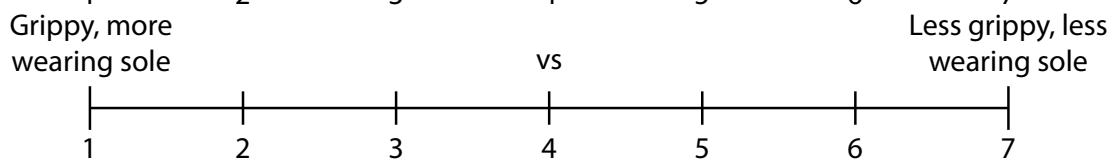
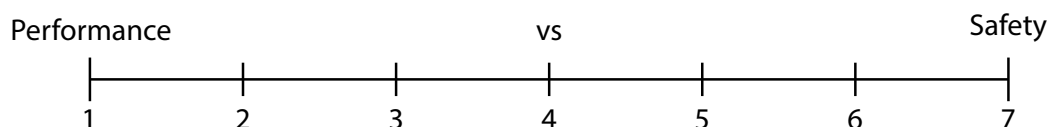
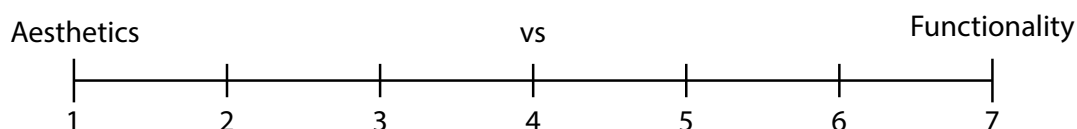
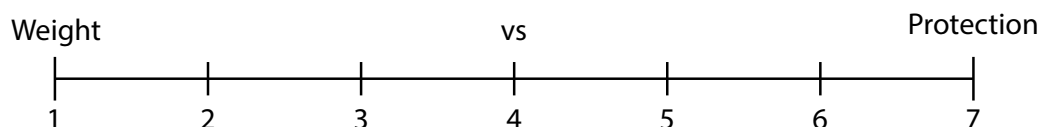
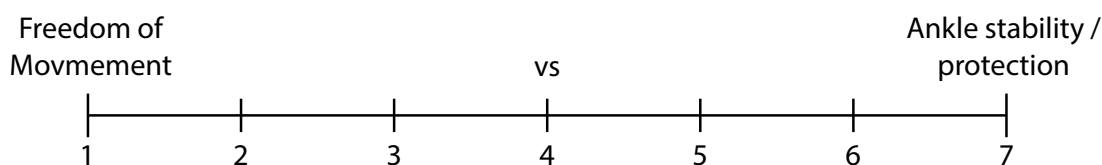
APPENDIX 4. PREPATATIONS RIDER SESSION



Name:

Shoe Size:

How many pairs of boots do you estimate to use in 1 racing season?



REVIT



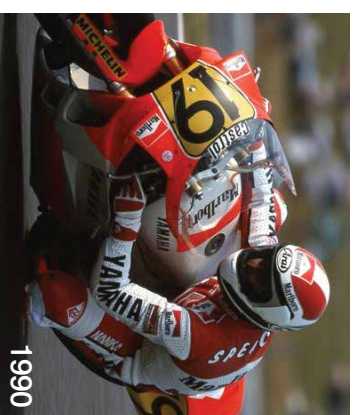
- Protection
- Weight
- Comfort
- Fit
- Technology
- Adjustment
- Weight Reduction



History of Racing Gear

Only by understanding the history of racing gear and rider needs will allows us to shape its future.

You are giving shape to motorcycle racing history each race so who better to ask what can change.



Riding styles influences Protection needs

- Leg out
- Lean angle
- Slider position

Technological developments allow rider to keep pushing the limits of their machines and riding style. The better the tires, the higher the speed, the bigger the lean angle in corners. These developments allow riders to be faster then ever before and demand more durable protection solutions to be applied to ensure riders can focus on their performance without having to worry on their safety.

What developments do you foresee that will influence the look of your racing gear in the future?



Rider name:
Race Class:

No Limitations

No matter the reason for a demand, it may never sacrifice your performance

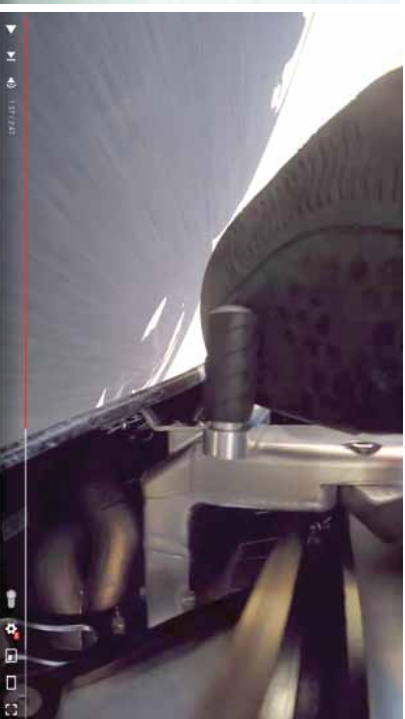
You are the best version of yourself when you perform at the

REV'IT! RIDER EVENT - SEASON 2022 | BRAINSTORM

Shifting up - top view



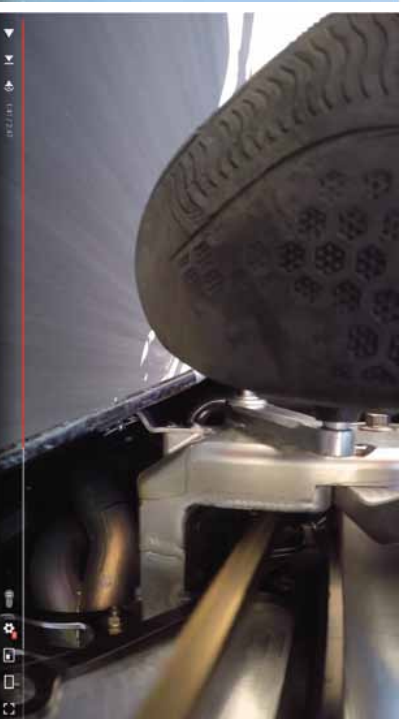
Shifting up - bottom view



Shifting up - top view



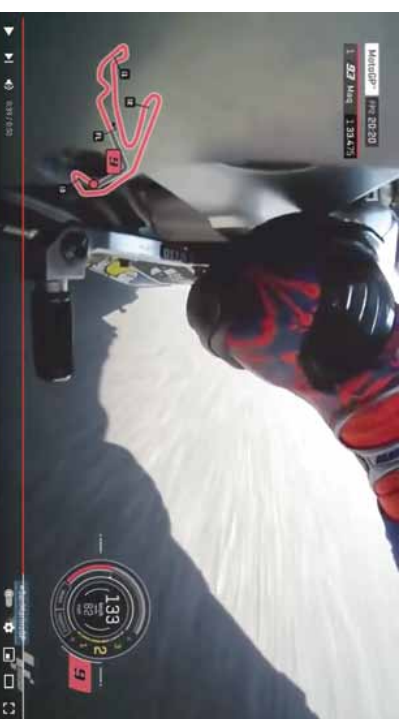
Shifting up - bottom view



Shifting down - top view



Shifting down - bottom view



Walking away from a Crash gives you the Confidence to go Faster

Crashes are an inherent part of motorcycle racing.

What was your most high speed crash?
How much do you value protection systems in your racing gear?
Which is the most important?



Protection systems in Racing Boots

In principle there are 3 racing boot systems available. All with their pro's and con's.

Do you have experience with them and which help you perform the best?

What are the advantages of these set-ups:

- Aerodynamics
- Protection
- Adjustability
- Confidence
- Freedom of Movement

External protection TOX RT-RACE



Internal Protection DAINESE D-AXIAL



Internal Protective Bootie ALPINESTARS SUPERTECH R



Future Vision

In a world where Nothing is left to chance and everything is done to go Faster no opportunity is left untouched to beat your Competitor

What would the gear of your preference look like?

In other sports there seems to be much more innovation on material, foams, inserts, which help athletes to enhance their performance. Pushing the limits of technology and production capabilities.

What do you find important?

- Aerodynamics
- Protection
- Adjustability
- Confidence
- Freedom of Movement
- Technology
- Customisation
- Weight reduction

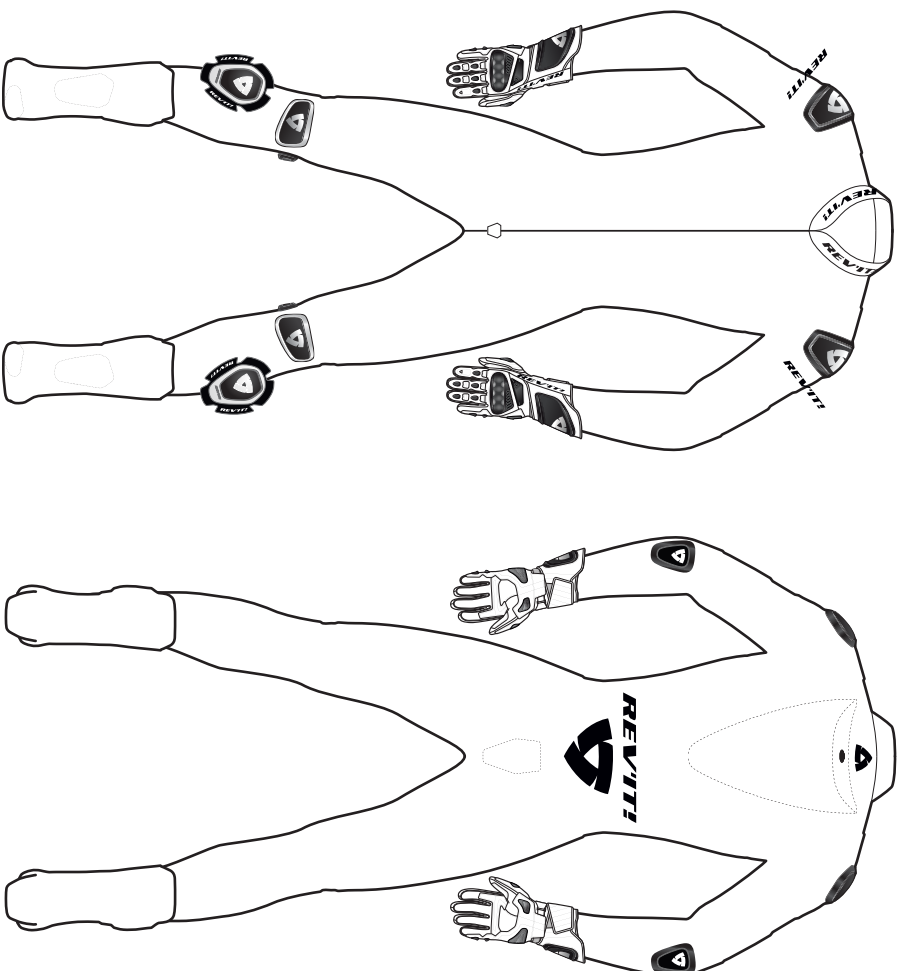


Racing Suit

What can be improved?

Sketch and note down your ideas

- Comfort
- Weight
- Materials
- Aerodynamics
- Freedom of Movement



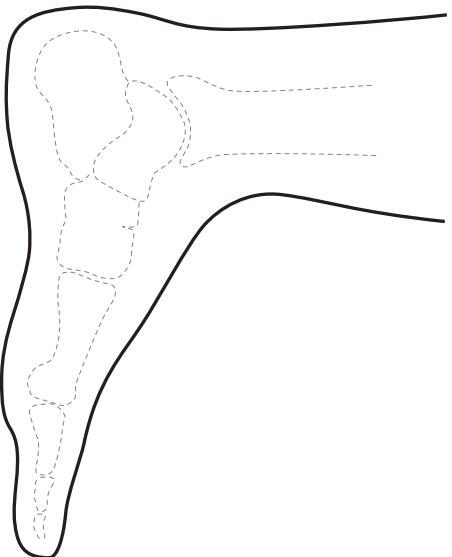
RIDER NAME:



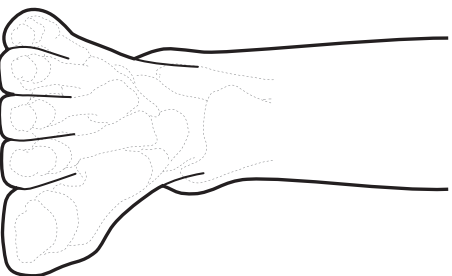
Ergonomics

Indicate where you would like to get feedback from the bike/boot during racing.

Sketch and note down your ideas



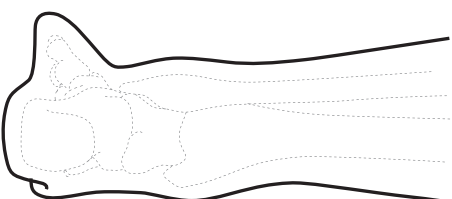
LATERAL VIEW



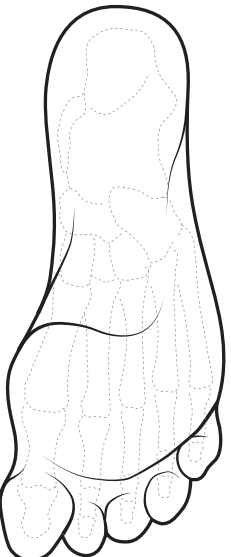
FRONT VIEW



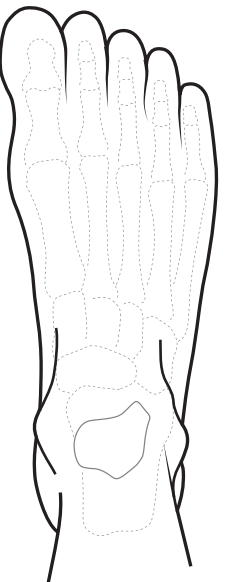
MEDIAL VIEW



BACK VIEW



BOTTOM VIEW



TOP VIEW

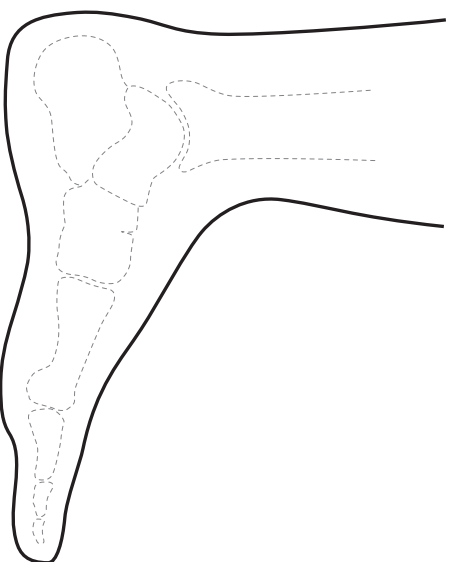
RIDER NAME:

Page 2 of 4

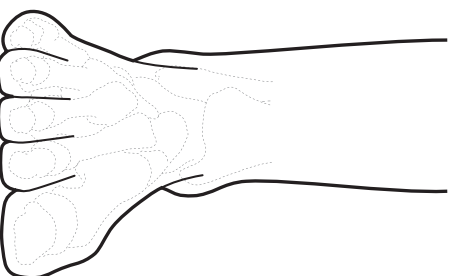
Protection

Indicate where you would like to be protected during racing and which area you want to be flexible

Sketch and note down your ideas



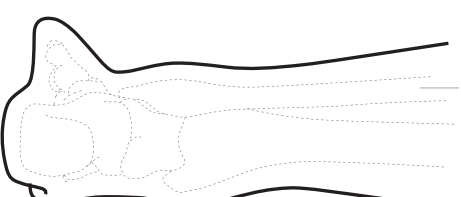
LATERAL VIEW



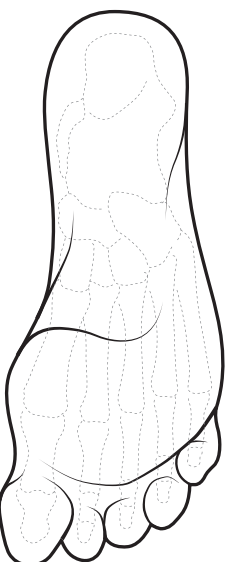
FRONT VIEW



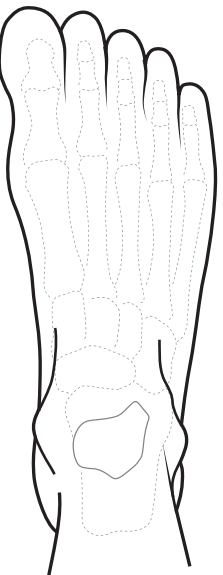
MEDIAL VIEW



BACK VIEW



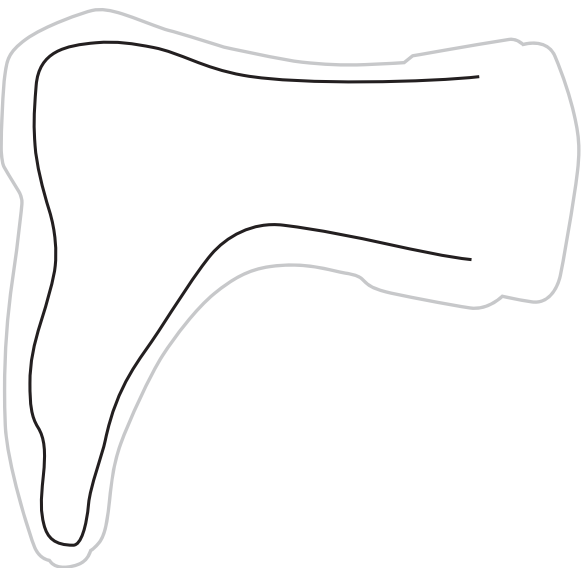
BOTTOM VIEW



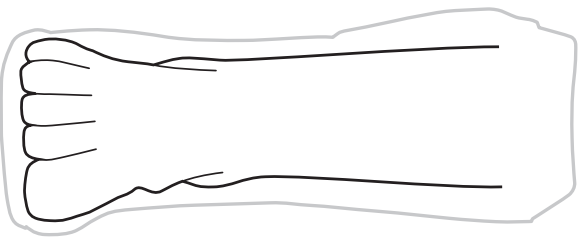
TOP VIEW

RIDER NAME: _____

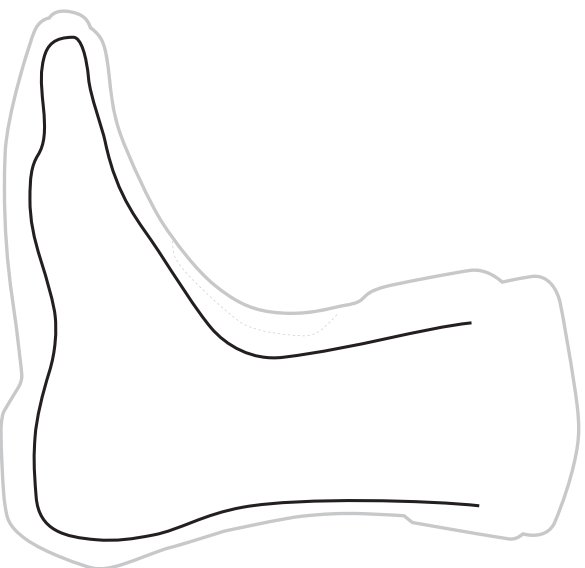
Sketch your Future Racing Boot



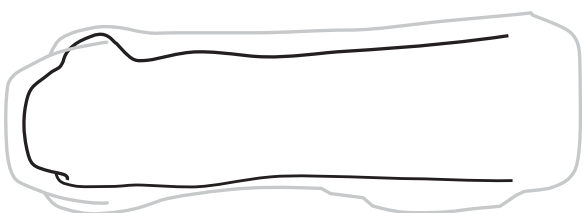
LATERAL VIEW



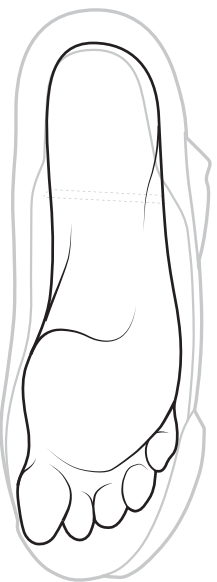
FRONT VIEW



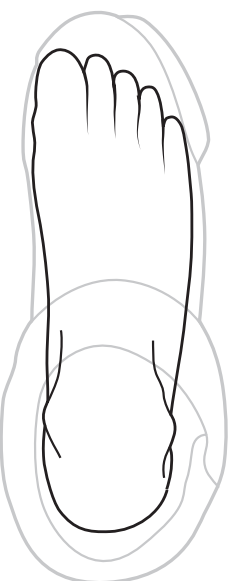
MEDIAL VIEW



BACK VIEW



BOTTOM VIEW



TOP VIEW

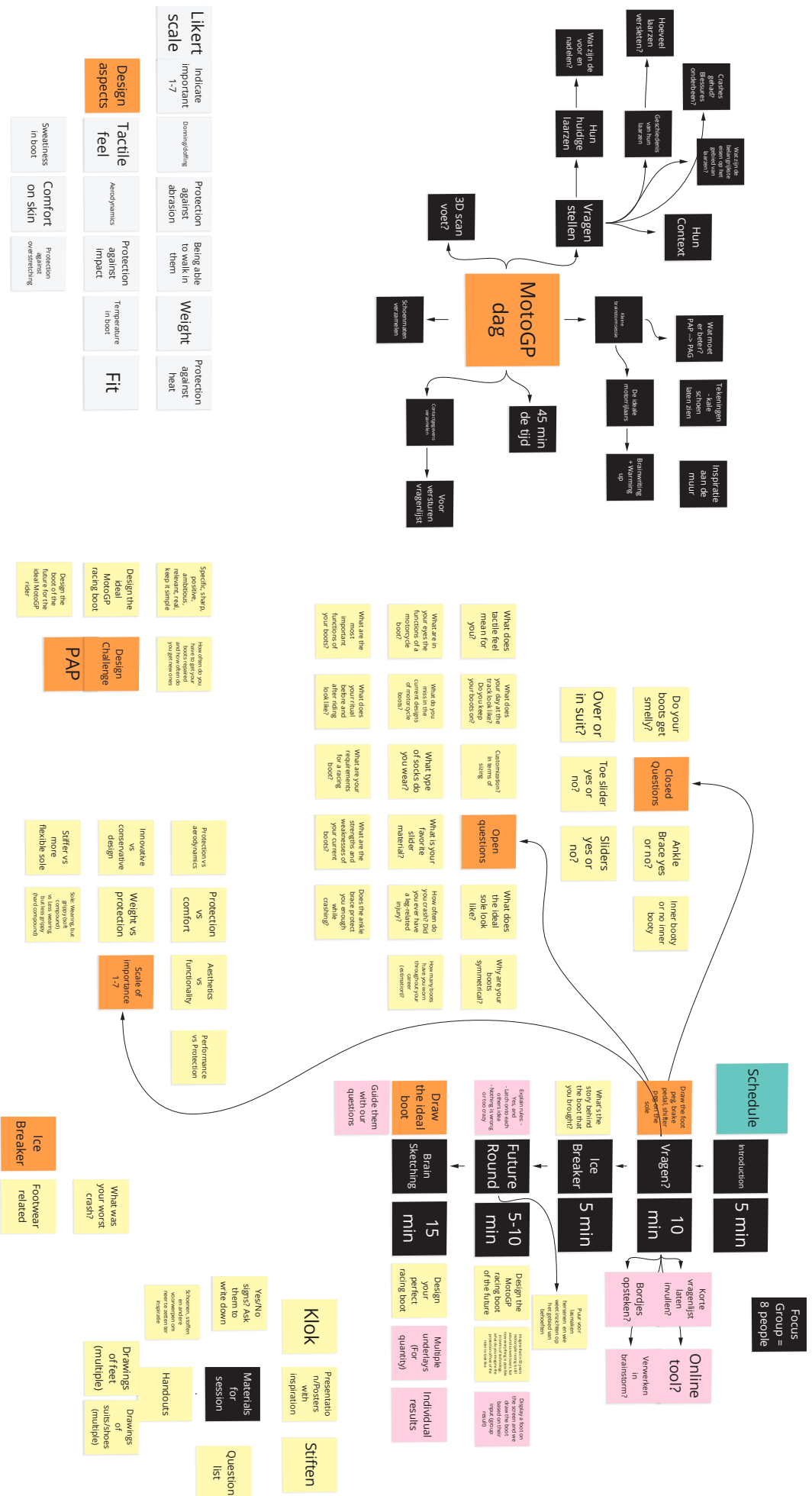
RIDER NAME:

Ride Safe!

REV'IT! RIDER EVENT - SEASON 2022 | BRAINSTORM



THANK YOU







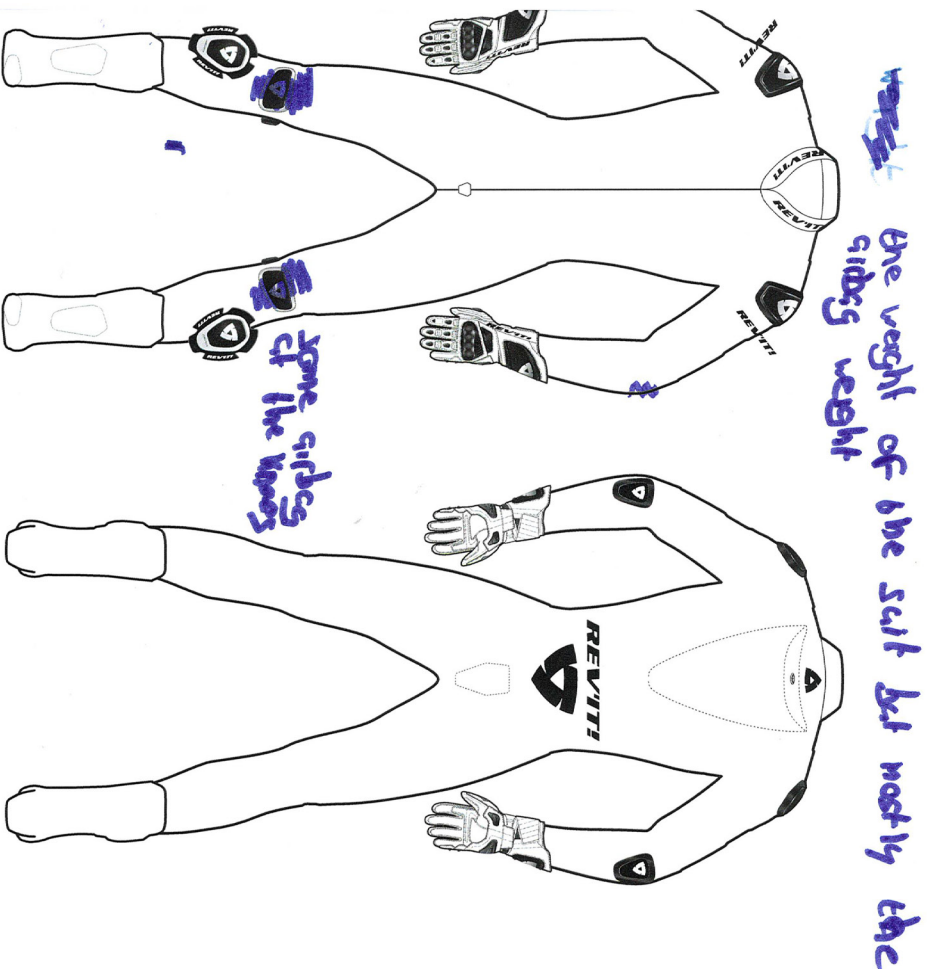
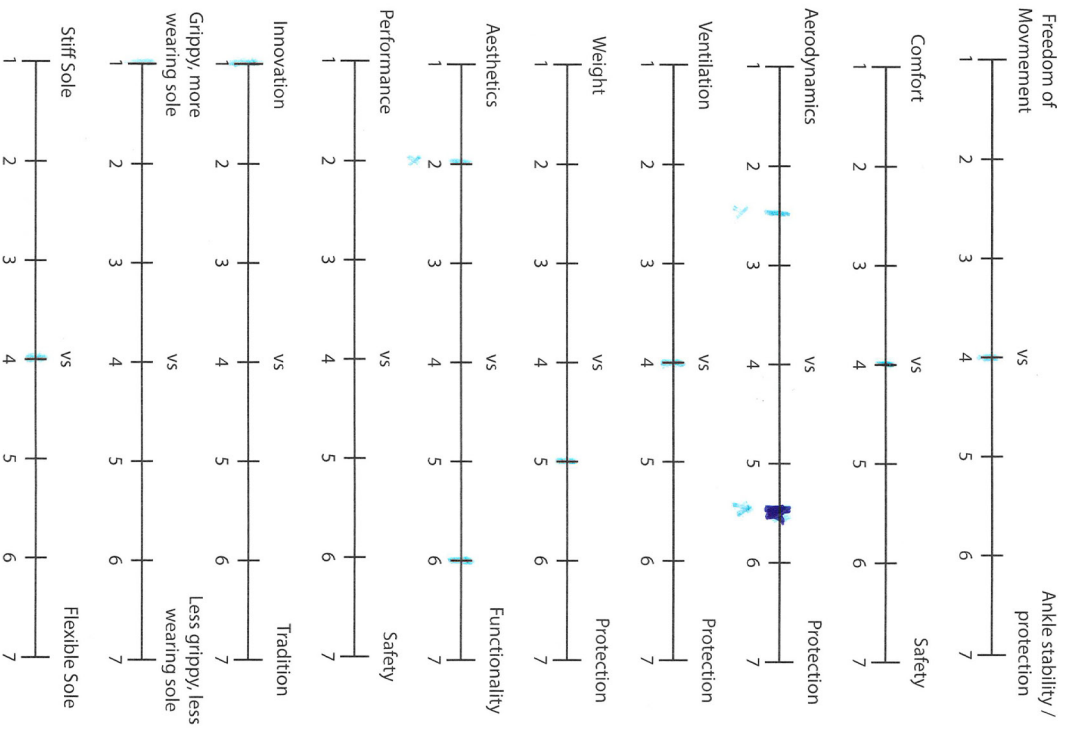


APPENDIX 5. FILLED IN HAND-OUTS RIDERS



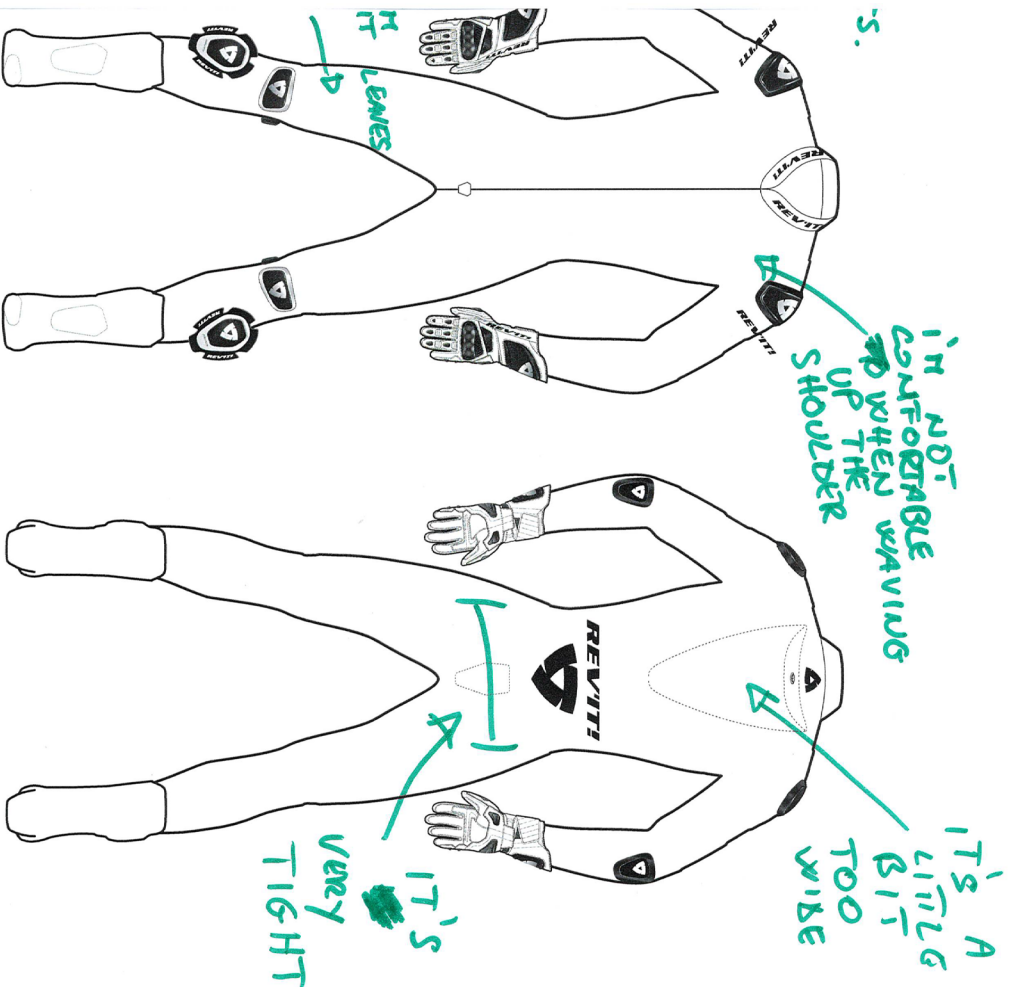
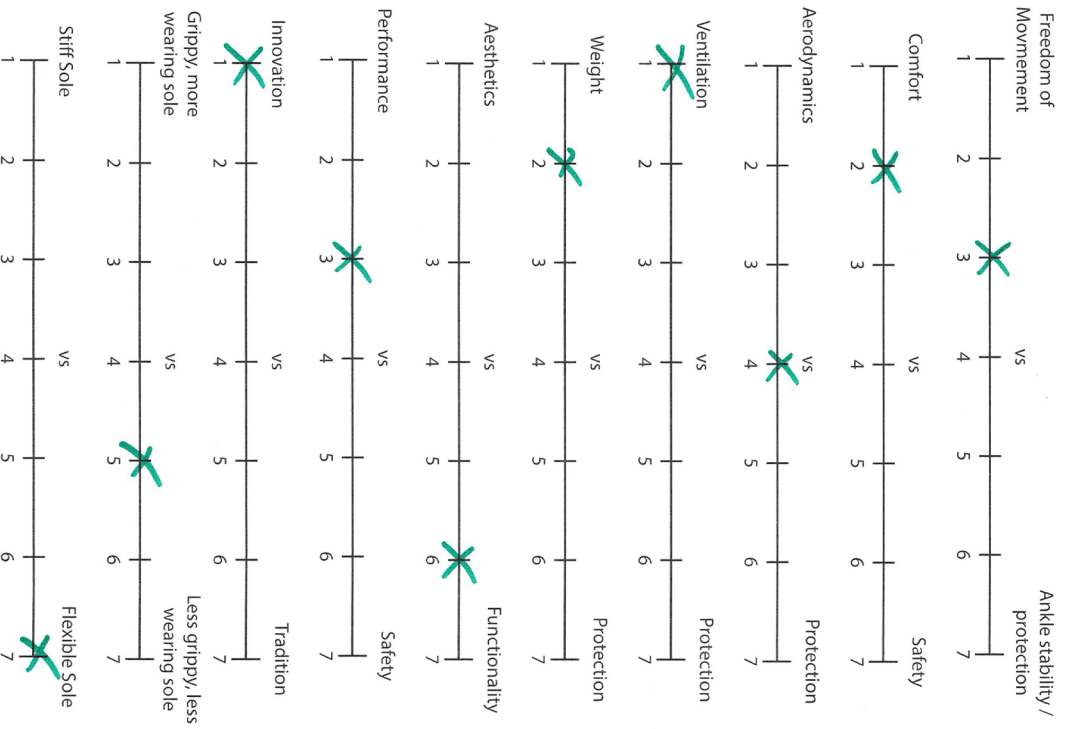
Shoe Size: 42

How many pairs of boots do you estimate to use in 1 racing season? 16?



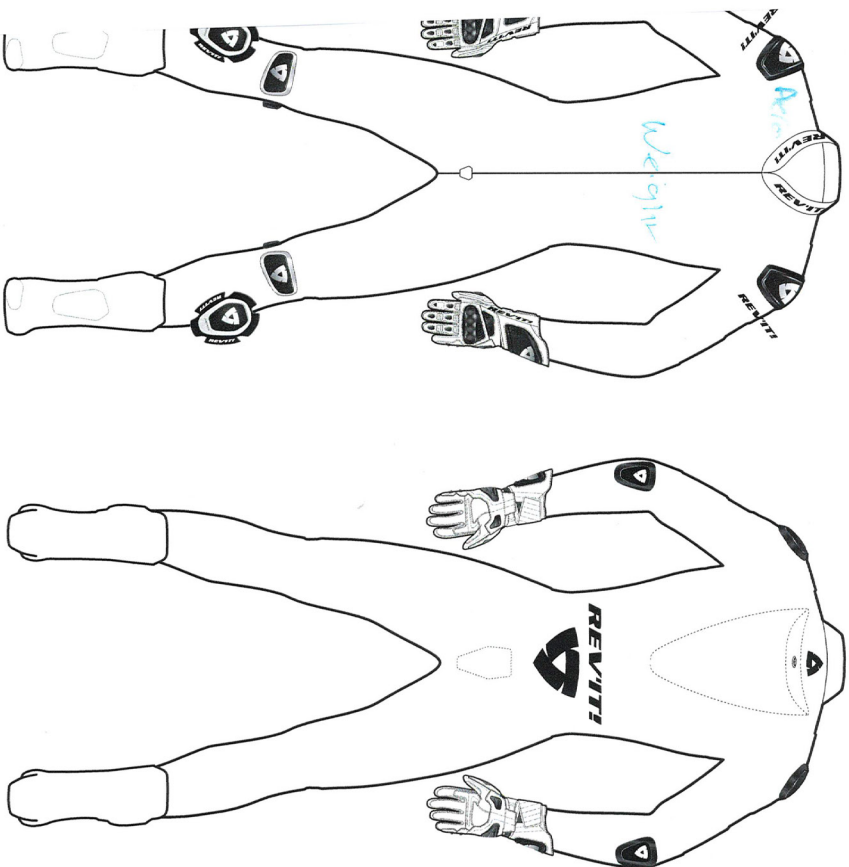
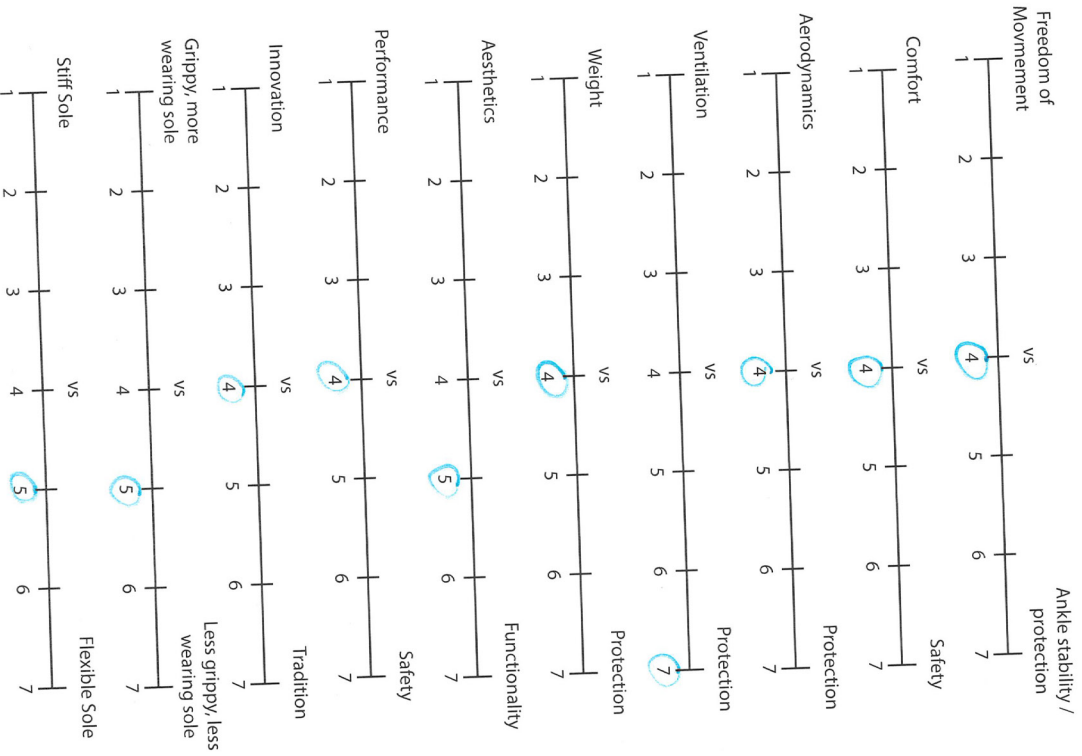
Shoe Size: **40.5**

How many pairs of boots do you estimate to use in 1 racing season? **15 PAIRS**



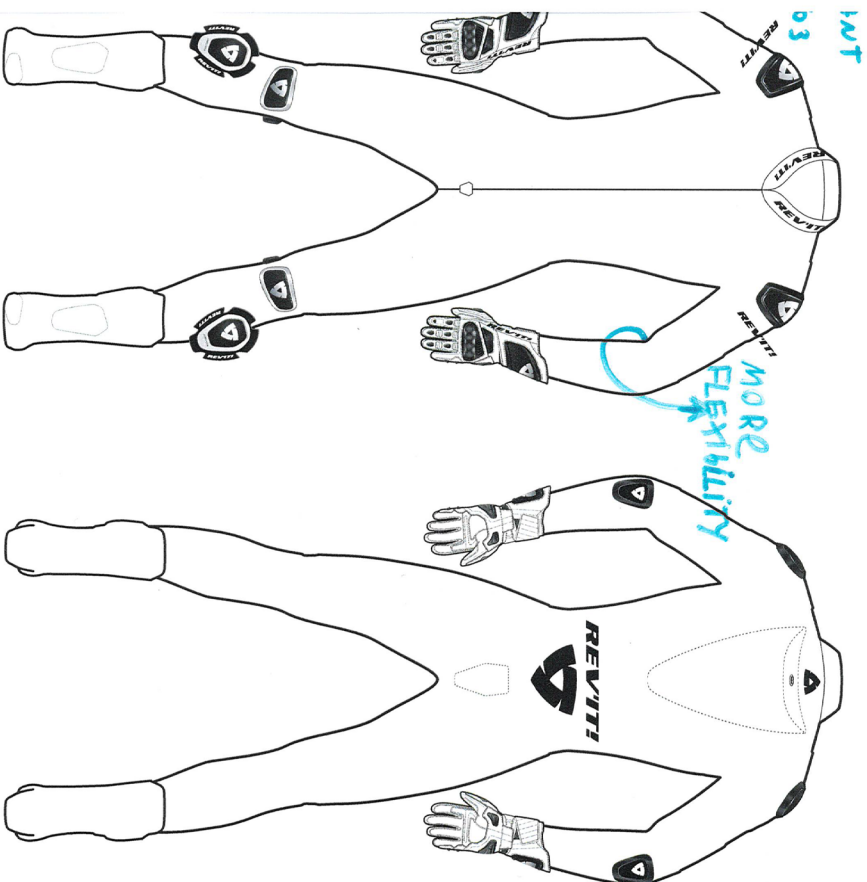
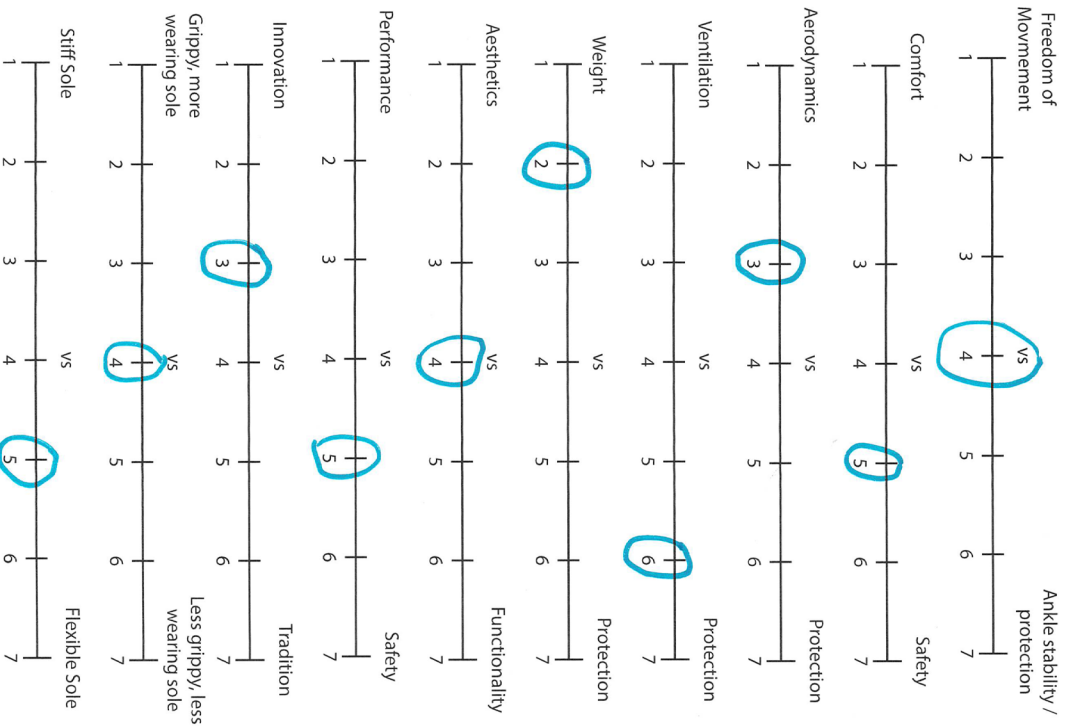
Shoe Size: 8

How many pairs of boots do you estimate to use in 1 racing season? 7



Shoe Size: **47**.....

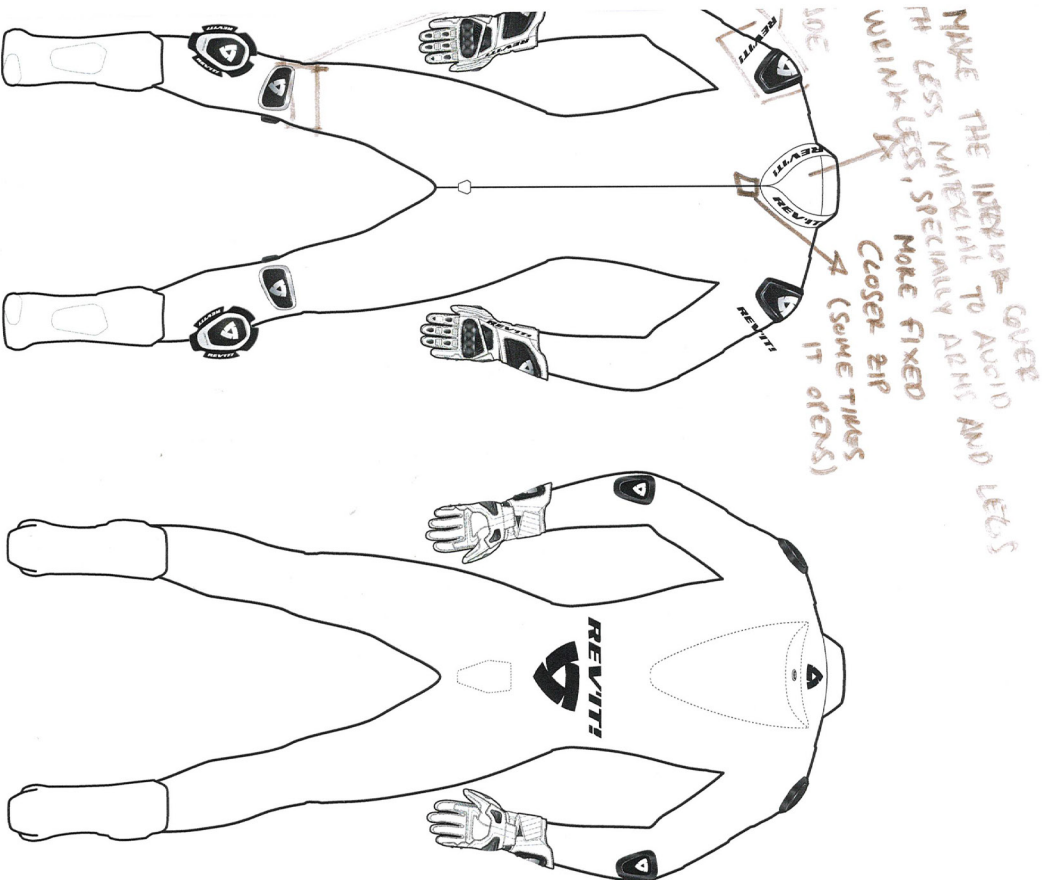
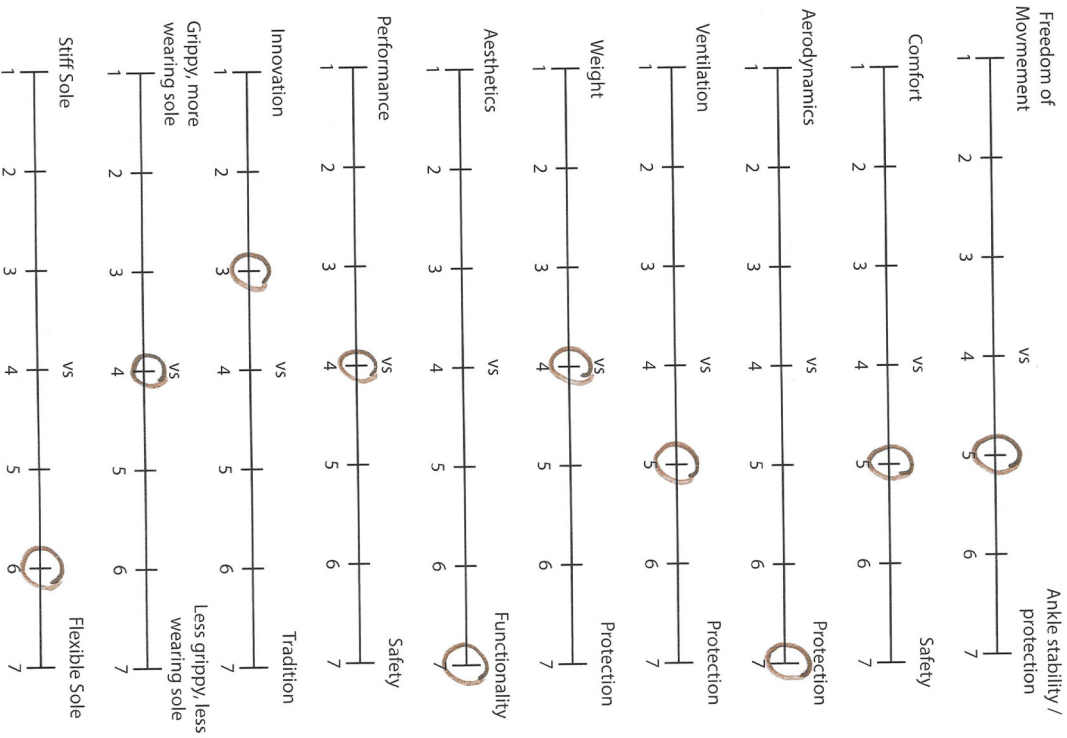
How many pairs of boots do you estimate to use in 1 racing season? **2**.....



Shoe Size: **37**

How many pairs of boots do you estimate to use in 1 racing season? **10 + TEST = 15**

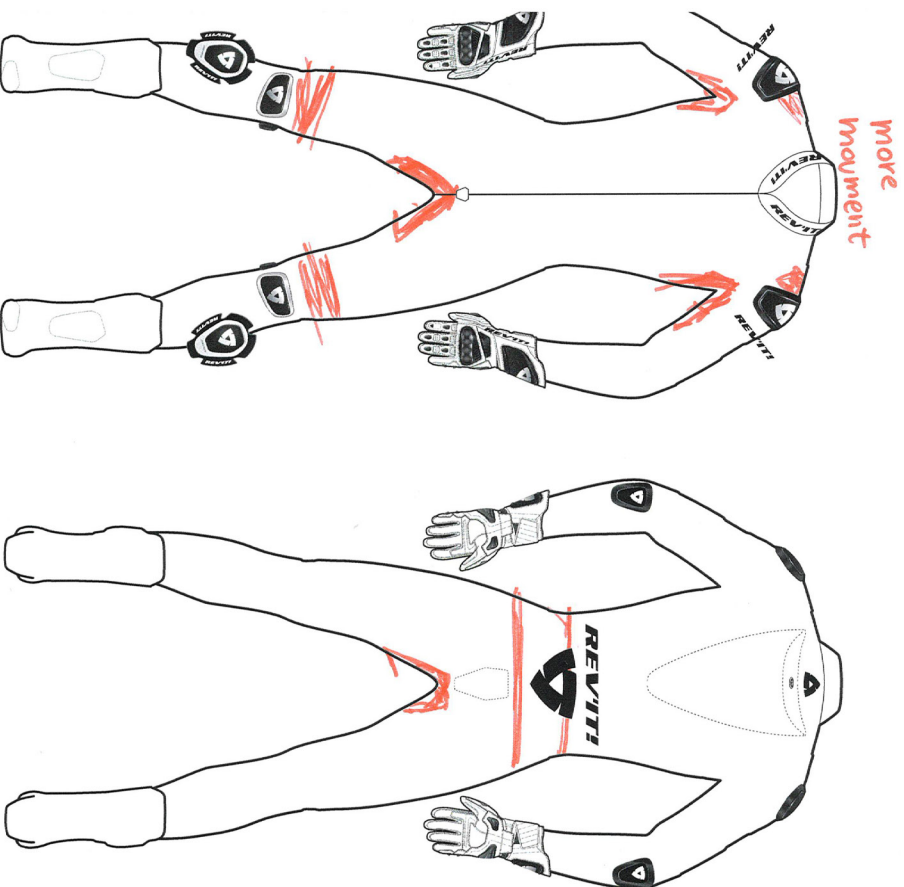
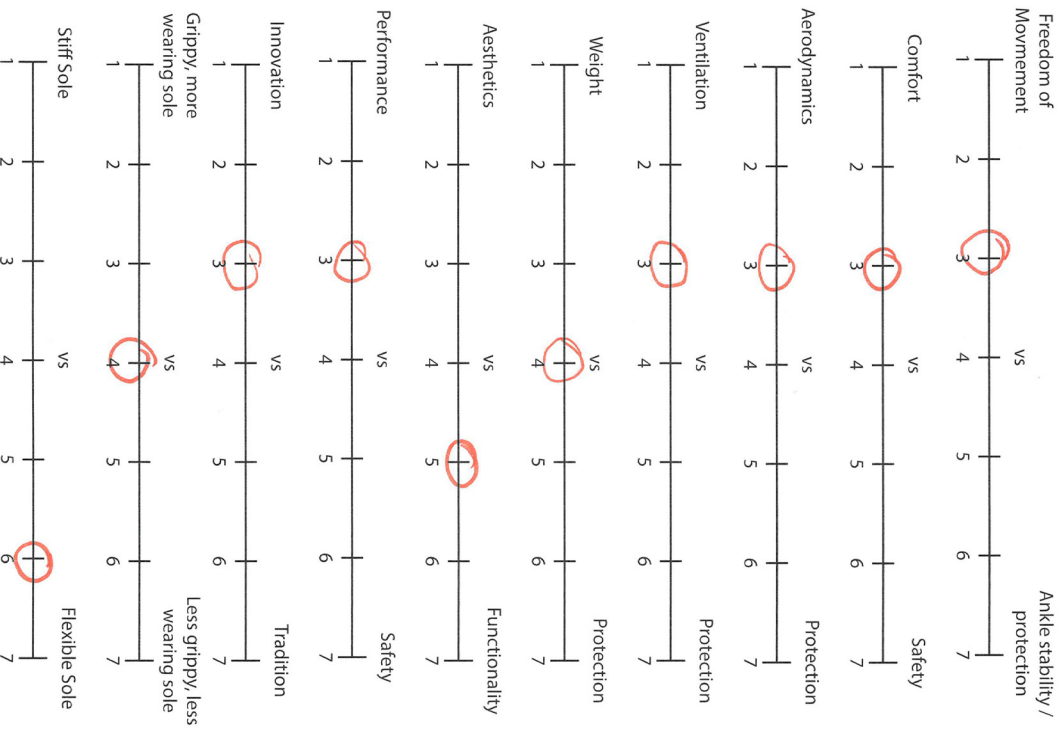
P5



Shoe Size: **43**

How many pairs of boots do you estimate to use in 1 racing season? **10/12**

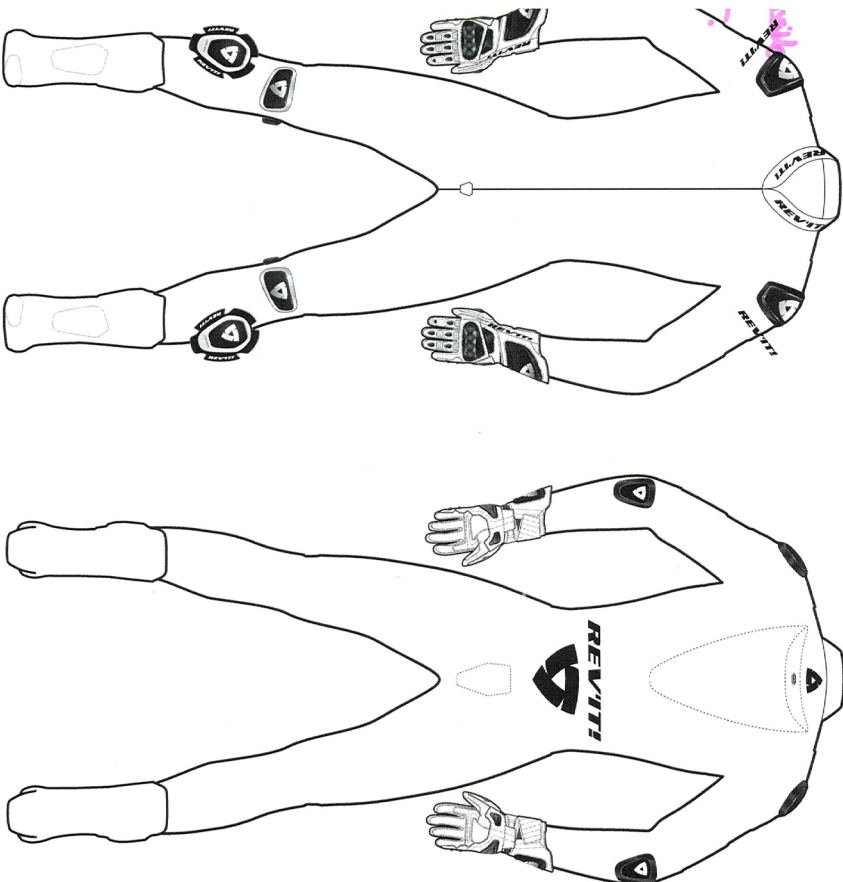
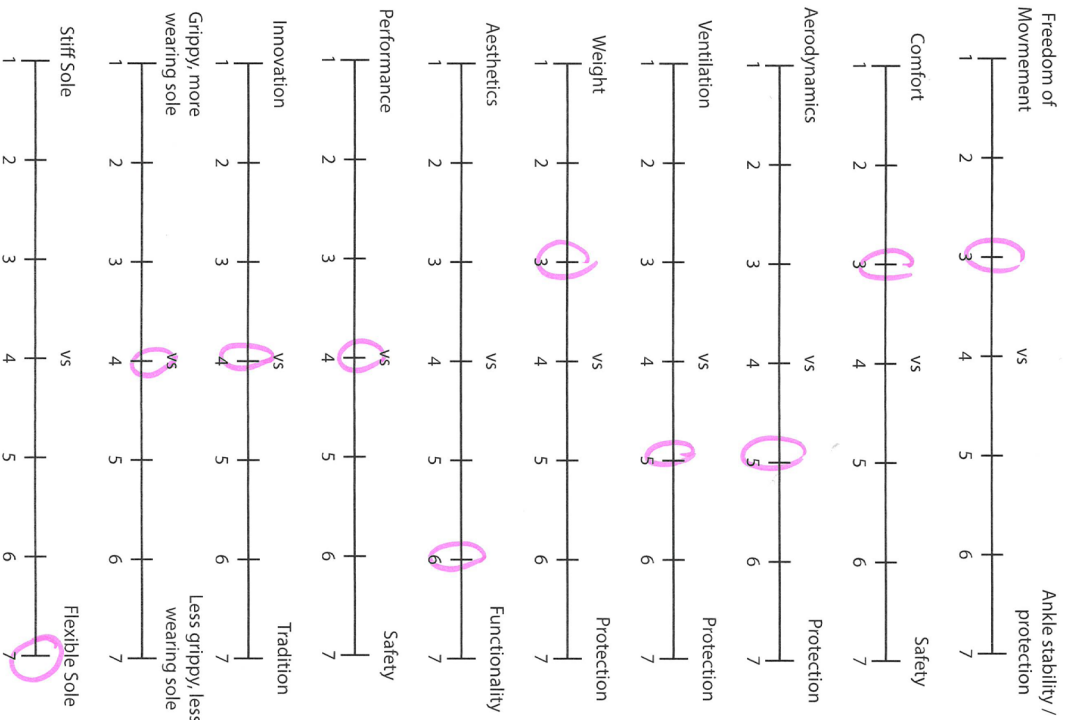
P6



Shoe Size: **42,5**

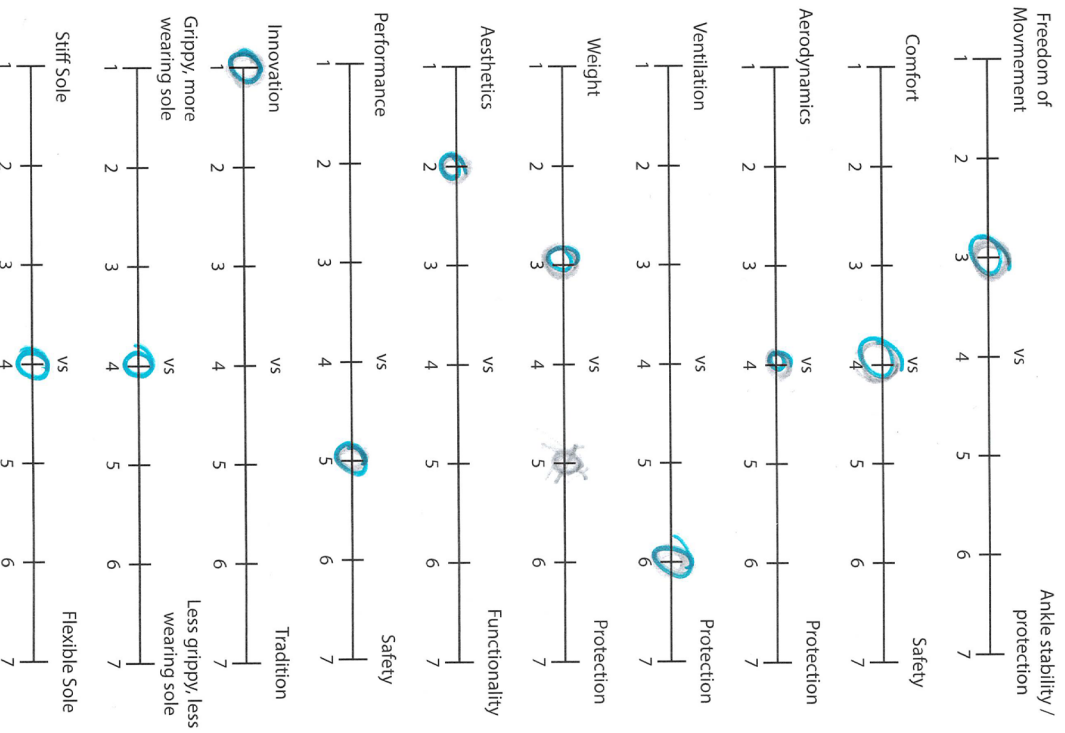
How many pairs of boots do you estimate to use in 1 racing season? **40**

P7

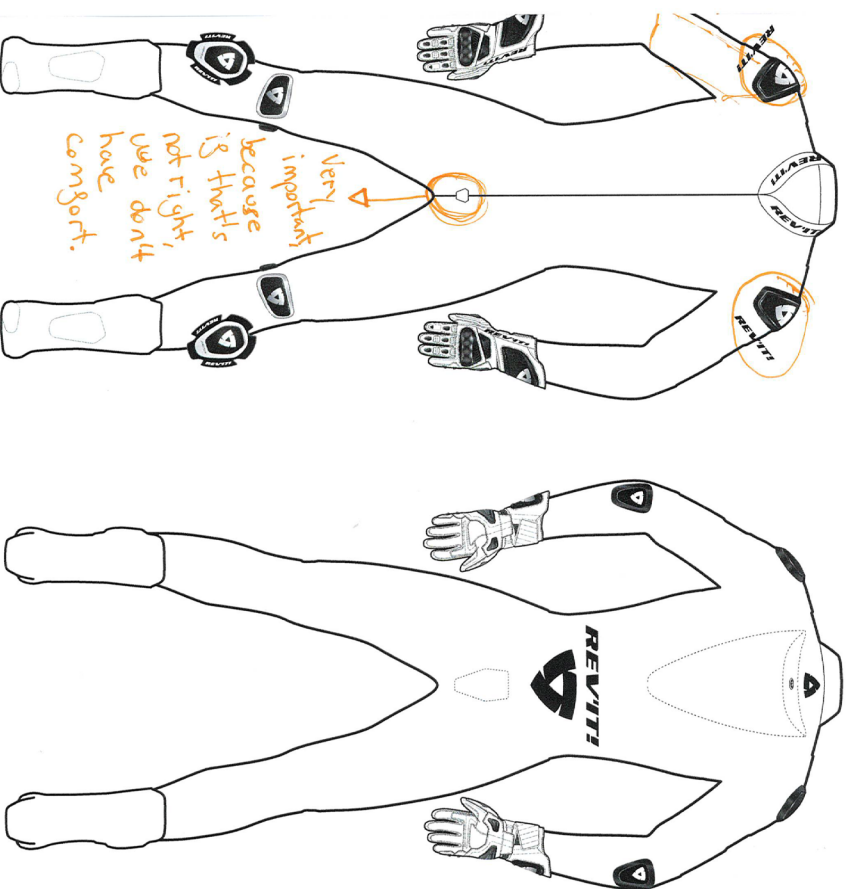


Shoe Size: *42-43 (it depends)*

How many pairs of boots do you estimate to use in 1 racing season? *506*



It the best weight, so you can help us to be motorcycle turns more, and in Moto3 is very important



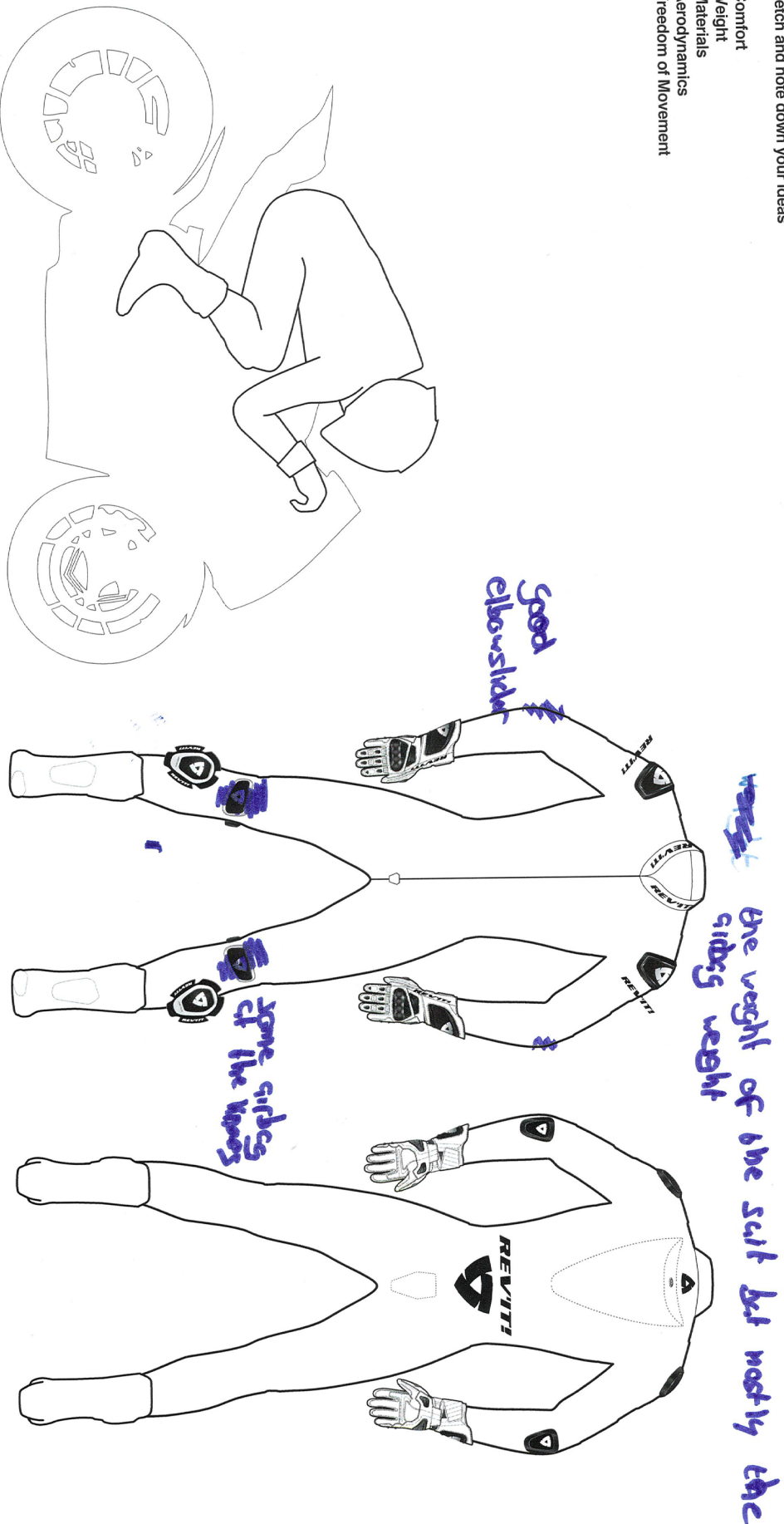
P1

Racing Suit

What can be improved?

Sketch and note down your ideas

- Comfort
- Weight
- Materials
- Aerodynamics
- Freedom of Movement



RIDER NAME:

Page 4 of 4

Racing Suit

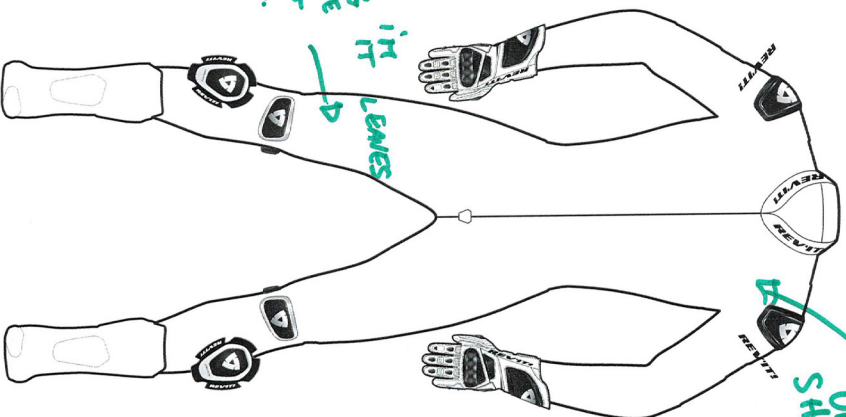
What can be improved?

Sketch and note down your ideas

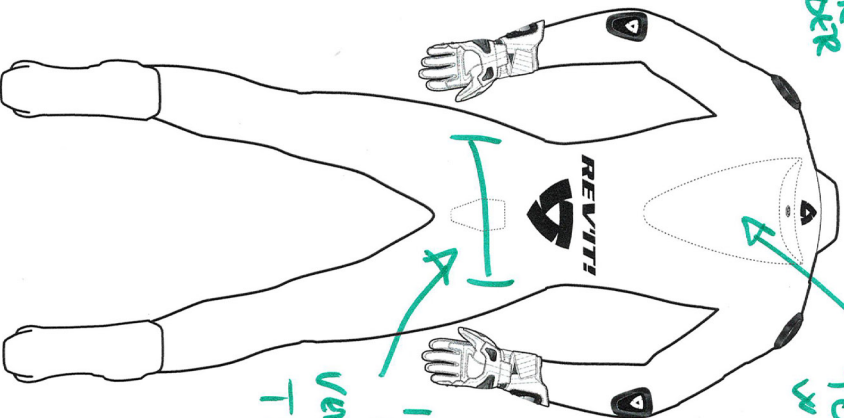
- Comfort **ON THE CHEST AND LEGS**
- Weight
- Materials **IT'S A LITTLE BIT HARD, SPECIALLY ON THE PRINT PARTS.**
- Aerodynamics **JUST MORE MOVEMENT ON LEGS AND SHOULDERS UP.**
- Freedom of Movement



WHILE IT'S RISING HE THE SEWING MARK.



IT'S NOT COMFORTABLE WHEN WAVING UP THE SHOULDER



IT'S A LITTLE BIT TOO WIDE

IT'S VERY TIGHT

RIDER NAME:

Page 1 of 4

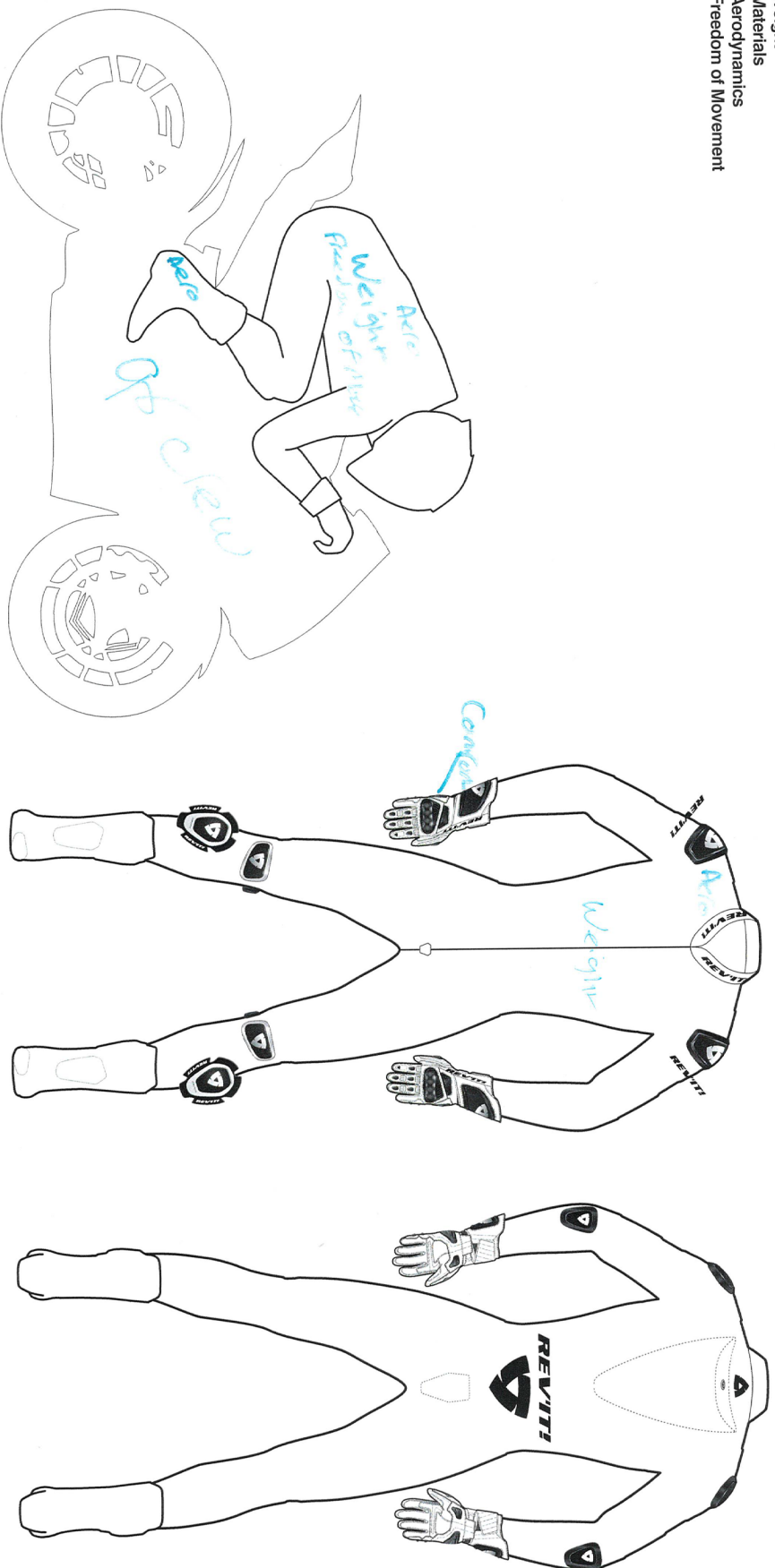
P2

Racing Suit

P3

What can be improved?
Sketch and note down your ideas

- Comfort
- Weight
- Materials
- Aerodynamics
- Freedom of Movement



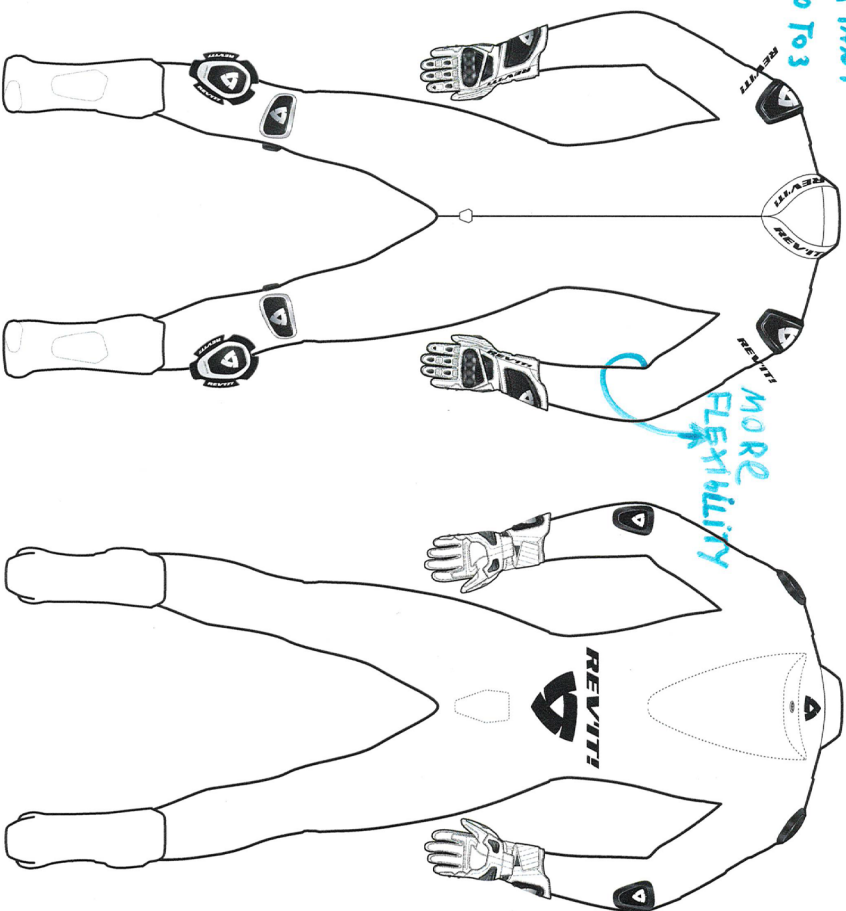
RIDER NAME

Racing Suit

What can be improved?

Sketch and note down your ideas

- Comfort *! really enjoy, All perfect*
- Weight *for the motos bike the weight is very important*
- Materials *perfect*
- Aerodynamics *the same like the weight for the motos*
- Freedom of Movement *perfect*



P4

RIDER NAME:

Page 1 of 4

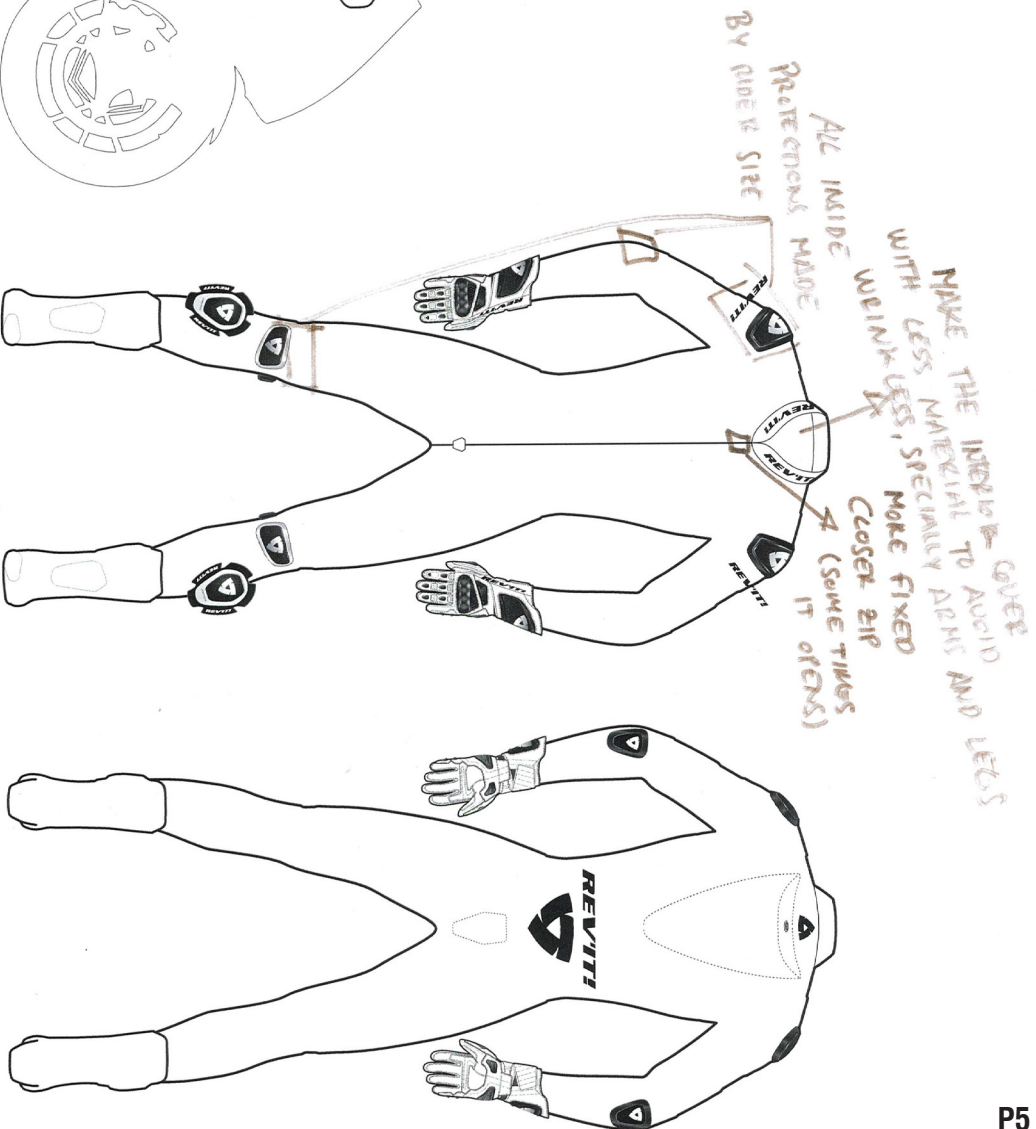


Racing Suit

What can be improved?

Sketch and note down your ideas

- Comfort
- Weight
- Materials
- Aerodynamics
- Freedom of Movement



P5

RIDER NAME:

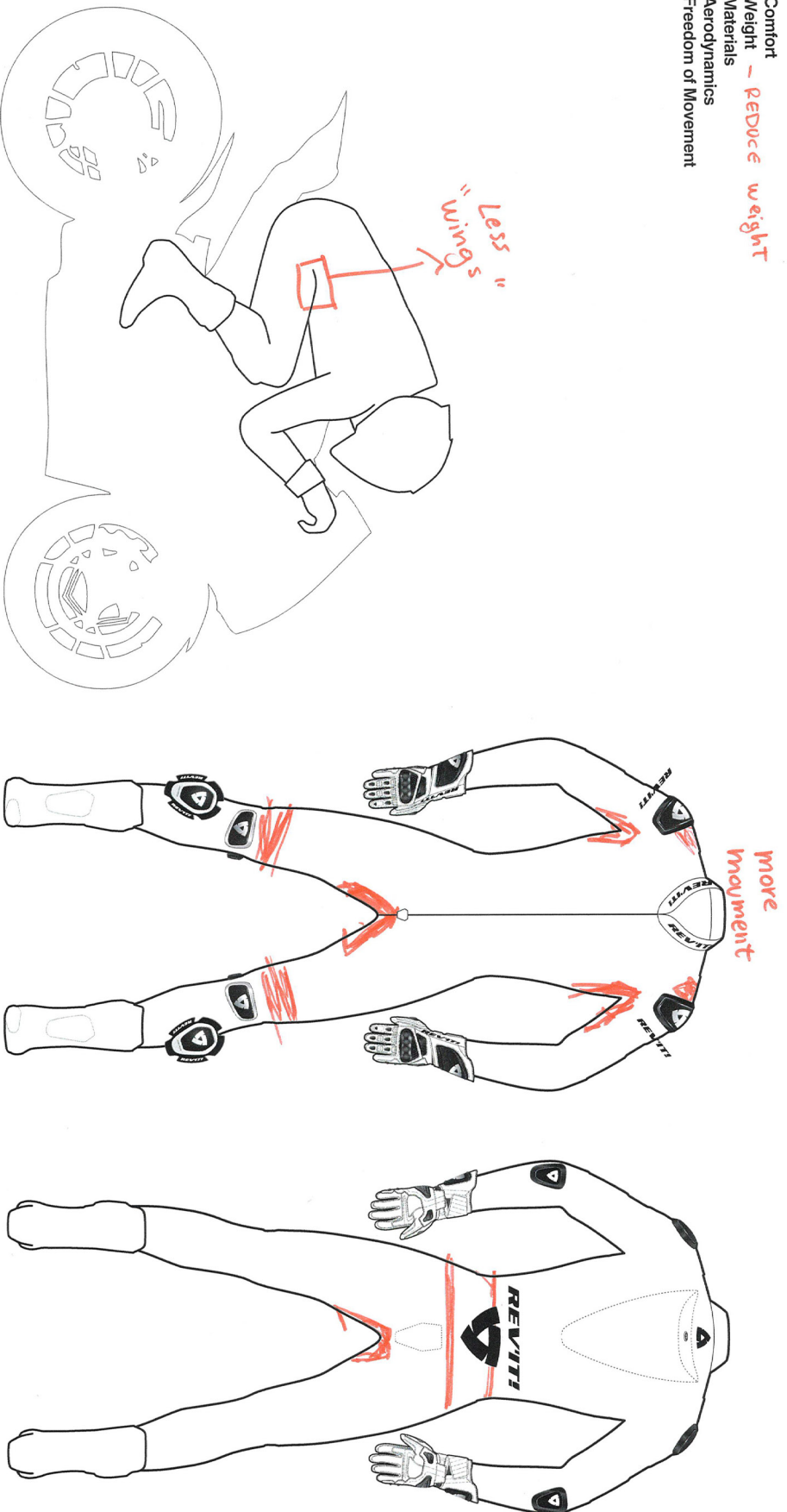
Racing Suit

P6

What can be improved?

Sketch and note down your ideas

- Comfort
- Weight - **REDUCE weight**
- Materials
- Aerodynamics
- Freedom of Movement



RIDER NAME:

Page 1 of 4

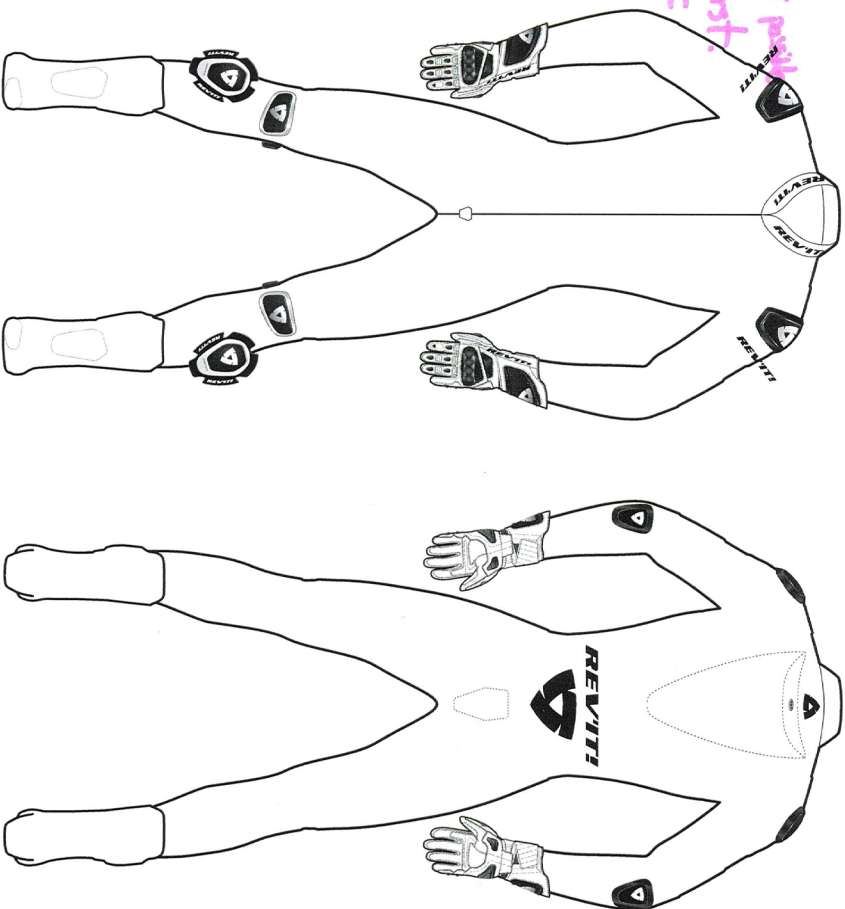
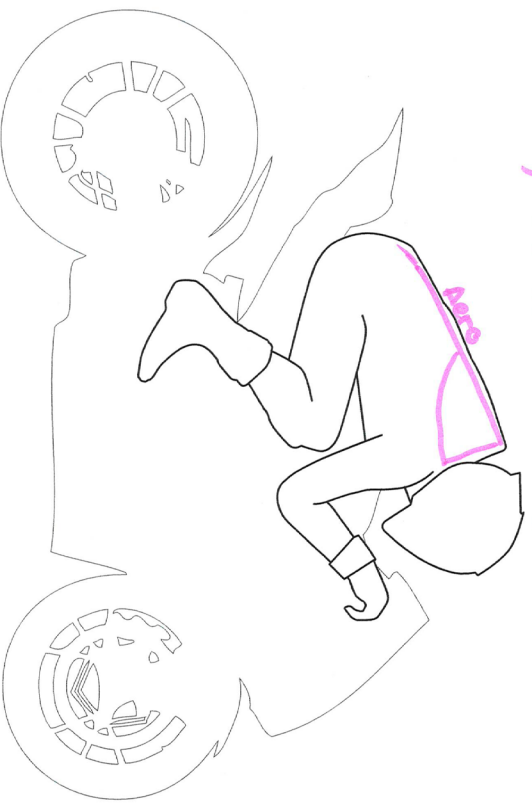
Racing Suit

What can be improved?

Sketch and note down your ideas

- Comfort
- Weight
- Materials
- Aerodynamics
- Freedom of Movement

The best leather would be one that has max. comfort, less weight possible. About the materials is important the freedom of movements first. Then also, has to be not to thin that can easy break in a crash.
- of course really important the aerodynamics.



P7

RIDER NAME:

Page 1 of 4

Racing Suit

What can be improved?

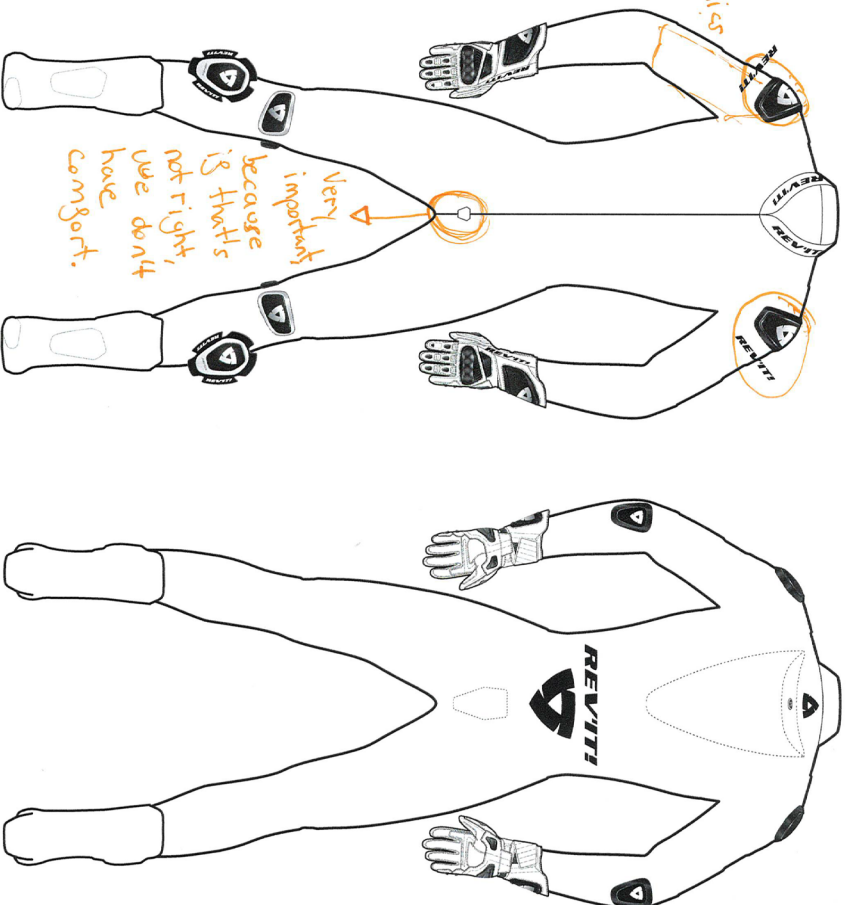
Sketch and note down your ideas

- Comfort
- Weight
- Materials
- Aerodynamics
- Freedom of Movement

Is very important get the best weight, so you can help us to be lighter so that the motorcycle runs more. and in Moto3 is very important

For me is very important freedom of Movement, because in Moto3, is very important the aerodynamics can be improve in Materials shoulder more aerodynamics, especially in Moto3.

I think a very comfort in the back, to be able to be more aerodynamics



Very important because is that's not tight, we don't have comfort.

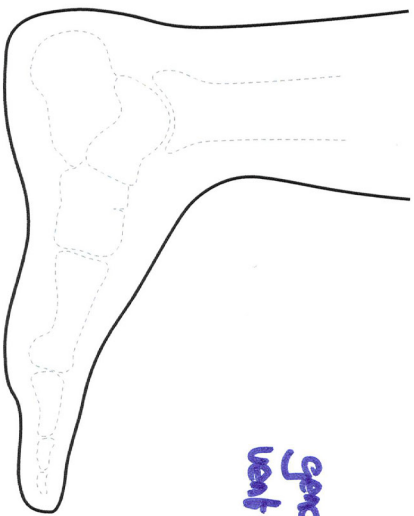
RIDER NAME:

Ergonomics

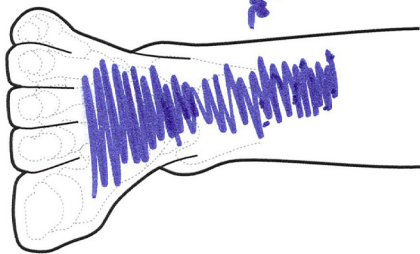
P1

Indicate where you would like to get feedback from the bike/boot during racing.

Sketch and note down your ideas



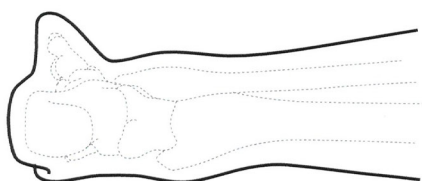
LATERAL VIEW



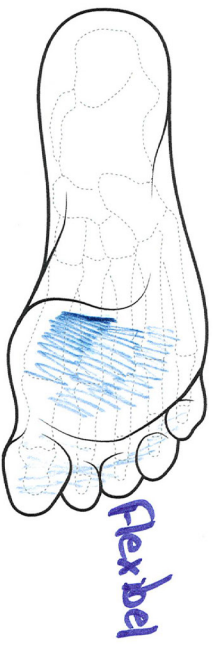
FRONT VIEW



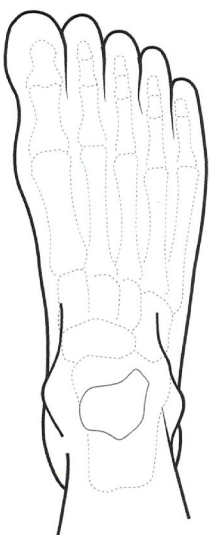
MEDIAL VIEW



BACK VIEW



BOTTOM VIEW



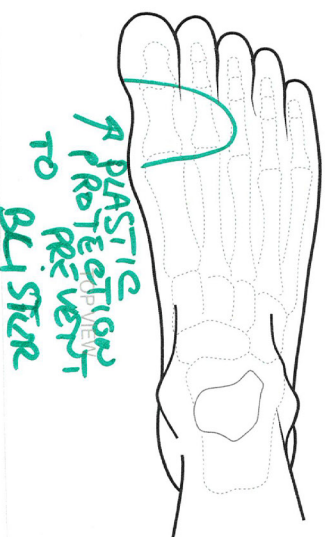
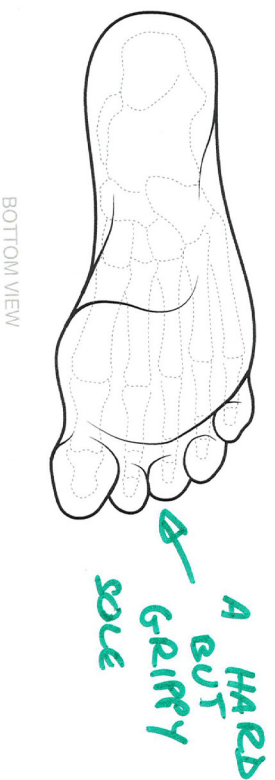
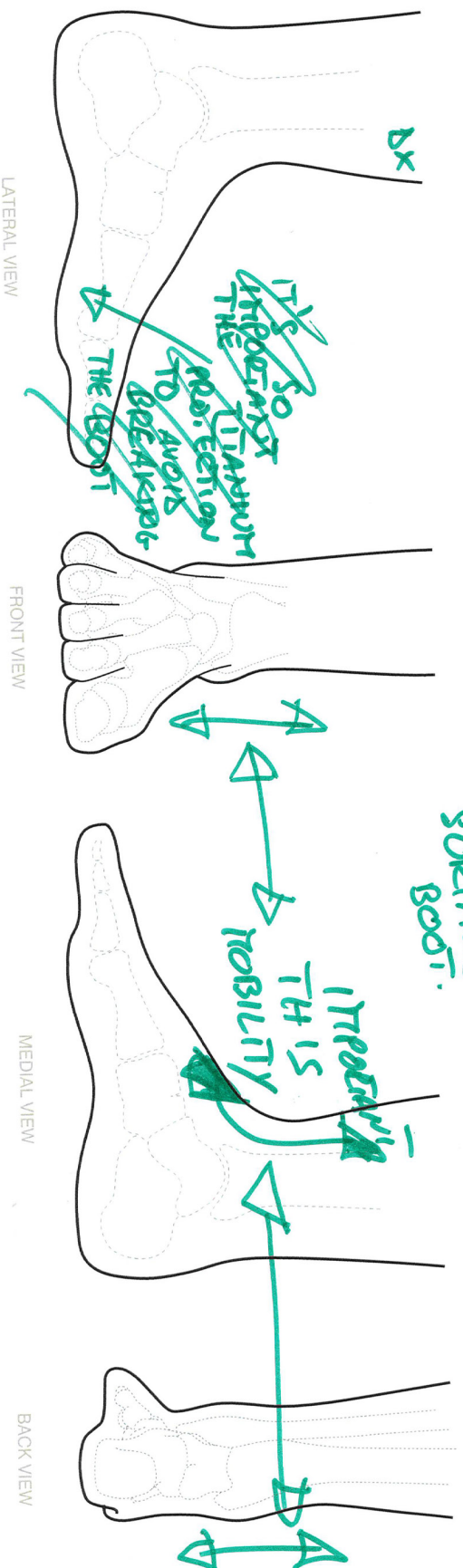
TOP VIEW

RIDER NAME:

Ergonomics

Indicate where you would like to get feedback from the bike/boot during racing.

Sketch and note down your ideas



RIDER NAME:

Ergonomics

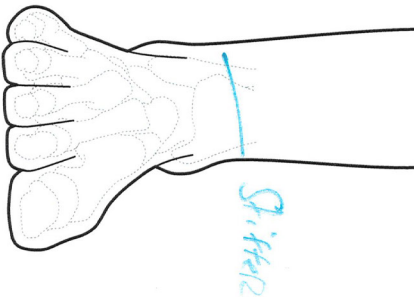
Indicate where you would like to get feedback from the bike/boot during racing.

Sketch and note down your ideas

P3



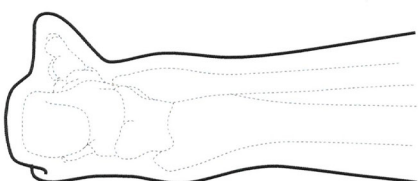
LATERAL VIEW



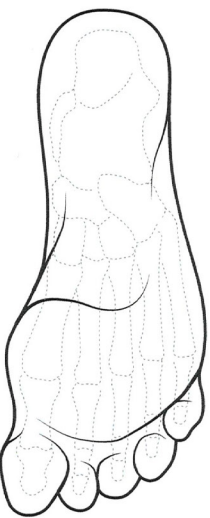
FRONT VIEW



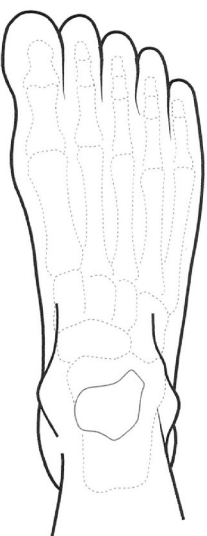
MEDIAL VIEW



BACK VIEW



BOTTOM VIEW



TOP VIEW

RIDER NAME:

Ergonomics

Indicate where you would like to get feedback from the bike/boot during racing.

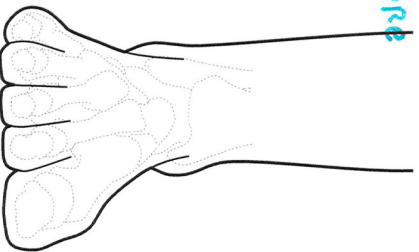
Sketch and note down your ideas

P4

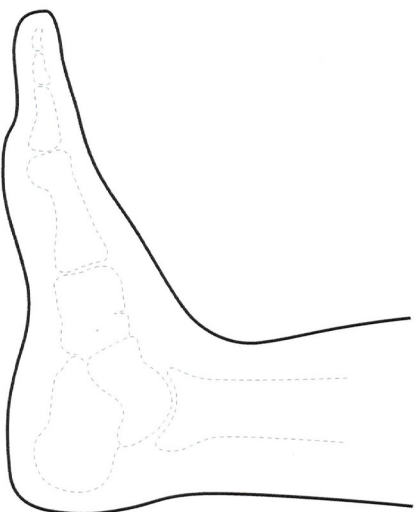
MAYBE MORE FLEXIBLE AND THE WEIGHT.
AND THE SOLE MORE
DURABILITY



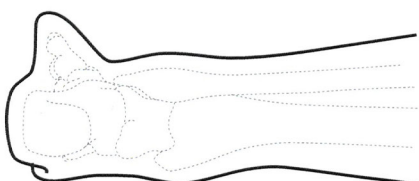
LATERAL VIEW



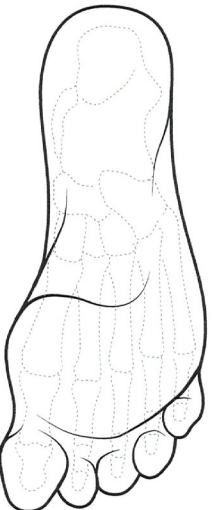
FRONT VIEW



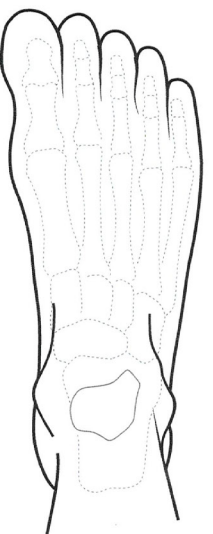
MEDIAL VIEW



BACK VIEW



BOTTOM VIEW



TOP VIEW

RIDER NAME:

Ergonomics

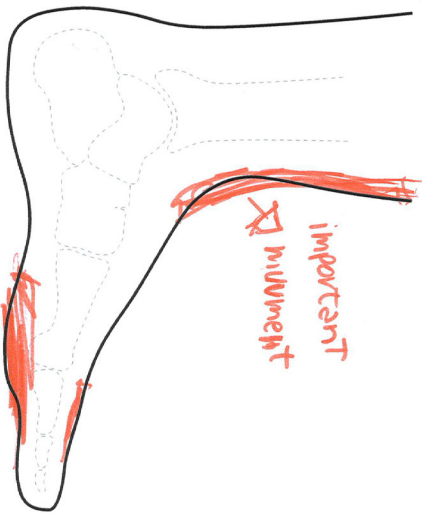
P6

Indicate where you would like to get feedback from the bike/boot during racing.

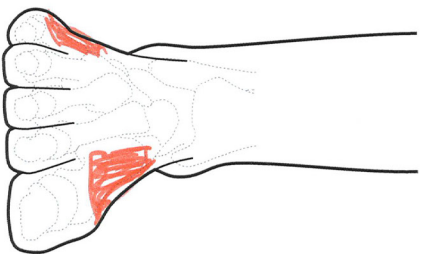
Sketch and note down your ideas

more Ventilation

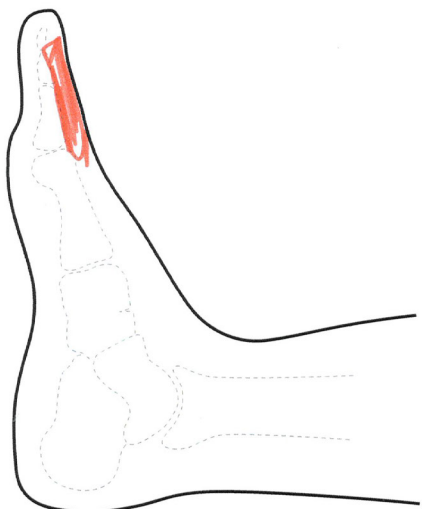
important movement



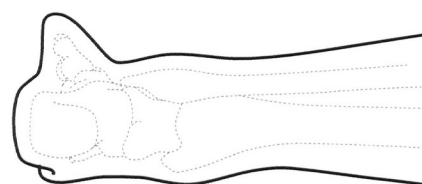
LATERAL VIEW



FRONT VIEW



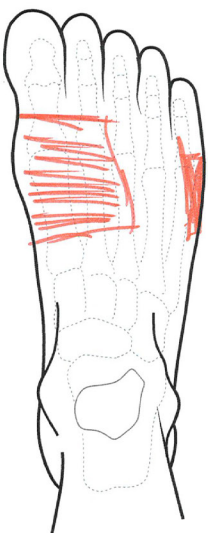
MEDIAL VIEW



BACK VIEW



BOTTOM VIEW



TOP VIEW

RIDER NAME:

Ergonomics

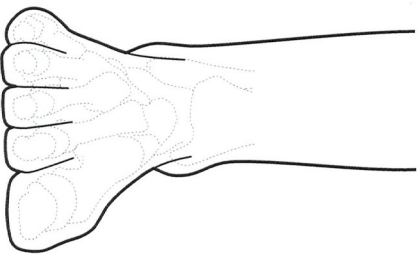
Indicate where you would like to get feedback from the bike/boot during racing.

Sketch and note down your ideas

P7



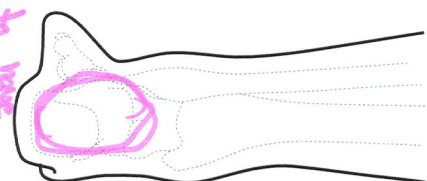
LATERAL VIEW



FRONT VIEW

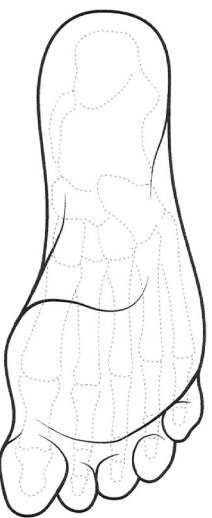


MEDIAL VIEW



BACK VIEW

Important to have a good protector here as we don't need mobility and sensibility



BOTTOM VIEW



TOP VIEW

Would be great to improve some protection without losing mobility or feedback.

RIDER NAME:

Ergonomics

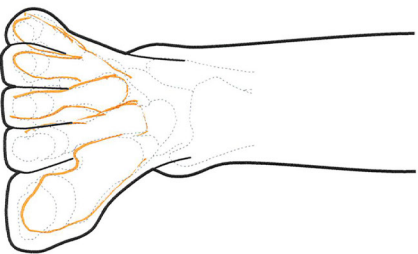
Indicate where you would like to get feedback from the bike/boot during racing.

Sketch and note down your ideas

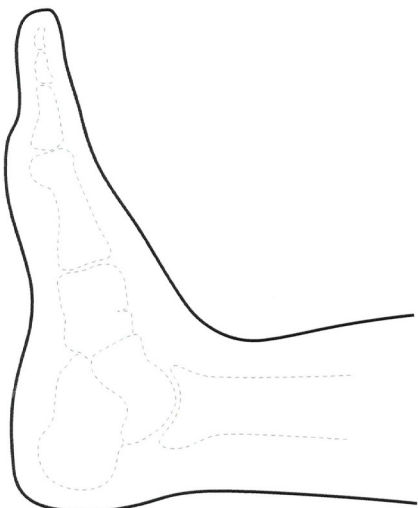
P8



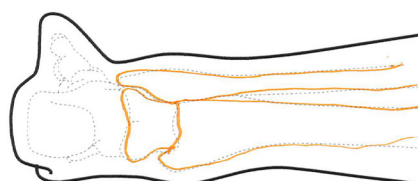
LATERAL VIEW



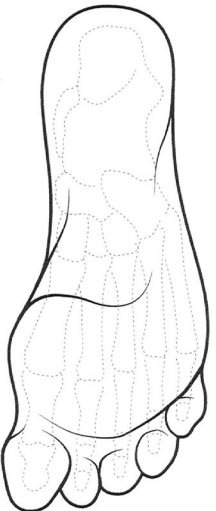
FRONT VIEW



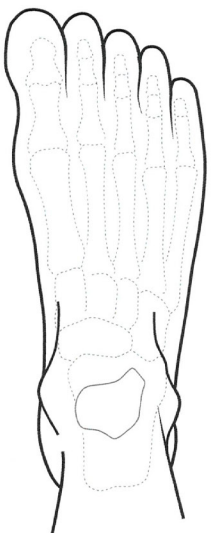
MEDIAL VIEW



BACK VIEW



BOTTOM VIEW



TOP VIEW

RIDER NAME:

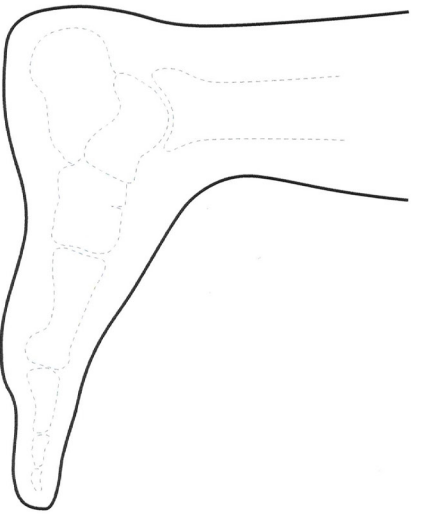
Ergonomics

Indicate where you would like to get feedback from the bike/boot during racing.

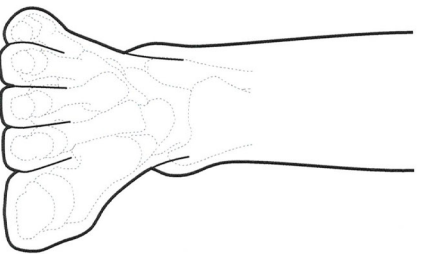
Sketch and note down your ideas

P5

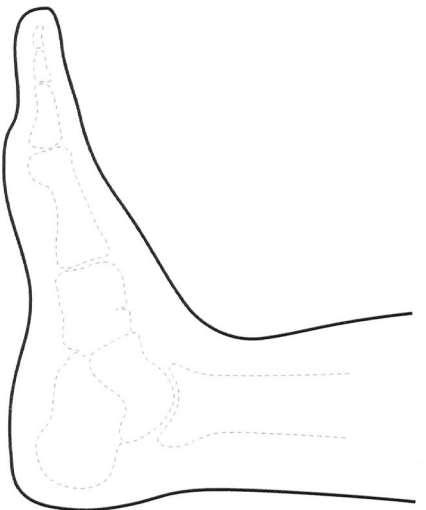
EASY PUT AND TAKE OUT BOOT
SPECIALLY THINKING IN CASE OF INJURY
COMFORTABLE IN THE INSIDE, SPECIALLY WITH TOES



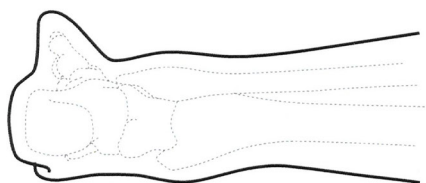
LATERAL VIEW



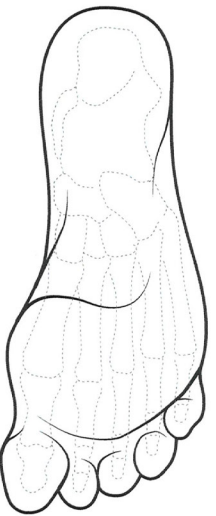
FRONT VIEW



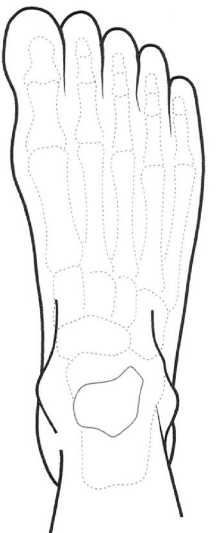
MEDIAL VIEW



BACK VIEW



BOTTOM VIEW



TOP VIEW

GOOD MOBILITY OF ANKLE UP AND DOWN, BUT NOT A LOT TO THE SIDE
TO AVOID ANKLE INJURIES

GOOD VENTILATION

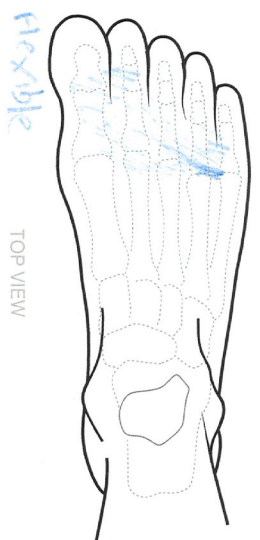
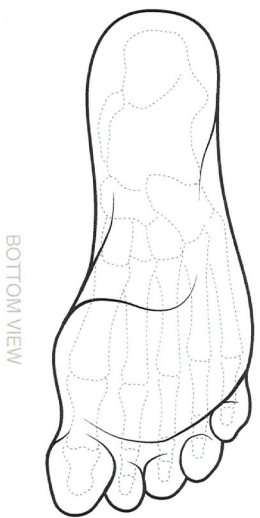
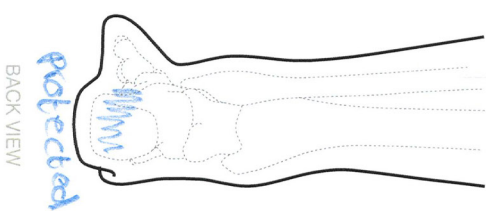
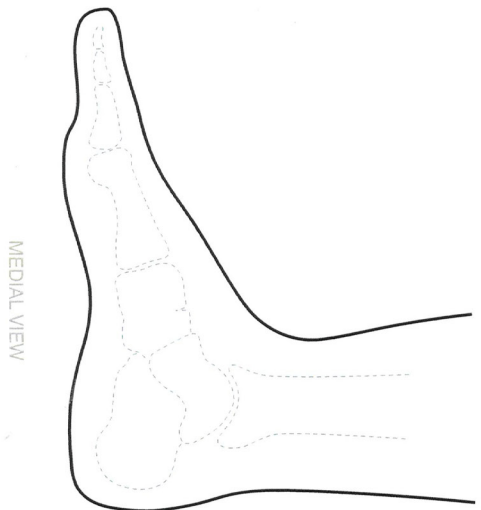
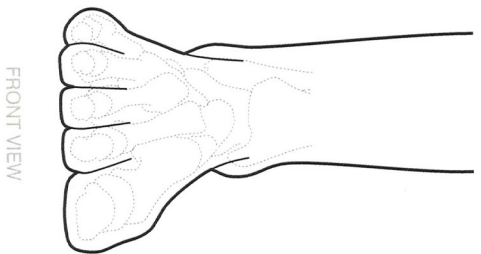
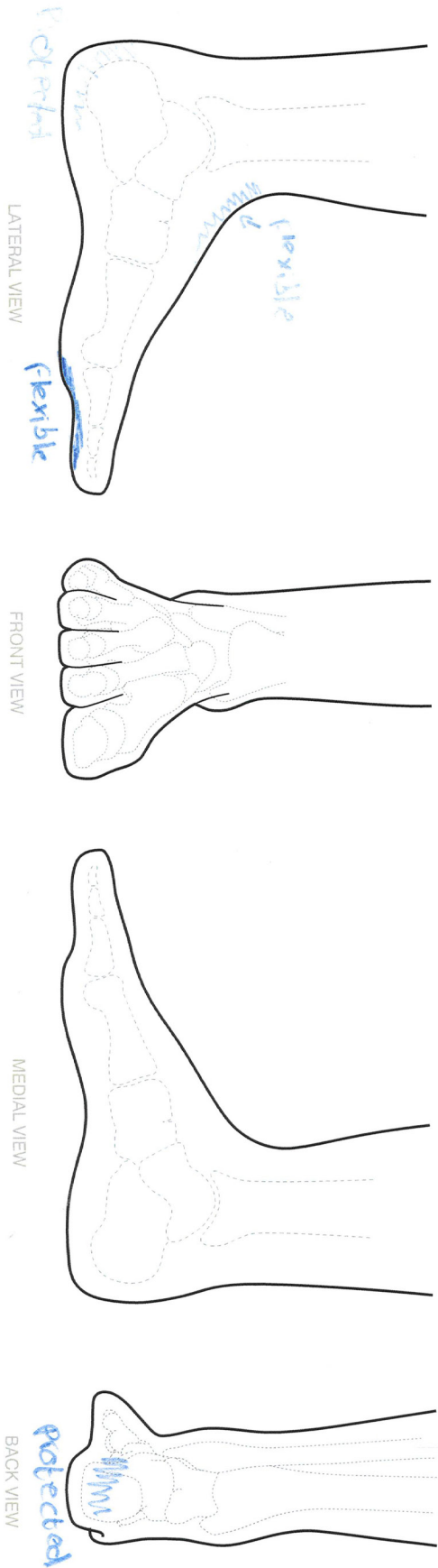
RIDER NAME:

Protection

P1

Indicate where you would like to be protected during racing and which area you want to be flexible

Sketch and note down your ideas



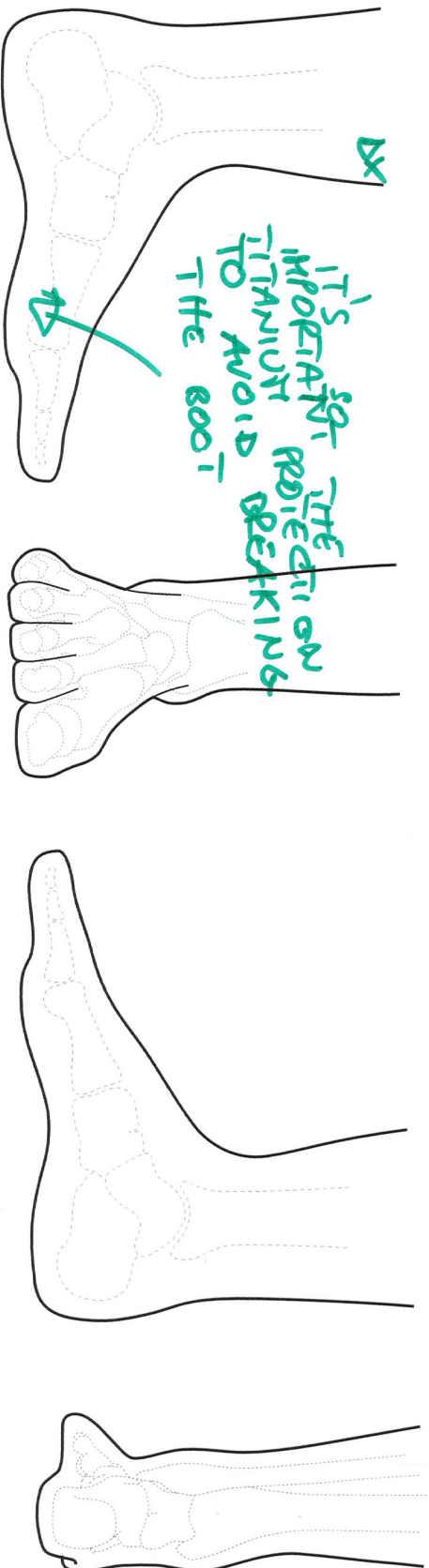
RIDER NAME:

Protection

P2

Indicate where you would like to be protected during racing and which area you want to be flexible

Sketch and note down your ideas

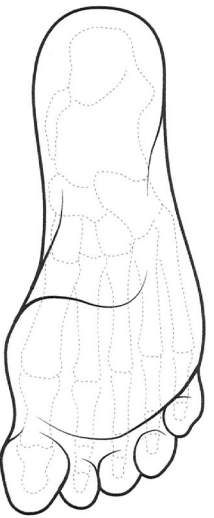


LATERAL VIEW

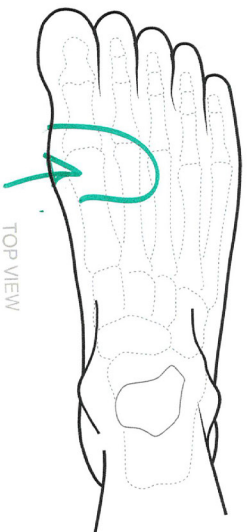
FRONT VIEW

MEDIAL VIEW

BACK VIEW



BOTTOM VIEW



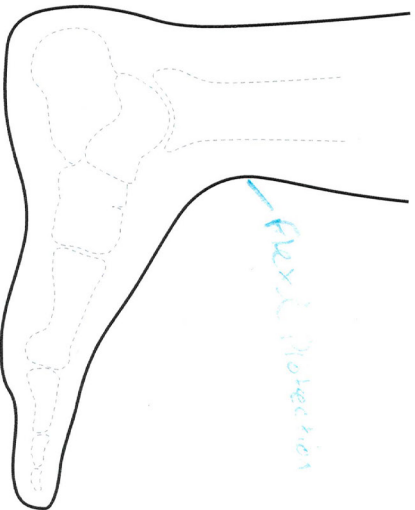
TOP VIEW

RIDER NAME:

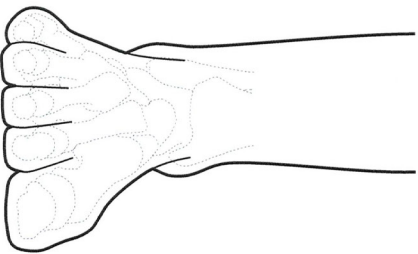
Protection

Indicate where you would like to be protected during racing and which area you want to be flexible

Sketch and note down your ideas



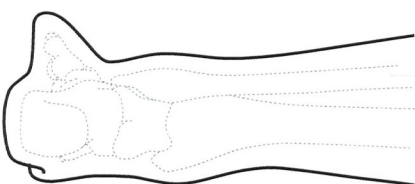
LATERAL VIEW



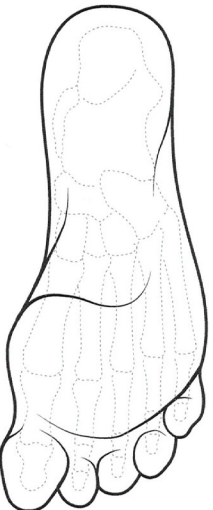
FRONT VIEW



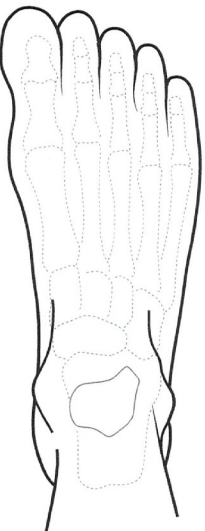
MEDIAL VIEW



BACK VIEW



BOTTOM VIEW



TOP VIEW

RIDER NAME:

Protection

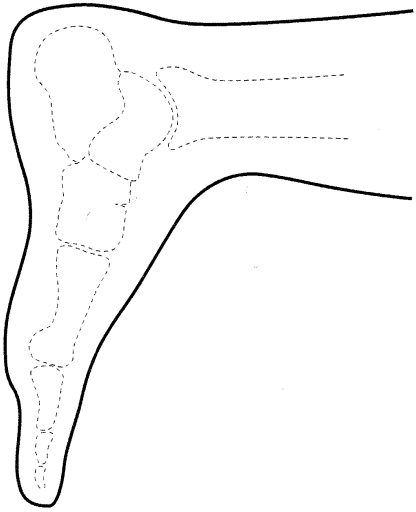
Indicate where you would like to be protected during racing and which area you want to be flexible

Sketch and note down your ideas

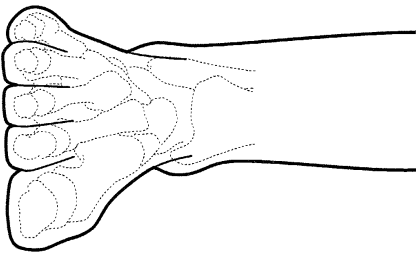
REV'IT! RIDER EVENT - SEASON 2022 | BRAINSTORM

P5

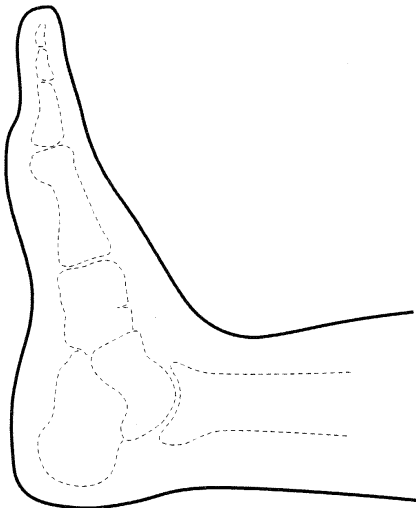
REINFORCEMENT EXHAUSTION PROTECTION AND GOOD VIBRATION DAMPING IN THE HEEL AND MIDFOOT



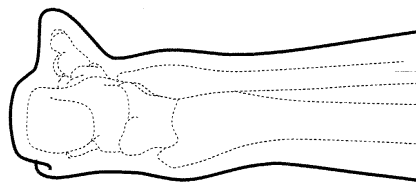
LATERAL VIEW



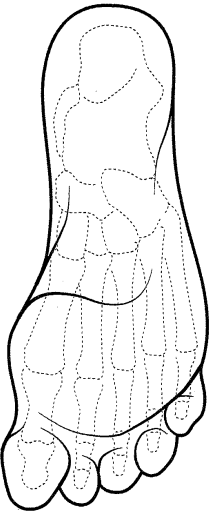
FRONT VIEW



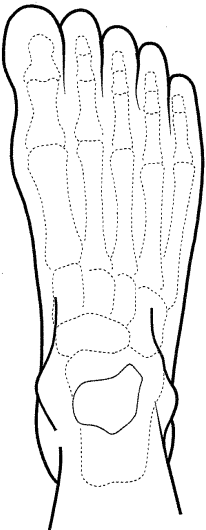
MEDIAL VIEW



BACK VIEW



BOTTOM VIEW



TOP VIEW

RIDER NAME:

Page 3 of 4

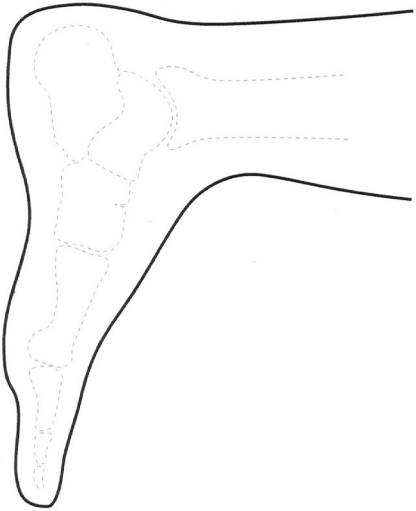


Protection

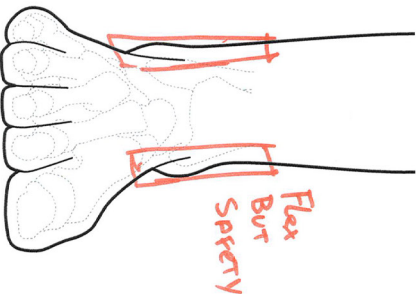
Indicate where you would like to be protected during racing and which area you want to be flexible

Sketch and note down your ideas

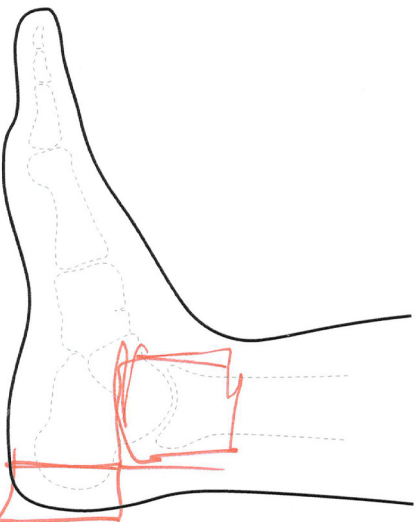
P6



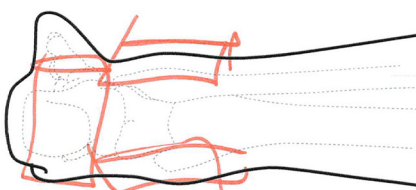
LATERAL VIEW



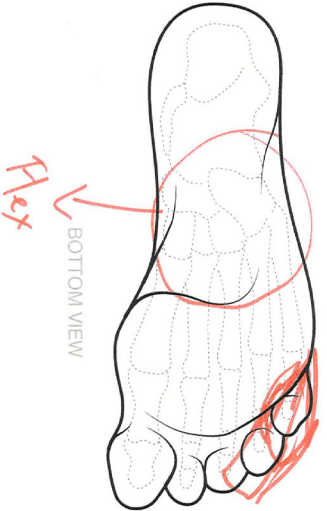
FRONT VIEW



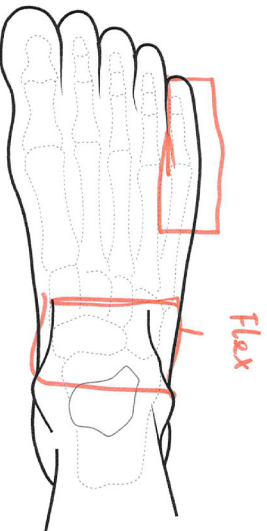
MEDIAL VIEW



BACK VIEW



BOTTOM VIEW



TOP VIEW

RIDER NAME:

Protection

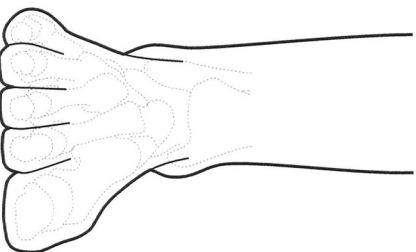
Indicate where you would like to be protected during racing and which area you want to be flexible

Sketch and note down your ideas

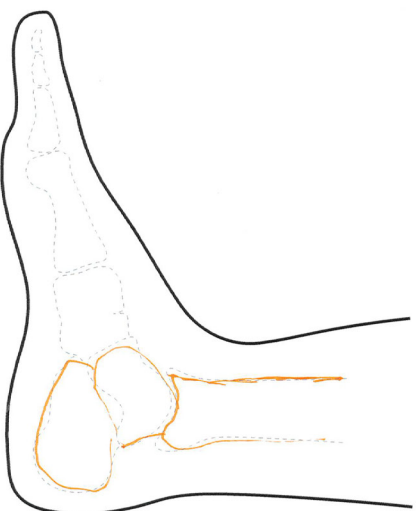
P8



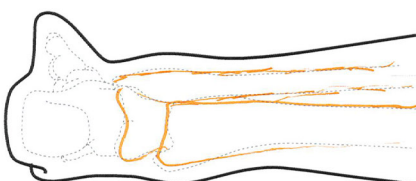
LATERAL VIEW



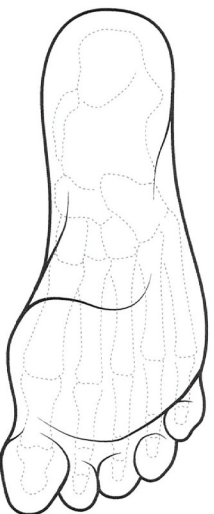
FRONT VIEW



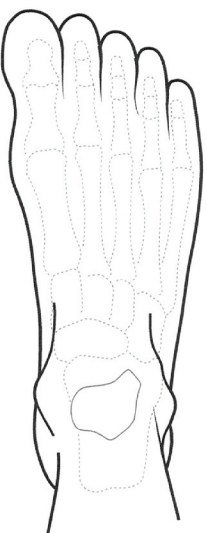
MEDIAL VIEW



BACK VIEW



BOTTOM VIEW

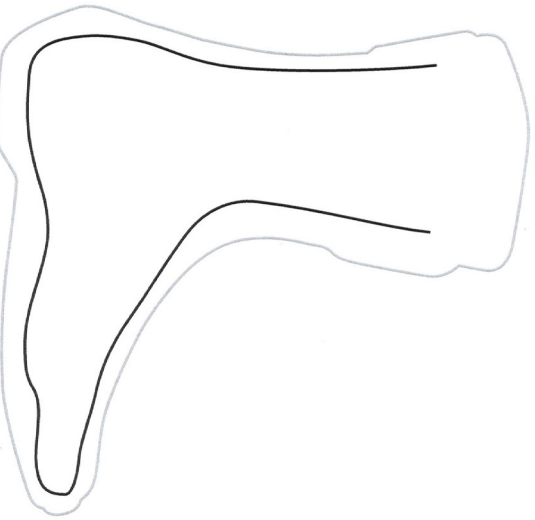


TOP VIEW

RIDER NAME:

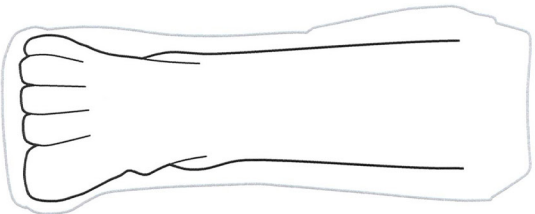
Sketch your Future Racing Boot

zipper

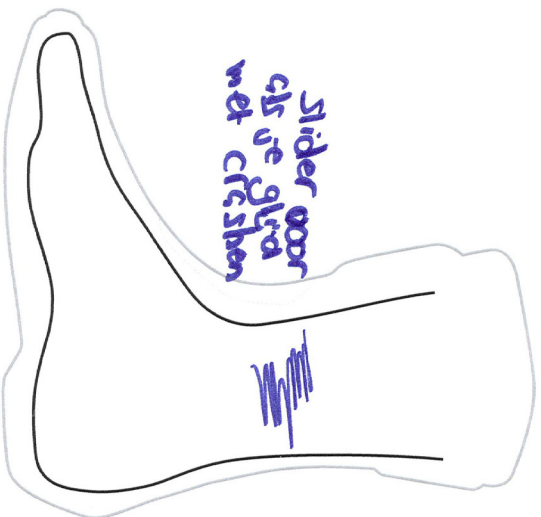


LATERAL VIEW

ongeveer de vorm als het plekje
hierboven



FRONT VIEW



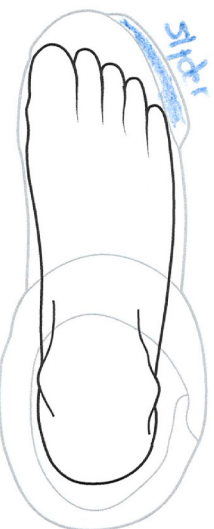
MEDIAL VIEW

slider voor
als de glijd
met cirkels

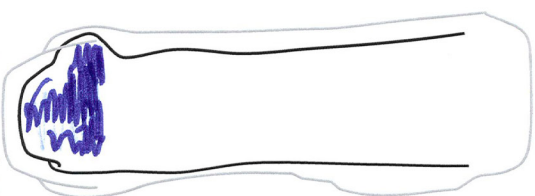


BOTTOM VIEW

slider voor
rijders die
de voet uitdoen
tijdens 't remmen



TOP VIEW



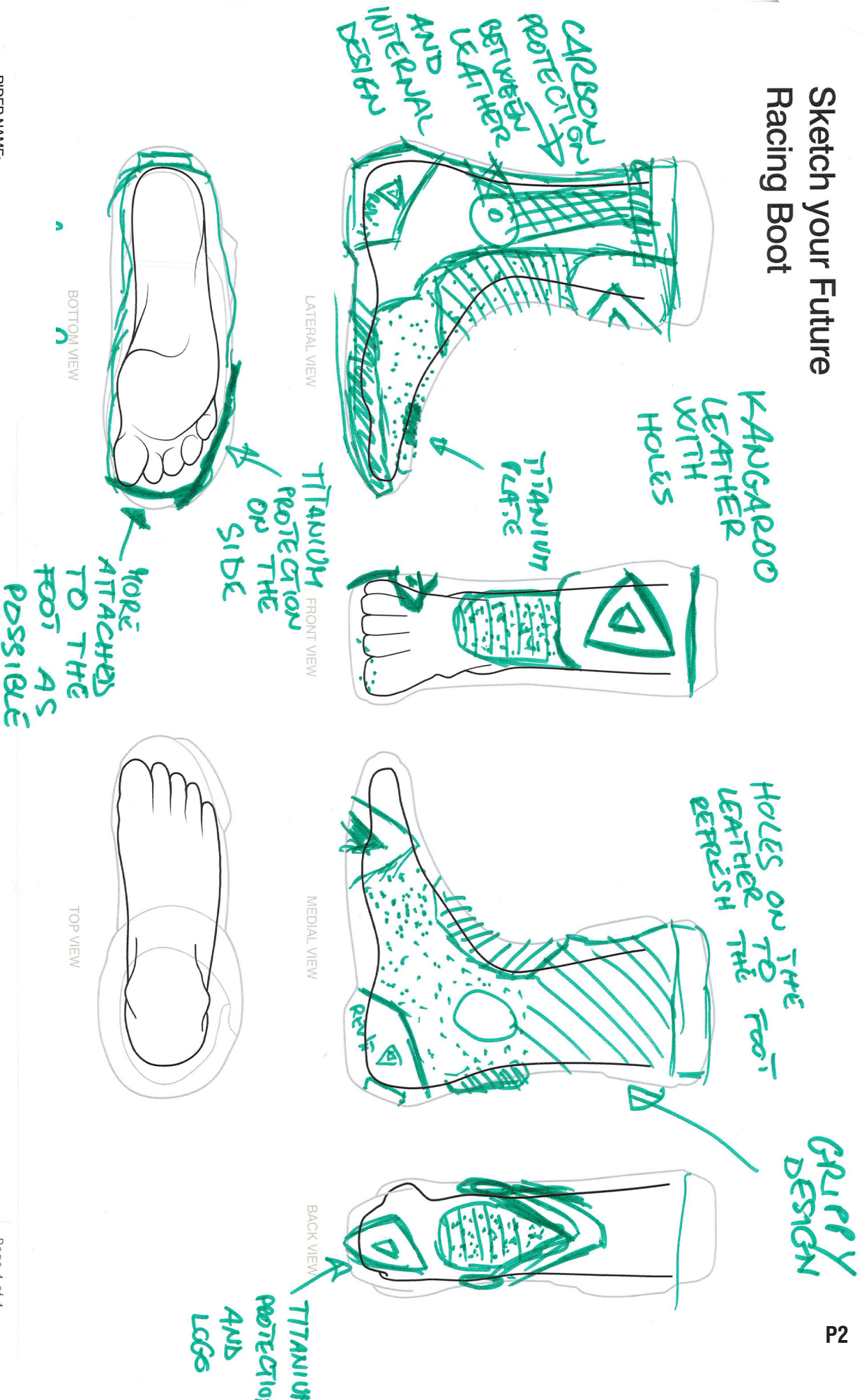
BACK VIEW

protectie
/ uitbij indren
mogelijk

RIDER NAME:

P2

Sketch your Future Racing Boot



RIDER NAME:



Sketch your Future Racing Boot

I would like to wear the

interior boot

more durability

LATERAL VIEW

THE SOLE

FRONT VIEW

MEDIAL VIEW

BACK VIEW

BOTTOM VIEW

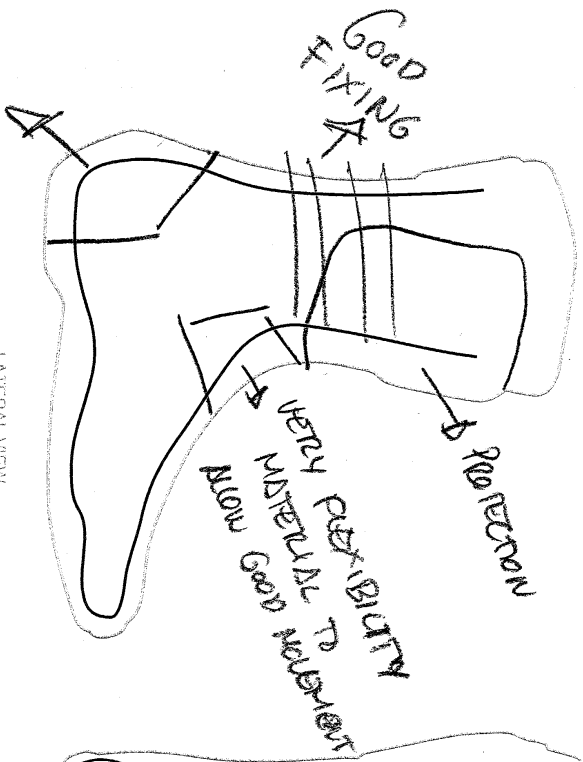
TOP VIEW

THIS SLIDES MORE SMALL
because it is smaller

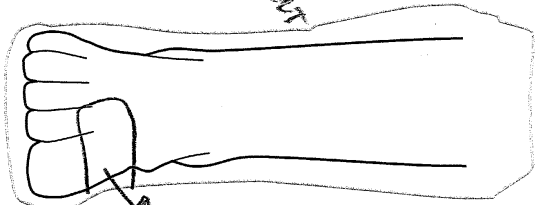
P4

RIDER NAME:

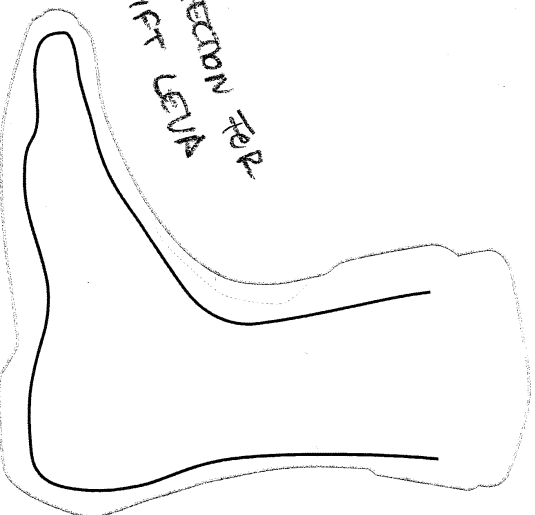
Sketch your Future Racing Boot



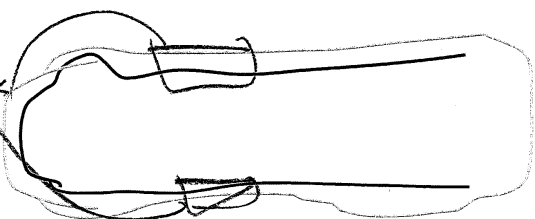
LATERAL VIEW



FRONT VIEW

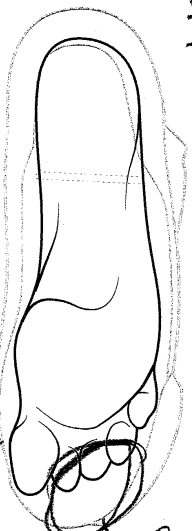


MEDIAL VIEW

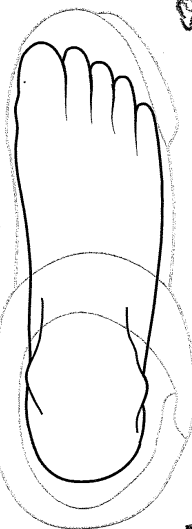


BACK VIEW

PROTECTION TO AVOID
HEEL INJURY



BOTTOM VIEW



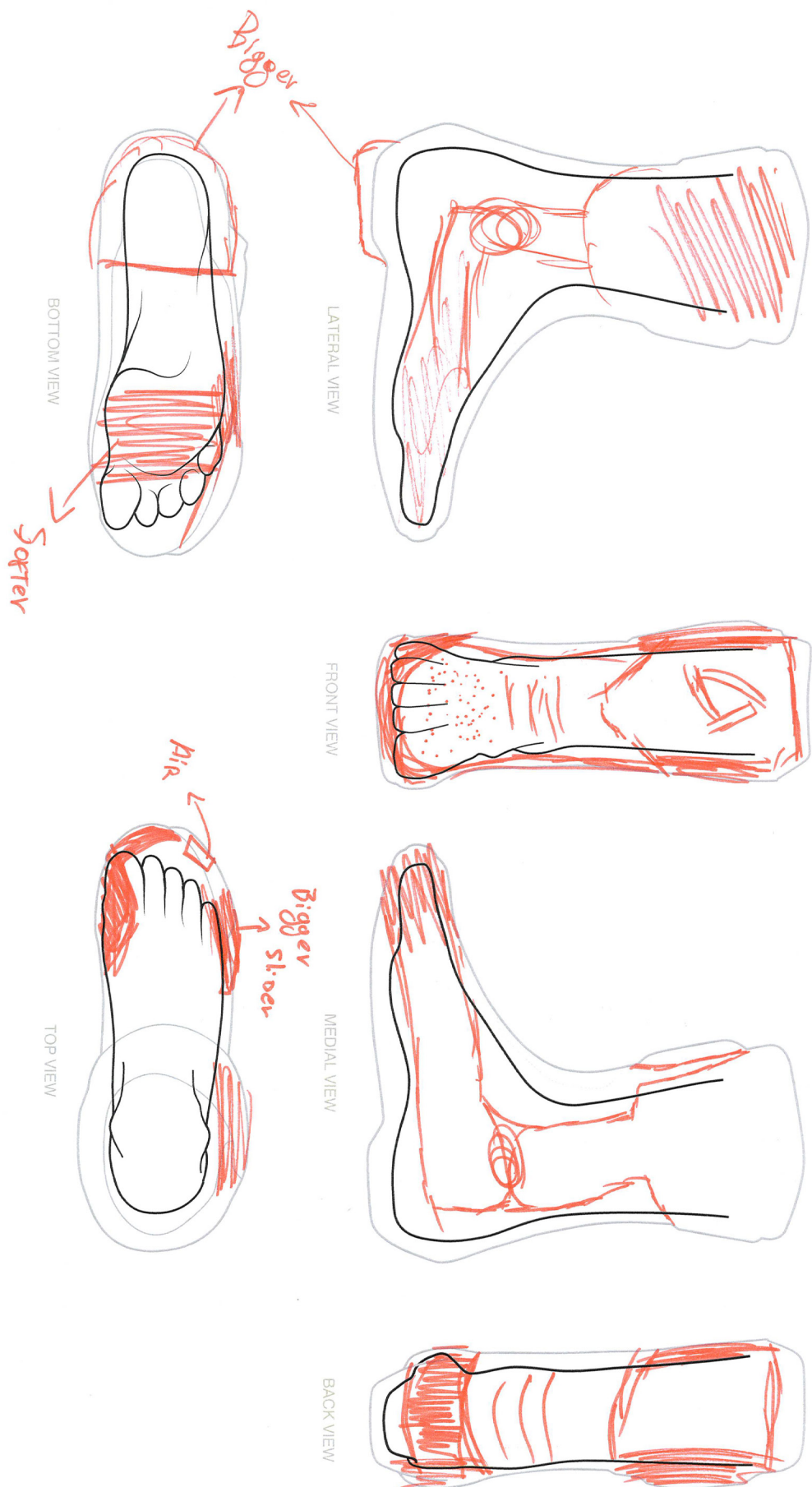
TOP VIEW

Good FIXING TO DON'T
ALLOW THE ANKLE
MOVE TO THE SIDE

RIDER NAME:

Sketch your Future Racing Boot

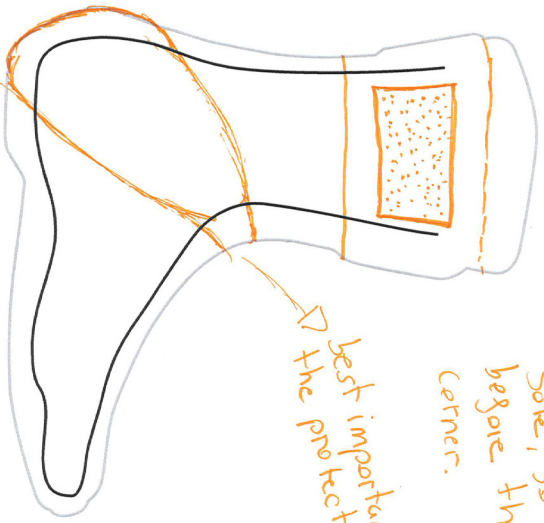
P6



RIDER NAME:

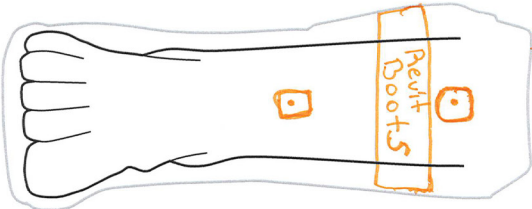
Sketch your Future Racing Boot

My boot of the future would be, very flexible in the ankle and at the same time great protection in that place. It would have a very good material on the sole, so that riders do not have a wear problem when taking their feet out of the corner.

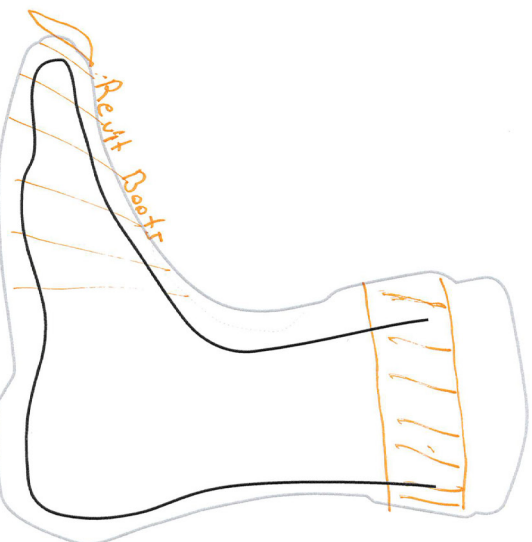


LATERAL VIEW

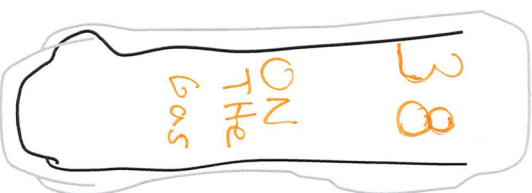
best important
the protection



FRONT VIEW



MEDIAL VIEW

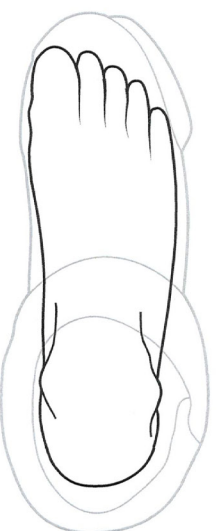


BACK VIEW



BOTTOM VIEW

ventilation



TOP VIEW

RIDER NAME:

APPENDIX 6. RESULTS REV'IT! RIDER EVENT

On the 10th of December the Riders of REV'IT! were invited to the headquarters of REV'IT!. The day had to be interactive, and an hour was reserved for the senior footwear designer and me for us to fill in to our liking. As this was the opportune moment to gain as much insight as possible regarding their experience with their racing boots and what they like and dislike, we had to set up a good plan. The result was a co-creation/Q&A session in which the riders could fill in the templates that were made for them and start discussions about certain questions. On top of that, we let them fill in a questionnaire. The templates, plan and visual stimulation used for this session can be found in Appendix 4. In this appendix the results can be found and including the conclusions based on Appendix 5 (results rider session).

Results

Results based on the results of the questionnaire, elaboration by Schamp (2021) and REV'IT! (2022e):

Name	Category	Number	Origin	Age	Shoe Size	Boots per season (2 to 15)
p1	Moto2	37	Spain	24	42,5	10
p2	Moto2	19	Italy	24	40,5	15
p3	Moto3	38	Spain	18	42/43	5 or 6
p4	Moto2	96	United Kingdom	25	8 (41-42)	7
p5	Moto2	84	The Netherlands	16	43	15
p6	WSBK	19	Spain	37	38	13 (3 test)
p7	Moto2	61	Italy	22	43	10 to 12
p8	Moto3	10	Brazil	17	41	2
p9 (not present)	MotoGP	40	South Africa	23	-	-
p10 (not present)	Moto2	12	Czech Republic	19	-	-
p11 (not present)	MotoGP	9	Italy	31	-	-

Results of the questionnaire:

Name	Freedom of Movement (1) vs Ankle stability/protection (7)	Comfort (1) vs Safety (7)	Aerodynamics (1) vs Protection (7)	Ventilation (1) vs Protection (7)	Weight (1) vs Protection (7)	Aesthetics (1) vs Functionality (7)	Performance (1) vs Safety (7)	Innovation (1) vs Tradition (7)	Grippy, more wearing sole (1) vs Less grippy, less wearing sole (7)	Stiff sole (1) vs Flexible sole (7)
Moto2	3	3	5	5	3	6	4	4	4	7
Moto2	3	2	4	1	2	6	3	1	5	7
Moto3	3	4	4	6	3	2	5	1	4	4
Moto2	4	4	4	7	4	5	4	4	5	5
Moto2	4	4	5,5	4	5	6	4	1	1	4
World SBK	5	5	7	5	4	7	4	3	4	6
Moto3	3	3	3	3	4	5	3	3	4	6
Moto3	4	5	3	6	2	4	5	3	4	5
Average	3,6	3,8	4,4	4,6	3,4	5,1	4,0	2,5	3,9	5,5

Results filled in hand-outs riders

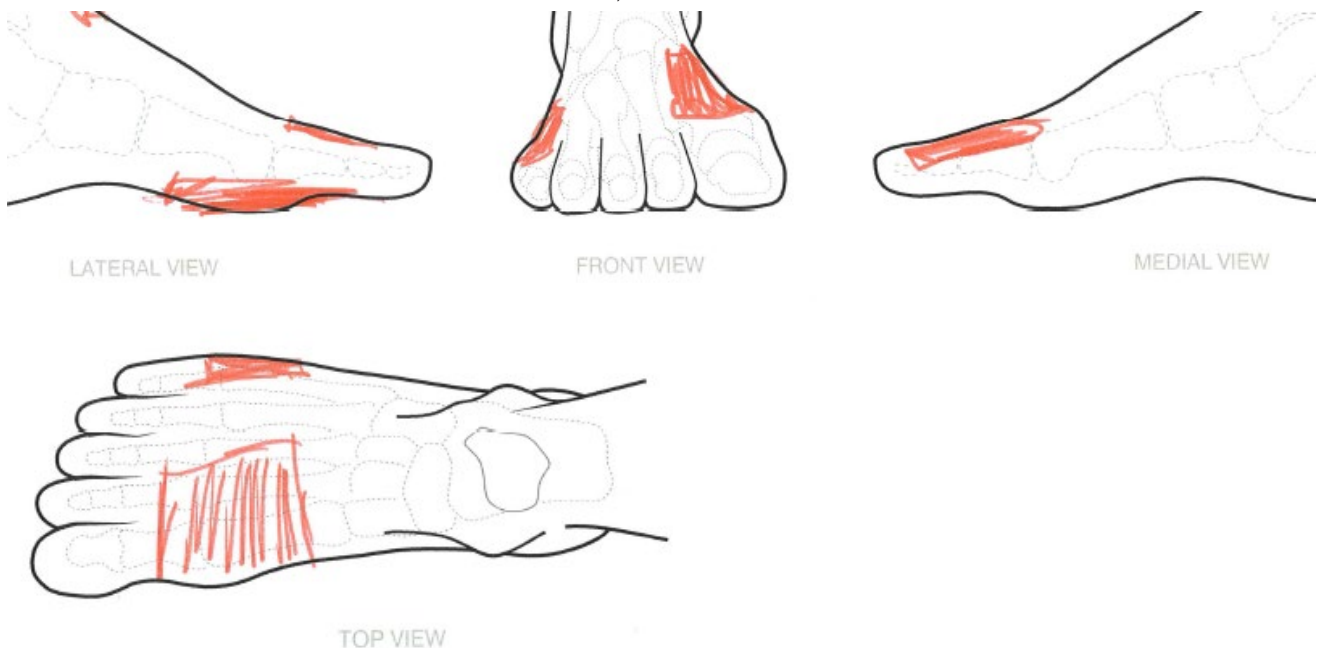
Improvements Racing Suit

- A lighter suit (indicated more frequently) – especially important in Moto3 and 2.
- An airbag at the knees.
- A narrower speed hump.

- Better aerodynamics of the suit (on the back) and the boots.
- Improved freedom of movement.
- There were some areas that were too tight or left seam imprints.
- Having all the protection parts adjusted to the size of the rider (customization).
- Making the interior tighter/with less material so it avoids wrinkles, especially in the arm and leg area.
- A better fixture at the top of the zipper, sometimes the zipper opens.
- Less “wings” on the legs, when sitting in tucked in position.

Ergonomics

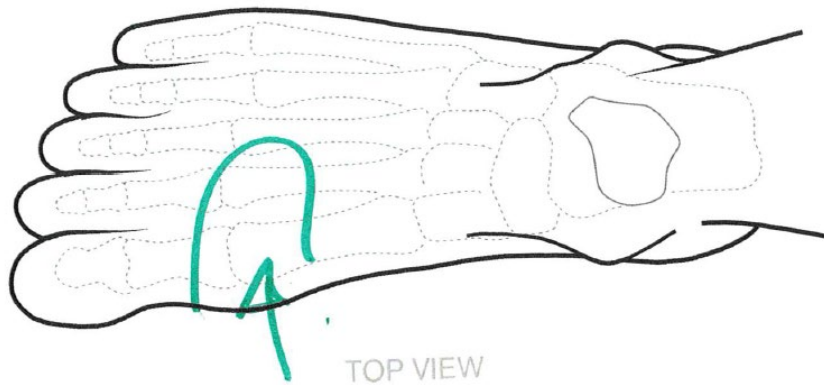
- The mobility in the plantar/dorsiflexion direction is very important (indicated more frequently). But sideways movements should be prevented to avoid ankle injury.
- It's important that it's easy to put the boots on and take them off, especially when they have an injury.
- The lasting board under the ball of the foot should be flexible (indicated multiple times).
- Low weight.
- Good ventilation is important (in the flex area) (indicated multiple times).
- The boots should be comfortable on the inside, especially in the toe area.
- Moto2 rider prefers holes on the leather to have a soft surface of the boot.
- A hard, but grippy sole.
- A more durable outer sole.
- At the ball of the foot the sole should be soft, to feel the shift lever.



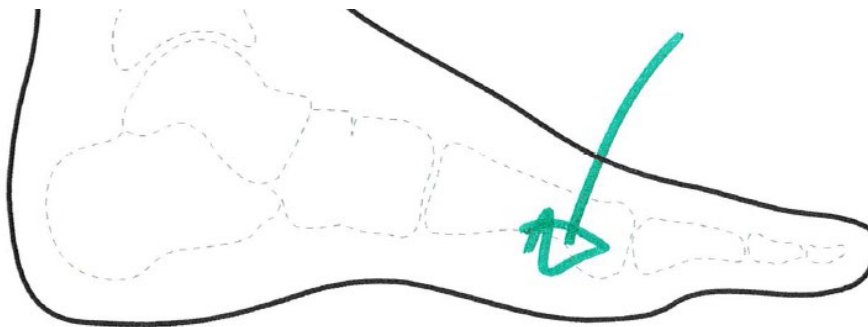
Protection

- It's important to have a good protector on the heel (indicated multiple times). They don't need mobility or sensibility there.
- The structure around the ankle should be stiffer.
- Shin protection is nice, but aerodynamics must be kept in mind.
- The protection in terms of transverse rigidity could be improved, without losing mobility or feedback in the sole.

- Plastic protection just behind the toes to prevent blisters (Moto2 rider):



- Titanium protection to avoid breaking the boot (Moto2 rider), here:

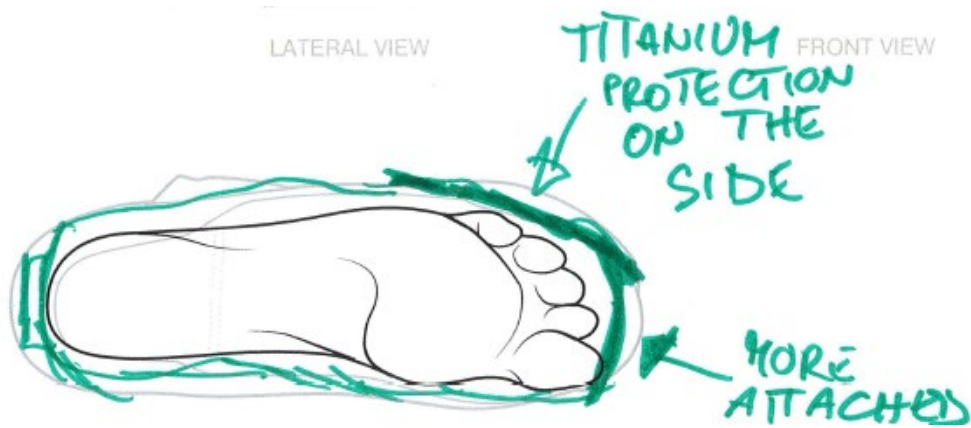


- The flex area should be flexible, yet protective.
- There should be ankle protection on the medial and lateral side of the ankle and on the side of the smaller toes.
- There should be protection for the ankle joint.

Boot of the Future

- A slider under the ball of the foot for putting the feet on the ground before a curve, a zipper, sliders on the side of the boot for sliding, an airbag in the heel cup and a toe slider (Moto2 rider)
- Perforated material, a closer fit to the toes, an internal carbon fibre ankle joint protector, titanium protection on the side of the foot (toe slider area), a grippy design on the medial side of the foot (on the top parts), titanium protection on the heel cup, titanium plate on top of the boot (shifter pad) (Moto2 rider).

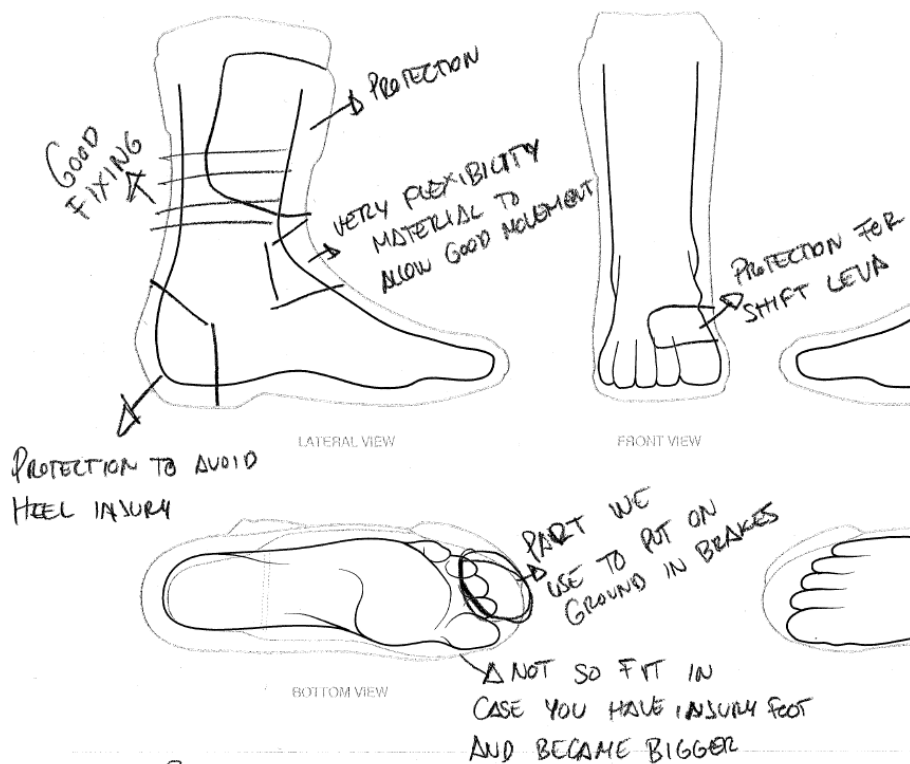




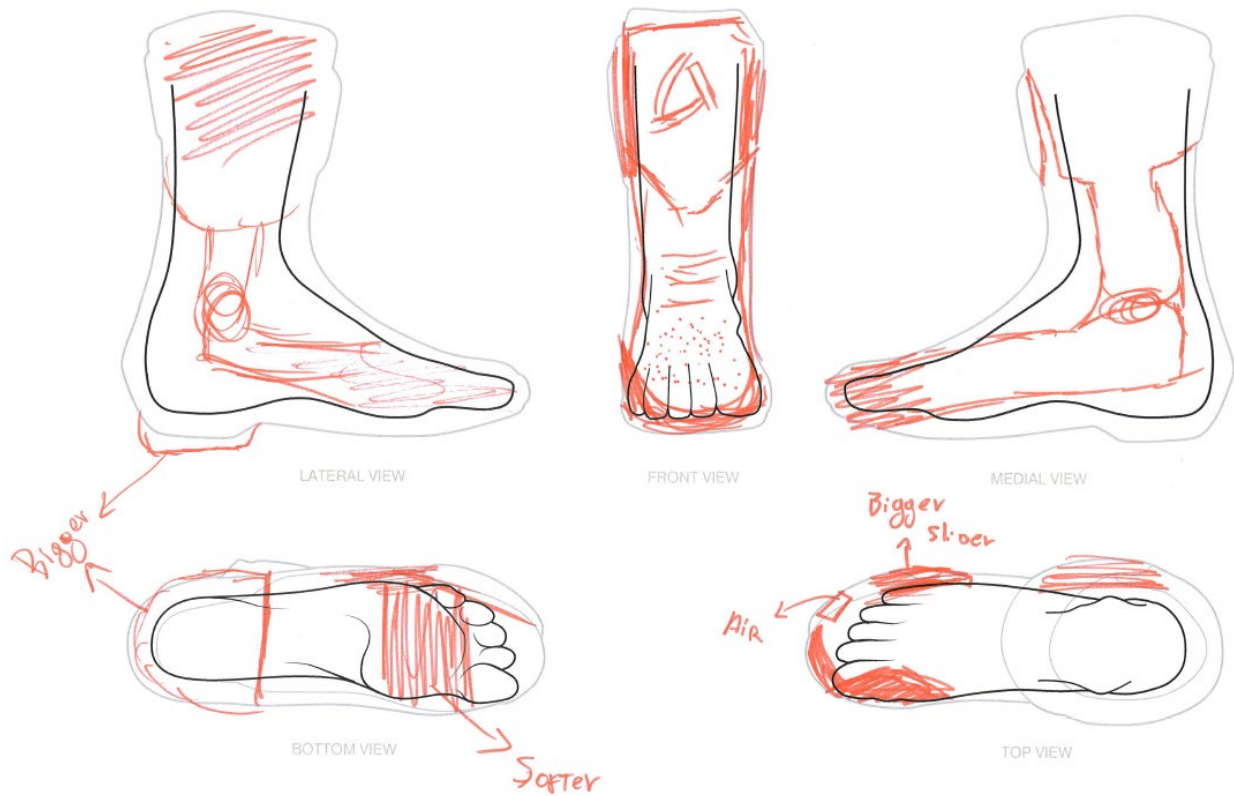
- Ankle brace, small/no shin protector (Moto2 rider):



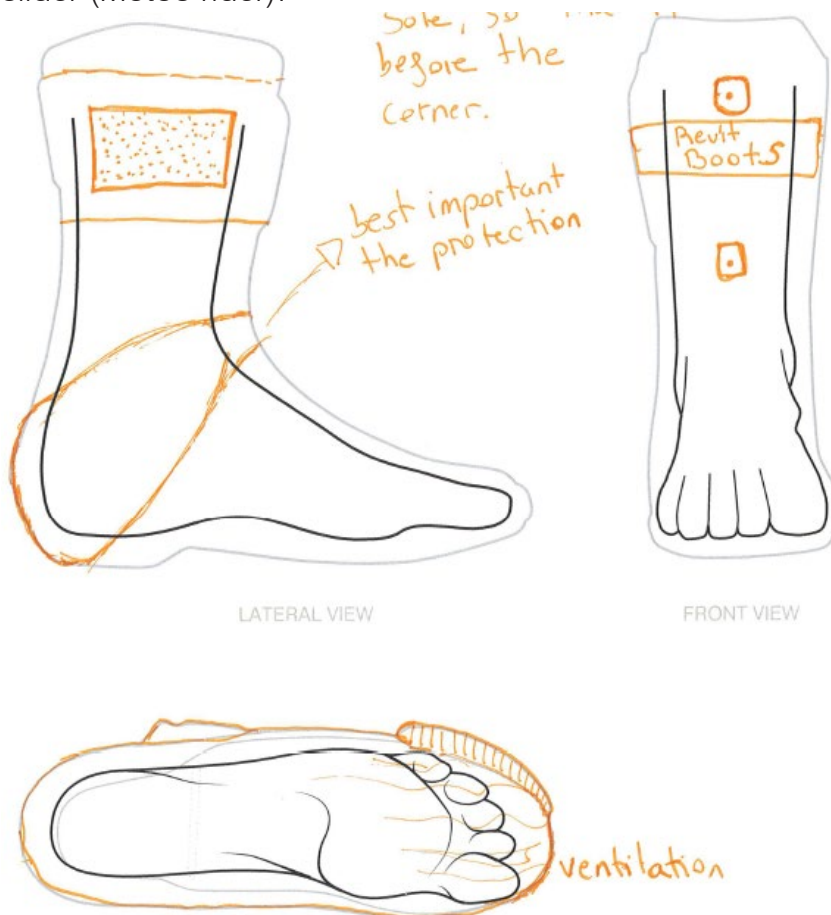
- An inner boot, a more durable outer sole, and a thinner toe slider (Moto3 rider).
- Heel protection, shin protection, protection for the shift lever, an extra part on the sole we use to put on the ground in brakes before a turn, a not too tight fit in case they have an injury and the foot gets swollen, good fixture above the foot on the shin, a very flexible material in the flex area that allows good movement and a good fixture of the ankle to not allow it to move to the side:



- A bigger heel on the outer sole, an ankle brace, a bigger slider on the side of the foot, an air inlet in the front and a softer sole under the ball of the foot:



- Air intake in the front of the boot, a better material on the sole that wears less, a very flexible boot in the ankle area while providing great protection in the meantime and a toe slider (Moto3 rider):



Other Comments in Q&A Session

- Maximum speed crashes > 200 km/h crashes. A highside – the speed is not so high, but the impact is worse, at higher speeds it's mostly sliding. So, you can crash at 200 km/h without any problem, but when you highside at 50 km/h you can have a big problem. This is a big problem in the Moto3 class.
- After crashing during a race, you're mostly mentally unsettled. Fortunately, when you crash 10 times only once you feel pain/have an injury. This is due to the gear; this became better over time.
- Having injuries takes away the focus from riding. Having a crash without injury makes it mentally easier than having a crash with injuries.
- The highsiders can cause a lot of pain, the lowsiders tend to hurt less.
- The problem with a highside is also that you don't have any control on how you will land (shoulder, feet, arms, etc.). But the feet always hit the ground hard (even if they follow the hands or something). The hips usually come afterwards and around the shoulders you have an airbag. Around the feet you only have the boots. And it's quite easy to injure the feet. The current boots limit injuries, but it's still easy to injure them. A broken ankle is what you see quite often. An airbag in the boot would be nice, but that's impossible as it is so stiff, so it doesn't expand.
- It's not a necessity to improve in terms of safety, as it's not too dangerous at this point, but there is a lot of room for improvement. Especially in the boot area.
- Zonta gets the boots right of the shelf, no customization.
- The customization of the boots is just in terms of size.
- They all wear socks.
- The comfort needs to be kept into account though when looking at protection.
- The delicacy in the boots is like the gloves.
- With the improvement of the technology, it helps the mind as you feel safer.
- Bautista: The replaceable parts on the boots are very nice as this means the boots can break in nicely and can become very comfortable. This weighs up against the added weight that comes with that.
- Ankle injuries still happen, ideal would be to have an airbag around the foot.

Donning/Doffing

- Top entry can be very painful while donning/doffing, side entry is much more comfortable.
- They usually always have some kind of injury, that's why it's important to consider that in the design. They are not always fit.

Design Drivers

- The weight and aerodynamics of the boots are very important. In terms of aerodynamics Dainese probably has the best ones. But just in the wind tunnel. In lap times it doesn't show.
- A few grams go unnoticed, but a big difference in weight doesn't.

Outer Sole





- The outer soles wear very quickly.



- The outer soles can get destroyed in one session and holes can form. How grippy the soles must be, depends on the rider. Someone lets their soles be filed down they are smooth on the foot pegs, otherwise they are too sticky to the pegs.



Heat

- On the exhaust side is where foot gets the hottest (especially). This can become too hot.
- They use the ventilation vents, but it's not sufficient
- In rainy conditions, Bautista uses boots without perforation, so his feet stay a little drier, otherwise he wears perforated ones.
- The ventilation is really important, especially in hot conditions.
- The boots run very hot and almost get painful because of the heat of the bike. This however differs greatly per bike, but in general this could be a big improvement.
- Moto2, Moto3, MotoGP bikes run hotter as they are more aero, than superbikes.
- They generally don't run cold, as they can wear warmer socks and they are constantly moving. They are on the bike for 40-45 minutes. You can forget the cold, but you can't forget the heat.
- The Dainese boots run hot, more aero, feels safer as it is stiffer, even though you still get good movement, Alpinestars are a little less warm, but bulkier, they feel flimsy and less safe. But it is probably all up to preference.
- After a race they take off the boots, especially in warm conditions.



APPENDIX 7. ANALYSIS FOOT POSITIONS

General		Left					Right				
Picture	Action	Everson or Inversion	Abduction or Adduction	Dorsi- or Plantar flexion	Special action	Contact	Everson or Inversion	Abduction or Adduction	Dorsi- or Plantar flexion	Special action	Contact
 	Straight - Startup	Neutral - Inversion	Abduction	Plantar flexion	Shift up	Footpeg & Shift Lever	-	-	-	Stand	Circuit
 	Straight - Startup	Neutral	Adduction	Plantar flexion	Grip	Footpeg	-	-	-	Dangle	-



General		Left					Right				
	Straight - Startup										
		Neutral	Adduction	Plantar flexion	Grip	Footpeg & Bike	Neutral	Adduction	Neutral	Grip	Footpeg & Bike
	Straight - Startup										
		Neutral	Neutral	Plantar flexion	Grip	Footpeg	Neutral	Adduction	Dorsi-flexion	Grip	Footpeg & Bike

General		Left					Right				
	Turn Right										
	Straight - Startup	Neutral	Neutral	Plantar flexion	Grip	Footpeg	Neutral	Adduction	Neutral	Braking	Footpeg, Brake Pedal & Bike
		Neutral	Neutral - abduction	Plantar flexion	Grip	Footpeg	Eversion	Abduction	Plantar flexion	Grip	Footpeg & Brake Pedal






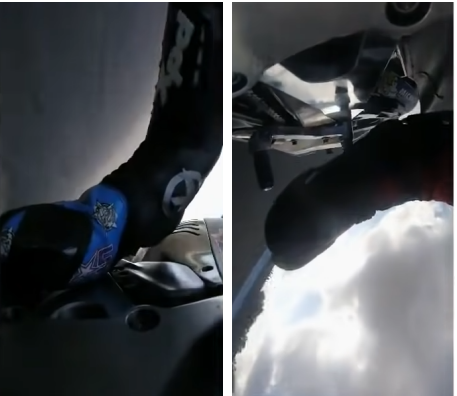
General		Left					Right				
	Turn Right	Neutral	Neutral - Abduction	Plantar flexion	Grip	Footpeg	Eversion	Abduction	Dorsi-flexion	Grip	Footpeg & Brake Pedal
	Turn Right	Neutral	Abduction	Plantar flexion	Grip	Footpeg	Inversion	Neutral	Dorsi-flexion	Grip	Footpeg





General		Left					Right				
	Turn Right	Neutral	Abduction	Plantar flexion	Grip	Footpeg	Neutral	Neutral	Dorsi-flexion	Grip	Footpeg
	Straight - Tucked	Neutral	Abduction	Plantar flexion	Shift Up	Footpeg & Shift Lever	Neutral	Neutral	Dorsi-flexion	Grip	Footpeg & Bike


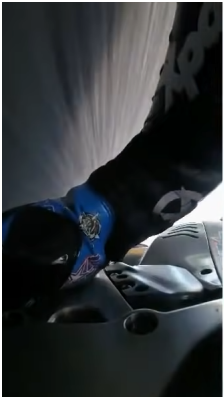


General	Left						Right				
	Straight - Tucked										
	Right Leg Dangle										
	Neutral										
	Abduction										
	Plantar flexion										
	Shift Up										
	Footpeg & Shift Lever										
	Neutral - Inversion										
	Adduction										
	Dorsi-flexion										
	Grip										
	Footpeg & Bike										
	-										



General		Left					Right				
	Right Leg Dangle	Neutral	Neutral	Plantar flexion	Grip	Footpeg & Bike	Neutral	Adduction	Dorsi-flexion	Drag	Circuit
	Turn Right	Neutral	Neutral	Plantar flexion	Grip	Footpeg & Bike	Eversion	Abduction	Plantar flexion	Braking	Footpeg, Brake Pedal & Bike
											





General		Left					Right				
 Straight - Tucked	Neutral	Neutral - Adduction	Neutral	Grip	Footpeg & Bike	Inversion	Abduction	Plantar flexion	Braking	Footpeg, Brake Pedal & Bike	
 Turn Right	Neutral	Neutral	Plantar flexion	Grip	Footpeg & Bike	Eversion	Abduction	Plantar flexion	Braking	Footpeg, Brake Pedal & Bike	



General		Left					Right				
	Turn Right	Neutral	Neutral	Plantar flexion	Grip	Footpeg & Bike	Eversion	Abduction	Plantar flexion	Braking	Footpeg, Brake Pedal & Bike
	Turn Left	Neutral - Eversion	Neutral- Abduction	Plantar flexion	Grip	Footpeg & Bike	Neutral	Neutral	Plantar flexion	Grip	Footpeg, Brake Pedal & Bike
	Turn Right										
	Turn Left										






General		Left					Right				
 	Turn Left	Neutral - Eversion	Neutral - Abduction	Plantar flexion	Grip	Footpeg & Bike	Neutral	Neutral - Abduction	Plantar flexion	Braking	Footpeg, Brake Pedal & Bike
	Turn Right	Inversion	Abduction	Dorsi- flexion	Grip	Footpeg & Bike	Neutral	Neutral	Dorsi- flexion	Grip	Footpeg, Brake Pedal & Bike

General		Left					Right				
	Turn Right	Neutral - Inversion	Abduction	Neutral	Grip	Footpeg & Bike	Everson	Abduction	Plantar flexion	Braking	Footpeg & Brake Pedal
	Turn Right	Neutral	Neutral	Plantar flexion	Grip	Footpeg & Bike	Everson	Abduction	Plantar flexion	Braking	Footpeg & Brake Pedal





General		Left					Right				
	Turn Right	Neutral	Neutral	Plantar flexion	Grip	Footpeg & Bike	Neutral	Neutral	Dorsi-flexion	Braking	Footpeg, Brake Pedal & Bike
	Straight - Tucked	Neutral Eversion	Abduction	Plantar flexion	Shift Up	Footpeg & Shift Lever	Neutral	Abduction	Plantar flexion	Braking	Footpeg, Brake Pedal & Bike
											





General		Left					Right				
	Turn Right										
		Neutral	Neutral	Plantar flexion	Grip	Footpeg & Bike	Neutral	Adduction	Dorsi-flexion	Drag	Circuit
											
		Neutral	Neutral	Plantar flexion	Grip	Footpeg & Bike	Eversion	Abduction	Plantar flexion	Braking	Footpeg, Brake Pedal & Bike

General		Left					Right				
	Turn Right	Neutral	Neutral	Plantar flexion	Grip	Footpeg & Bike	Neutral	Neutral	Plantar flexion	Braking	Footpeg, Brake Pedal & Bike
	Turn Right	Neutral	Neutral	Plantar flexion	Grip	Footpeg & Bike	Eversion	Abduction	Dorsi-flexion	Braking	Footpeg, Brake Pedal & Bike




General		Left					Right				
	Turn Left	Neutral - Eversion	Abduction	Plantar flexion	Shift Up	Footpeg & Shift Lever	Neutral	Adduction	Neutral	Grip	Footpeg & Bike
	Turn Left	Neutral - Eversion	Neutral	Plantar flexion	Grip	Footpeg & Bike	Neutral	Abduction	Plantar flexion	Braking	Footpeg, Brake Pedal & Bike

General		Left					Right				
	Turn Left - Leg Dangle	Neutral	Neutral	Plantar flexion	Dangle	-	Neutral	Abduction	Plantar flexion	Braking	Footpeg, Brake Pedal & Bike
	Turn Left	Neutral - Inversion	Neutral - Abduction	Plantar flexion	Grip	Footpeg & Bike	Neutral	Neutral	Plantar flexion	Grip	Footpeg, Brake Pedal & Bike

General		Left					Right				
 	Turn Left	Neutral - Everson	Neutral	Plantar flexion	Grip	Footpeg & Bike	Neutral	Neutral	Plantar flexion	Grip	Footpeg, Brake Pedal & Bike
	Right Leg Dangle	Neutral	Abduction	Plantar flexion	Shift Down	Footpeg & Shift Lever	Neutral	Neutral	Dorsi- flexion	Drag	Circuit
 											






General		Left					Right				
	Turn Right	Neutral	Neutral	Plantar flexion	Grip	Footpeg & Bike	Everson	Abduction	Plantar flexion	Braking	Footpeg, Brake Pedal & Bike
	Turn Right	Neutral	Neutral	Plantar flexion	Grip	Footpeg & Bike	Everson	Abduction	Dorsi-flexion	Braking	Footpeg, Brake Pedal & Bike




General	Left					Right				
Turn Right	Neutral	Abduction	Plantar flexion	Grip	Footpeg & Bike	Eversion	Abduction	Neutral	Braking	Footpeg, Brake Pedal & Bike
Turn Right	Neutral	Neutral	Plantar flexion	Grip	Footpeg & Bike	Eversion	Abduction	Dorsi-flexion	Grip	Footpeg, Brake Pedal & Bike





General		Left					Right				
	Turn Right	Neutral	Neutral	Plantar flexion	Grip	Footpeg, & Bike	Eversion	Abduction	Plantar flexion	Braking	Footpeg, Brake Pedal & Bike
	Turn Right	Neutral	Abduction	Plantar flexion	Shift Up	Footpeg, Shift Lever & Bike	Eversion	Abduction	Neutral	Braking	Footpeg, Brake Pedal & Bike
	Turn Right	Neutral	Abduction	Plantar flexion	Shift Up	Footpeg, Shift Lever & Bike	Eversion	Abduction	Neutral	Braking	Footpeg, Brake Pedal & Bike
	Turn Right	Neutral	Abduction	Plantar flexion	Shift Up	Footpeg, Shift Lever & Bike	Eversion	Abduction	Neutral	Braking	Footpeg, Brake Pedal & Bike

General		Left					Right				
	Turn Right	Neutral	Neutral	Plantar flexion	Grip	Footpeg & Bike	Everson	Abduction	Plantar flexion	Braking	Footpeg, Brake Pedal & Bike
	Turn Right	Neutral	Neutral	Plantar flexion	Grip	Footpeg & Bike	Neutral	Abduction	Plantar flexion	Braking	Footpeg, Brake Pedal & Bike


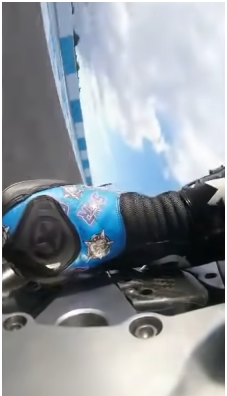





General		Left					Right				
	Turn Right	Neutral	Neutral	Plantar flexion	Grip	Footpeg & Bike	Neutral	Abduction	Dorsi-flexion	Braking	Footpeg, Brake Pedal & Bike
	Straight - Tucked	Neutral	Neutral	Neutral	Grip	Footpeg & Bike	Neutral	Neutral	Neutral	Grip	Footpeg & Bike





General		Left					Right				
	Straight - Tucked	Neutral - Inversion	Abduction	Plantar flexion	Shift Down	Footpeg & Shift Lever	Neutral	Neutral	Dorsi- flexion	Grip	Footpeg & Bike
	Straight - Tucked	Neutral	Neutral	Plantar flexion	Grip	Footpeg & Bike	Neutral	Neutral	Dorsi- flexion	Grip	Footpeg & Bike





General		Left					Right				
 	Straight - Tucked										
		Neutral	Neutral	Plantar flexion	Grip	Footpeg	Neutral	Neutral	Plantar flexion	Braking	Footpeg, Brake Pedal & Bike
 	Straight - Tucked										
		Neutral	Abduction	Plantar flexion	Shift Down	Footpeg & Shift Lever	Neutral	Neutral	Plantar flexion	Grip	Footpeg & Bike



General		Left					Right				
	Left Leg Dangle	Neutral	Adduction	Neutral	Drag	Circuit	Neutral	Neutral	Plantar flexion	Braking	Footpeg, Brake Pedal & Bike
	Turn Left	Neutral - Eversion	Neutral	Plantar flexion	Grip	Footpeg & Bike	Neutral	Neutral	Plantar flexion	Braking	Footpeg, Brake Pedal & Bike





General		Left					Right				
	Turn Left	Neutral - Eversion	Neutral	Plantar flexion	Grip	Footpeg & Bike	Neutral	Neutral	Plantar flexion	Braking	Footpeg, Brake Pedal & Bike
	Straight - Tucked	Neutral - Eversion	Abduction	Plantar flexion	Grip	Footpeg & Bike	Neutral	Neutral	Neutral	Grip	Footpeg & Bike
											



General		Left					Right				
	Straight - Tucked										
	Straight - Tucked	Neutral - Eversion	Abduction	Plantar flexion	Shift Up	Footpeg & Shift Lever	Neutral	Adduction	Dorsi-flexion	Grip	Footpeg & Bike
		Neutral	Abduction	Plantar flexion	Shift Up	Footpeg & Shift Lever	Neutral	Abduction	Neutral	Braking	Footpeg, Brake Pedal & Bike




General		Left					Right				
	Straight - Tucked										
	Straight - Tucked										
	Neutral - Eversion										
	Abduction										
	Plantar flexion										
	Shift Up										
	Footpeg & Shift Lever										
	Neutral - Eversion										
	Abduction										
	Dorsi- flexion										
	Grip										
	Footpeg & Bike										



General		Left					Right				
	Straight - Tucked										
	Right Leg Dangle										
	Neutral										
	Neutral										
	Plantar flexion										
	Grip										
	Footpeg & Bike										
	Neutral										
	Neutral										
	Dorsi-flexion										
	Dangle										
	-										




General		Left					Right				
 	Right Leg Dangle	Neutral	Neutral - Adduction	Plantar flexion	Grip	Footpeg & Bike	Neutral	Adduction	Dorsi- flexion	Drag	Circuit
	Turn Right	Neutral	Neutral	Plantar flexion	Grip	Footpeg & Bike	Eversion	Abduction	Neutral	Braking	Footpeg, Brake Pedal & Bike

General		Left					Right				
	Turn Right	Neutral	Neutral	Plantar flexion	Grip	Footpeg & Bike	Eversion	Abduction	Plantar flexion	Braking	Footpeg, Brake Pedal & Bike
	Turn Right	Neutral	Neutral	Plantar flexion	Grip	Footpeg & Bike	Neutral	Abduction	Plantar flexion	Braking	Footpeg, Brake Pedal & Bike



General		Left					Right				
 	Turn Right	Neutral	Neutral	Plantar flexion	Grip	Footpeg & Bike	Neutral	Neutral	Dorsi- flexion	Grip	Footpeg, Brake Pedal & Bike
	Turn Right	Neutral	Neutral - Adduction	Plantar flexion	Grip	Footpeg	Neutral	Neutral	Neutral	Braking	Footpeg, Brake Pedal & Bike

		Left					Right				
General											
	Straight - Tucked										
		Neutral	Adduction	Neutral	Grip	Footpeg & Bike	Neutral	Abduction	Plantar flexion	Braking	Footpeg, Brake Pedal & Bike






https://www.youtube.com/watch?v=3Mng_XY8hEE

Picture - Left Foot Jack Miller	Action	Eversion or Inversion	Abduction or Adduction	Dorsi- or Plantar flexion	Special action	Contact
	Standing	Neutral	Abduction	Dorsiflexion	Grip > Shift Up	Footpeg & Shift Lever
	Standing	Neutral	Abduction	Plantar flexion	Shift Up	Footpeg & Shift Lever
	Standing	Neutral	Abduction	Dorsiflexion	Shift Up > Grip	Footpeg & Shift Lever

	Standing						Footpeg & Bike (Heel Guard)
	Straight - Tucked	Inversion	Adduction	Plantar flexion	Grip		Footpeg & Bike (Heel Guard)
	Straight - Tucked	Inversion	Adduction	Plantar flexion	Grip		Footpeg & Bike (Heel Guard)



	Straight - Tucked	Inversion	Abduction	Plantar flexion	Shift Up	Footpeg & Shift Lever
	Straight - Tucked	Inversion	Abduction	Dorsiflexion	Shift Up	Footpeg & Shift Lever
	Straight - Tucked	Neutral	Neutral	Plantar flexion	Shift Up > Grip	Footpeg & Bike (Heel Guard)




	Straight - Tucked	Neutral	Adduction	Plantar flexion	Grip	Footpeg & Bike (Heel Guard)
	Straight - Tucked	Inversion	Abduction	Plantar flexion	Shift Down	Footpeg & Shift Lever
	Straight - Tucked	Neutral	Neutral	Plantar flexion	Shift Down > Grip	Footpeg & Bike (Heel Guard)

	Turn Right					
	Inversion					
	Abduction					
	Plantar flexion					
	Grip					
	Footpeg & Bike (Heel Guard)					

	Turn Right					
	Inversion					
	Abduction					
	Plantar flexion					
	Shift Up					
	Footpeg & Shift Lever					
	Shift Down					
	Footpeg & Shift Lever					
	Plantar flexion					
	Abduction					
	Inversion					
	Turn Left					
	Footpeg & Bike (Heel Guard)					
	Grip					
	Dorsiflexion					
	Adduction					
	Inversion					
	Turn Left					




	Turn Left	Inversion	Neutral	Dorsiflexion	Grip	Footpeg & Bike (Heel Guard)
	Turn Left	Inversion	Adduction	Dorsiflexion	Grip	Footpeg & Bike (Heel Guard)
	Turn Left	Neutral	Neutral	Dorsiflexion	Grip	Footpeg & Bike (Heel Guard)

	Turn Left	Neutral	Neutral	Dorsiflexion	Grip	Footpeg & Bike (Heel Guard)
	Turn Left	Neutral	Neutral	Plantar flexion	Grip	Footpeg
	Turn Left	Neutral	Neutral	Dorsiflexion	Grip	Footpeg



		
Turn Left	Turn Left	Turn Left
Inversion	Neutral	Inversion
Abduction	Abduction	Abduction
Dorsiflexion	Dorsiflexion	Plantar flexion
Grip	Grip	Grip
Footpeg & Bike (Heel Guard)	Footpeg & Bike (Heel Guard)	Footpeg

	Turn Left	Neutral	Abduction	Dorsiflexion	Shift Up	Footpeg & Shift Lever
	Turn Left	Neutral	Neutral	Dorsiflexion	Shift Down	Footpeg & Shift Lever
	Turn Left	Neutral	Neutral	Plantar flexion	Shift Down	Footpeg & Shift Lever

	Footpeg & Bike (Heel Guard & Chain)	Grip	Dorsiflexion	Adduction	Inversion	Foot against chain
	Leg Dangle	Leg Dangle	Dorsiflexion	Neutral	Neutral	Leg Dangle Left
	-	Leg Dangle	Dorsiflexion	Neutral	Neutral	Leg Dangle Left



Method

The footage of the foot of Petrucci riding on the track was analysed. Every time the posture of one of the feet was changed, a new screenshot was taken. Per foot, a description of the kinematics of the foot and the specific action per foot and of the rider were noted down.

Conclusions

- Plantar flexion and dorsiflexion and plantar flexion are the most prominent movements of which a wider range of movement is used. The riders also indicate this as the most important area for freedom of movement.
- If the upcoming turn goes left, the left leg is dangled and if the upcoming turn goes right, the right leg is dangled.
- The leg dangle isn't performed before every turn. It's mainly done at the end of a longer straight that is followed by a turn.
- For both sides: The boot should allow for the maximum range of dorsi- and plantar flexion:



For both sides plantarflexion occurs more than dorsiflexion

- Potential to make the pair of boots asymmetric:
 - There is more force involved in braking than in shifting and the brake is used more than the shifter.
 - The greatest wear of the sole comes from dragging it over the circuit and what area that is, is greatly dependent on the rider. It would be interesting to look at this per rider and adapt the sole to this.
 - Depending on whether the track is driven clockwise or counter-clockwise, one boot wears more than the other. Different sole per circuit - depending on the foot that will be dragged most
 - The shifter pad on the right foot isn't used, only the side of it is a point of contact.
 - Shifting requires a greater range of motion than braking. And in this boot it's more important that performing dorsiflexion is comfortable for shifting down.
- The shifter pad could cover more of the toes as in some cases the shift lever is manoeuvred by the tips of the toes.



- The contact points of the boots with the bike are:
- Both sides: The front of the sole - Footpeg



- Left sides: The front of the sole - Shift lever



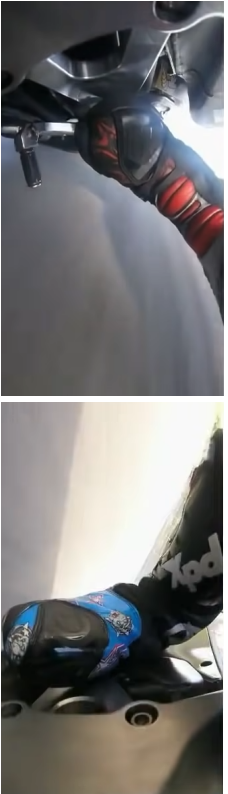
- Right sides: The toes area of the sole - Brake Pedal



- Right side: The lateral side of the sole - Brake Pedal



- Both sides: The medial side of the sole/forefoot - Chassis & The lateral side of the sole/forefoot - Footpegs



- Both sides: The middle of the sole - Footpegs



- Both sides: Area surrounding the medial malleolus - Chassis



- Both sides: The heel (sole and back of the boot) - Chassis



- Left side: The shifter pad - Shift Lever



- Both sides: The sole - Circuit



- Eversion and inversion are mainly happening to maintain grip with the bike while cornering, but the use of the movement in this direction is fairly limited.

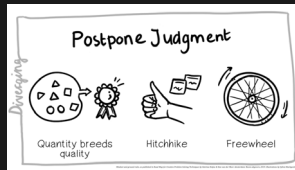
Notes

- Rider styles differ per rider (foot placement of the pegs, etc.)
- How they slide their foot over the asphalt differs per rider.
- I would recommend REV'IT! to do more in depth research in this area to define more precisely what angles are made and what the difference per rider is. It would be interesting to see how they ride when their ankle would be completely fixed in all directions but the one on dorsi and plantarflexion.
- For now I will assume the need for a full range of motion in the flexion/extension direction. The goal is to design a structure that allows all the natural movements, but prevents hyper-rotation in the direction of inversion, eversion, adduction and abduction.

APPENDIX 8. BRAINSTORM PER AREA OF IMPROVEMENT

PROBLEM STATEMENT

What does the ideal adjustment system of a motorcycle racing boot for the MotoGP rider look like?



5 min



FIRST IDEAS

- Write down any statements that come to mind
- No limitations
- Readable, concise, specific

How can we make sure a boot stays on the foot of a MotoGP rider?

What does the ideal donning/doffing system of a MotoGP motorcycle boot look like?

How can we make releasing and attaching a MotoGP boot from and to a foot ideal?

How can we strap a MotoGP rider foot into a protective structure?

What's the easiest way to put on a MotoGP boot?

What's the fastest and easiest way to don and doff a boot?

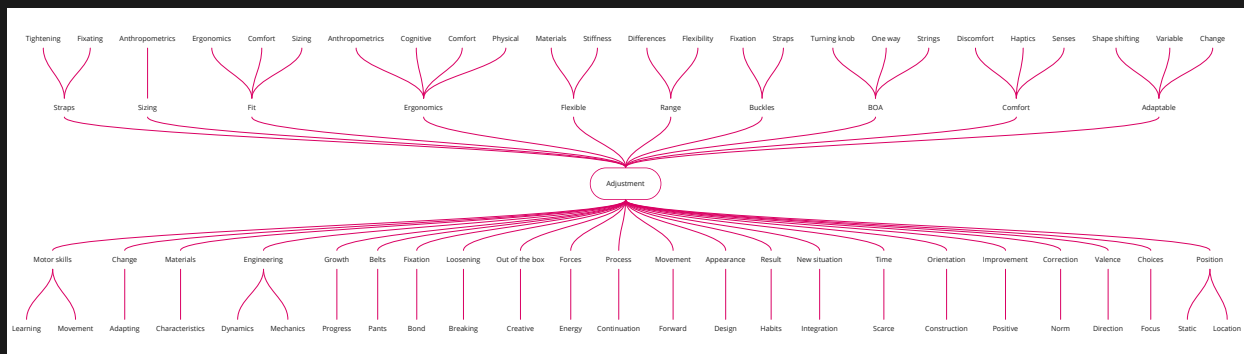


5 min



FLOWER ASSOCIATION

- What do you associate it with?
- What does it remind you of?
- What type of aspects does it consist of?



What does the ideal adjustment system of a motorcycle racing boot for the MotoGP rider look like?



10 min

SPARKING

- SPARK the PAG to create the PAP

SPARK

SPECIFIC, EVIDENCE, CONCRETE

POSITIVE: NO DENIALS NOR CRITERIA

AMBITIOUS: ENERGIZING, IMMERSEIVE

RELEVANT: FEASIBLE, IMPORTANT

KEEP IT SIMPLE: EASY TO UNDERSTAND, NO JARGON, NO ABBREVIATIONS

PARTS/REQUIREMENTS

Quick	Intuitive	Easy	Comfortable for the rider	Possible to attach the boot while injured	Convenient, the boot must be fast
Keeping the boot in place	Not interfering the riding	Lightweight	Should not obstruct movement	No interfering with the control of a bike	Comfortable interaction

How can we make sure a boot stays on the foot of a MotoGP rider?

What does the ideal donning/doffing system of a MotoGP motorcycle boot look like?

How can we make releasing and attaching a MotoGP boot from and to a foot ideal?

How can we strap a MotoGP rider foot into a protective structure?

What's the easiest way to put on a MotoGP boot?

What's the fastest and easiest way to don and doff a boot?

What does the perfect MotoGP boot donning and doffing system look like?

How can we make the donning and doffing of a motorcycle boot comfortable and safe?

What does the donning and doffing of a futuristic MotoGP boot look like?

What does the fastest donning and doffing system of a MotoGP boot look like?

How can we strap MotoGP riders into their boots?

How can we make the fastest donning/doffing experience with MotoGP boots?

How can we attach and detach MotoGP riders from their boots?

What does the perfect MotoGP boot donning and doffing interaction look like?

NEW PROBLEM STATEMENT

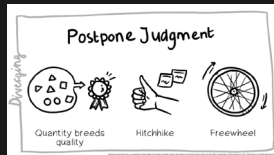
What does the perfect MotoGP boot donning and doffing system look like?



IDEA GENERATION - ADJUSTMENT

PROBLEM STATEMENT

What does the perfect MotoGP boot donning and doffing system look like?



5 min

- Write down any solution that comes to mind
- No limitations
- Readable, concise, specific

FIRST IDEAS

BOA system

Laces

Automatic lacing system - back to the future

Inflating air pocket

Sock with stretchy material

Automated straps

Shaping material - thermal memory

Buckles

Selftightening buckles

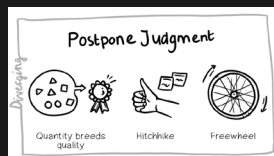
Seal them around their foot

Melt the halves of the boot together

Print it around the foot and dissolve it afterwards

Clay it around their feet

Black panther style



10 min



- Note down any criminal/illegal idea that will put you in jail

CRIMINAL ROUND

What does the perfect MotoGP boot donning and doffing system look like?

Make the boot part of their skin

Force them to sign a contract that they can never take the boots off

Glue the boots to the rider's feet

Alter their DNA to make their lower limbs sticky when they want

Steal many BOA systems

Grow a layer of protective skin over their feet

Steal all the IP including their CAD files from other motorcycle boot brands and combine it into the best donning and doffing system



5 min

- Took an excursion to loosen up the mind for out of the box ideas
- Now select an option/direction
- What does this option suggest for the problem statement?
- What does this option make you think in relation to the problem statement?

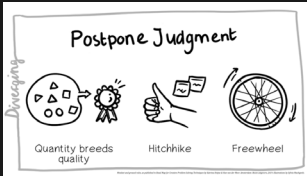
FORCE FITTING

A structure that "grows" around the feet of the riders

A perfectly fitted 3D knitted structure

Make the inner layer "stick" to the suit or the skin

Use BOA as a sponsor



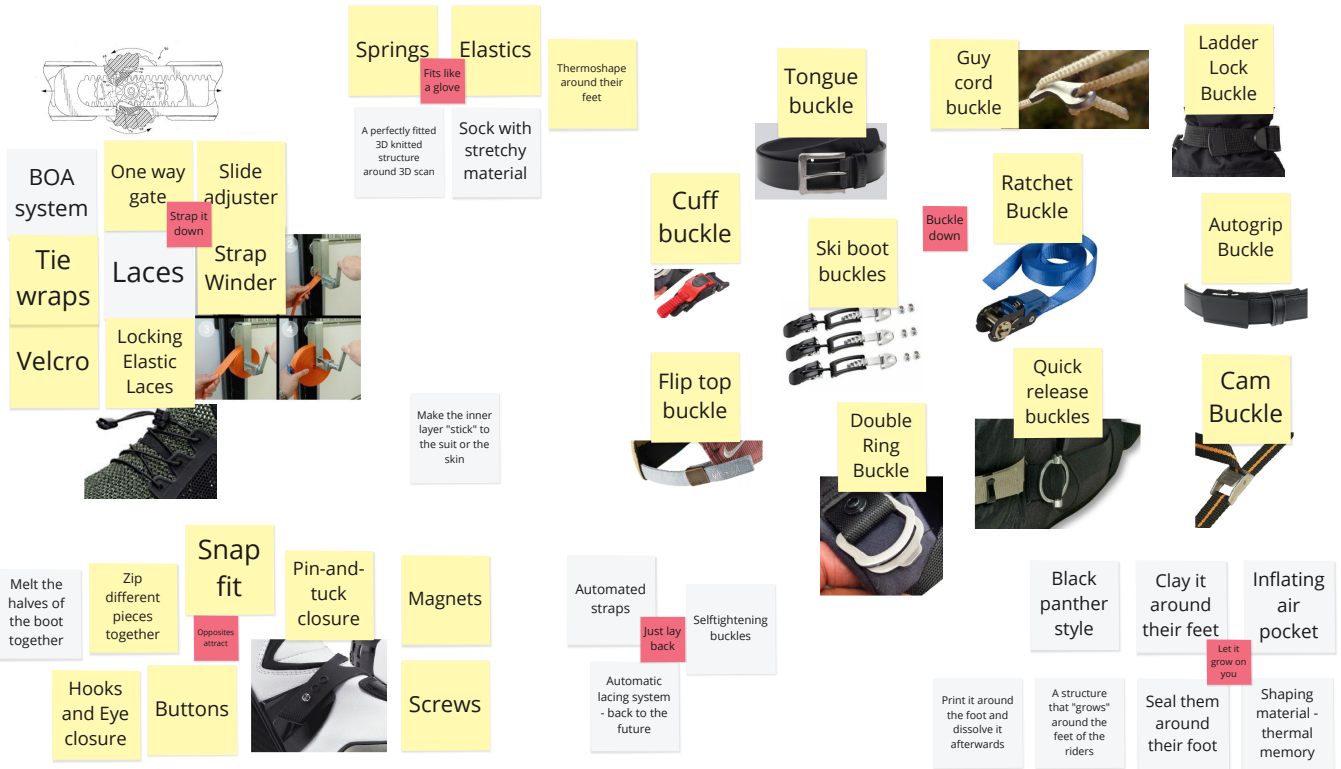
15 min

- Note down any option that comes to mind.
- One option per post-it
- Readable, concise, specific

BRAINWRITING WITH POST-ITS

Ideas from previous sections Best Ideas Clusters New ideas

What does the perfect MotoGP boot donning and doffing system look like?



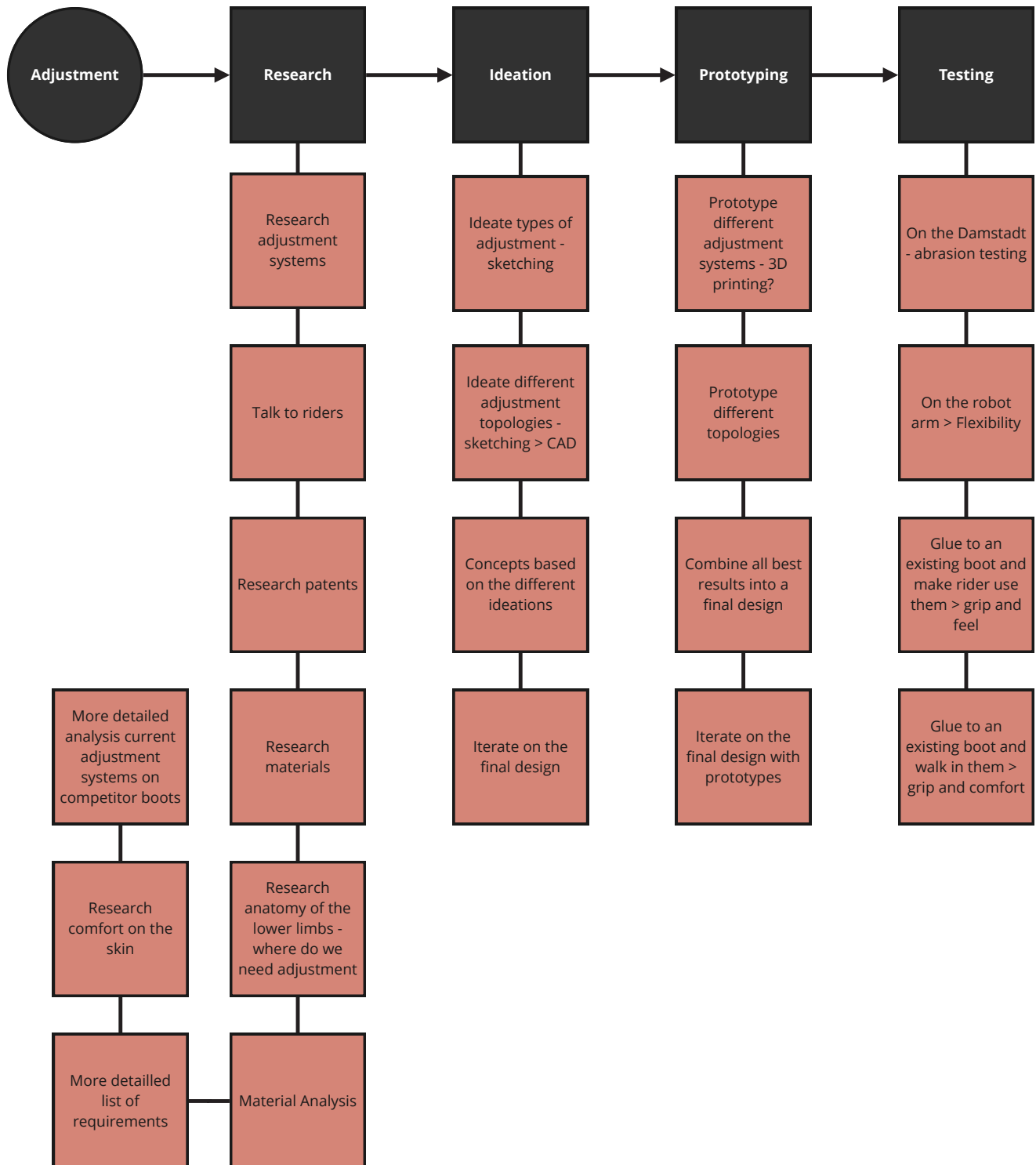
5 min

- Group similar options based on similarities of any kind (feeling & intuition)
- Name the cluster with a catchy and metaphorical title (with a verb)

SPONTANEOUS CLUSTERING



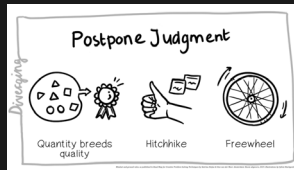
Expected Following Process



PROBLEM FINDING - ANKLE BRACE

PROBLEM STATEMENT

What does the ideal ankle brace of a motorcycle racing boot for the MotoGP rider look like?



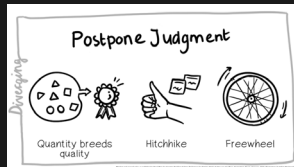
5 min



FIRST IDEAS

- Write down any statements that come to mind
- No limitations
- Readable, concise, specific

- How do we protect the ankle of a MotoGP rider from overstretching while crashing?
- How do we restrict movement?
- How do we prevent damage to the muscles and ligaments of MotoGP riders around their ankles?
- How can we allow for wanted movement while restricting unwanted movement?
- How can we provide the perfect ankle stability for MotoGP riders?
- How can we support an ankle under enormous forces?
- How can we prevent ankle injury in MotoGP riders?

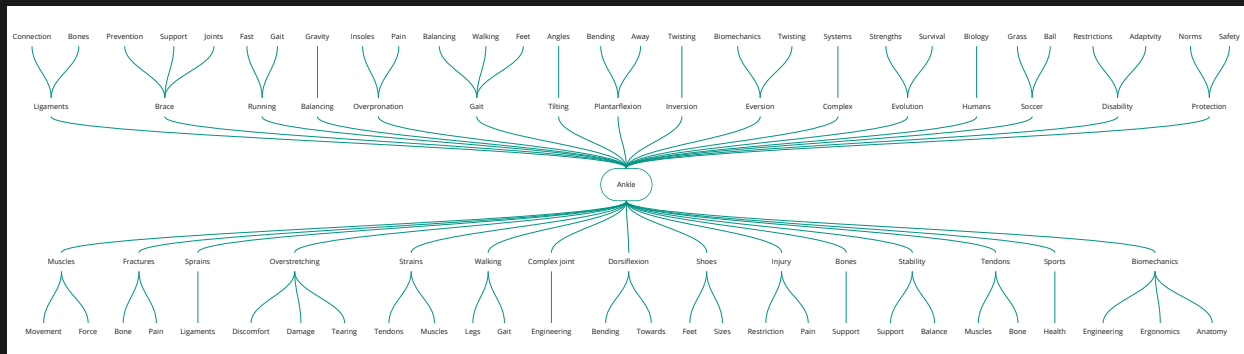


5 min



FLOWER ASSOCIATION

- What do you associate it with?
- What does it remind you of?
- What type of aspects does it consist of?



What does the ideal ankle brace of a motorcycle racing boot for the MotoGP rider look like?



10 min

SPARKING

- SPARK the PAG to create the PAP

SPARK

SPECIFIC, ESSENCE, CONCRETE

POSITIVE: NO DENIALS AND CRITERIA

AMBITIOUS: ENERGIZING, IMAGINATIVE

RELEVANT: FEASIBLE, IMPORTANT

KEEP IT SIMPLE: EASY TO UNDERSTAND, NO JARGON, NO ABBREVIATIONS

PARTS/REQUIREMENTS

- Prevent crushing
- No pressure points on the skin
- Prevent abrasion and control around the ankle joint
- Lightweight
- Allow for walking and riding movements
- Tension coefficient

- How can we protect the ankle of a MotoGP rider during a race?
- How do we restrict damaging movement of the ankle of a MotoGP rider?
- How do we protect the ankles of MotoGP rider?
- How can we prevent injury in the ligaments and muscles surrounding the ankle of a MotoGP rider?
- What does the ideal anti-ankle-strain-and-sprain device look like for a MotoGP rider?
- How to make an ankle joint and its supporting structure survive a MotoGP crash?
- How can we prevent overstretching of a joint under great forces?
- How can we protect the ankle of a MotoGP rider during a race?

NEW PROBLEM STATEMENT

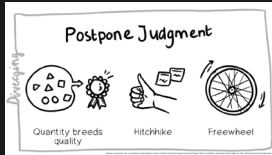
How to make an ankle joint and its supporting structure survive any MotoGP crash?



IDEA GENERATION - ANKLE BRACE

PROBLEM STATEMENT

How to make an ankle joint and its supporting structure survive any MotoGP crash?



5 min

- Write down any solution that comes to mind
- No limitations
- Readable, concise, specific

FIRST IDEAS

Airbag that stiffens on impact

Carbon fiber lay up that bends in a specific direction

Tape it like you would with an ankle injury

Wires

Exo-L

Wear an ankle brace inside

Operate and put a structure between the bones

Bar-linkage

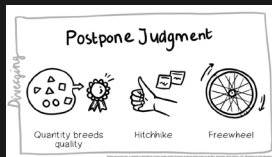
Put on ski boots

Special 3D printed structure

Gears

Springs and dampers

Blockage of the hinge system during a crash



10 min



- Note down any criminal/illegal idea that will put you in jail

CRIMINAL ROUND

How to make an ankle joint and its supporting structure survive any MotoGP crash?

Operate and strengthen the ligaments and tendons

Operate and replace the ligaments and tendons by stronger materials

Steal money to afford the required surgery

Cut off their feet and replace them by a prothesis

Lock up anyone that doesn't have the right ankles for racing - natural selection

Breed the perfect ankle joint in a lab

Sabotage all the other rider so that the riders can take it slow and not risk ankle injury

Eliminate the people that get an ankle injury from the race so that the riders will come up with their own solutions

Remove the ankle joint and replace it by a mechanical system that can withstand the forces

Start a drugs lab that sells drugs that strengthen ankles - ankle doping

Constantly spike the riders with pain killers so they won't feel the injury

Cut off their lower legs whenever they get an injury and keep on replacing it by donor legs

A shocking device that stiffens the muscles for impact



5 min

FORCE FITTING

- Took an excursion to loosen up the mind for out of the box ideas
- Now select an option/direction
- What does this option suggest for the problem statement?
- What does this option make you think in relation to the problem statement?

A structure that supports/strengthen the ankle joint in its capabilities

A mechanical structure - linkage system

A structure with sensors to detect when it's necessary to interfere (active system)

A piece of material in the right places that acts as a brake in certain directions (passive system)

External "ligaments" and "muscles"

My thought: The ankle joint is well engineered but isn't equipped for the impact of a crash and should be supported or strengthened



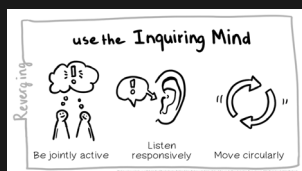
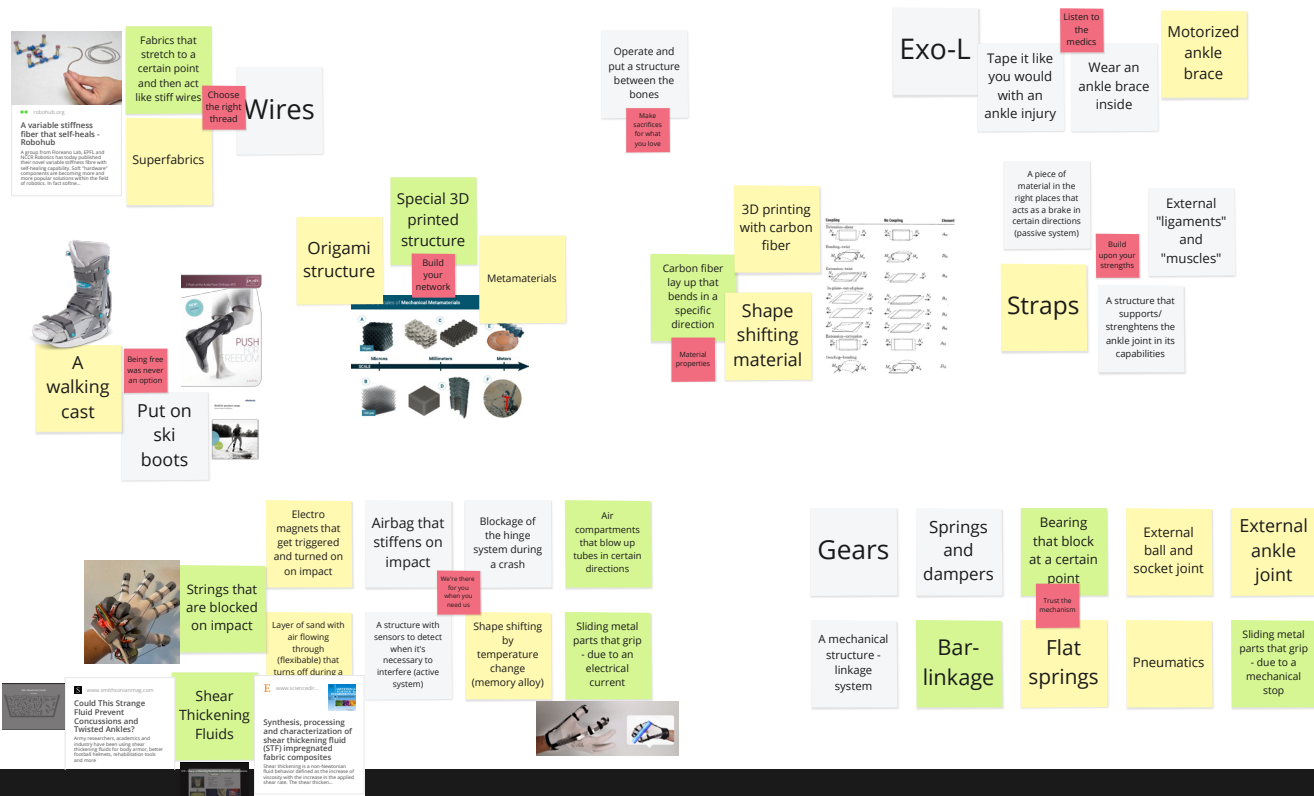
15 min

BRAINWRITING WITH POST-ITS

- Note down any option that comes to mind.
- One option per post-it
- Readable, concise, specific

Ideas from previous sections **Best Ideas** **Clusters** **New Ideas**

How to make an ankle joint and its supporting structure survive any MotoGP crash?



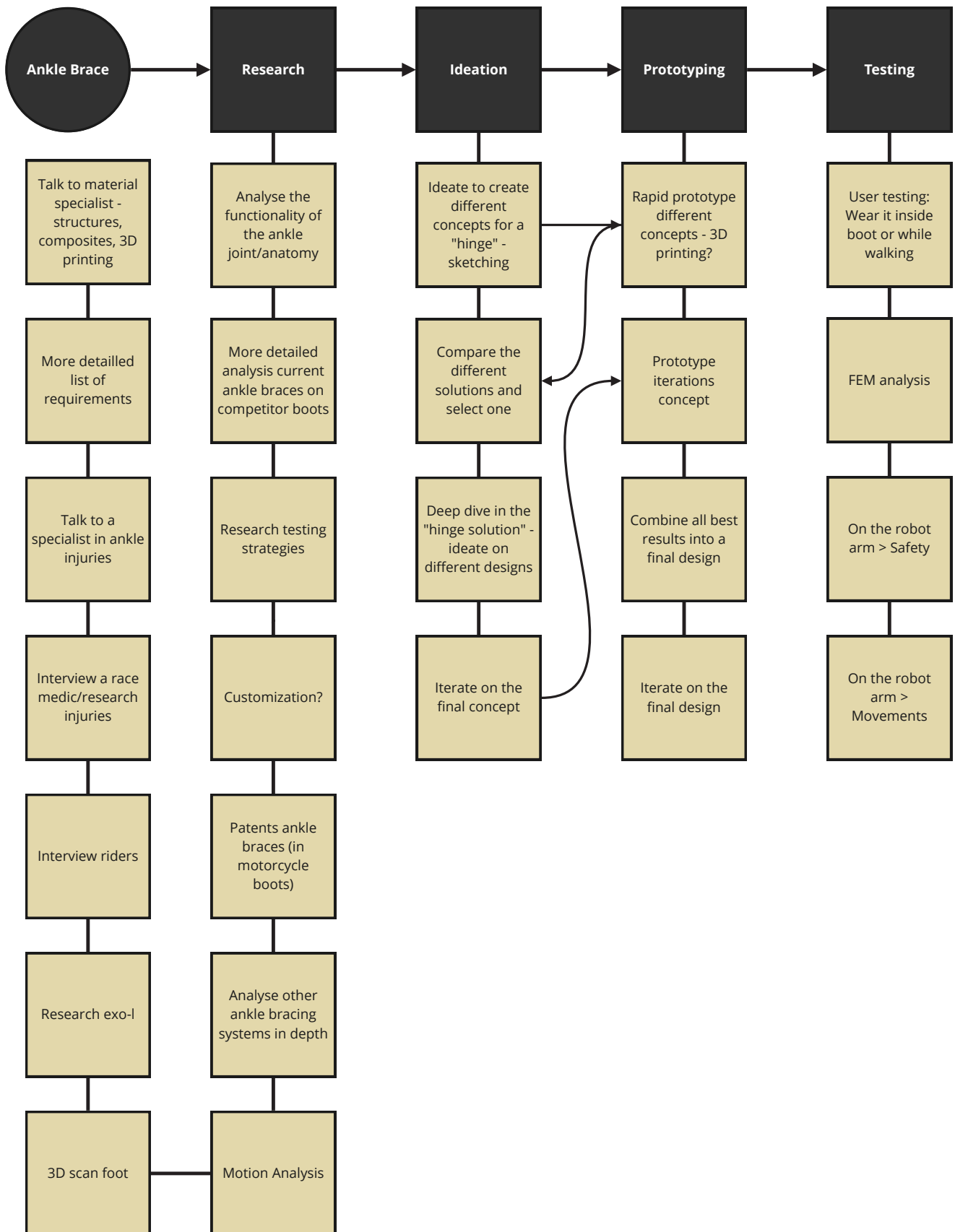
5 min

SPONTANEOUS CLUSTERING

- Group similar options based on similarities of any kind (feeling & intuition)
- Name the cluster with a catchy and metaphorical title (with a verb)



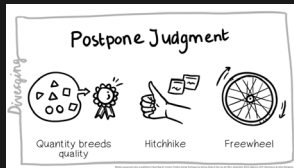
Expected Following Process



PROBLEM FINDING - OUTER SOLE

PROBLEM STATEMENT

What does the ideal outer sole of a motorcycle racing boot for the MotoGP rider look like?



5 min



FIRST IDEAS

- Write down any statements that come to mind
- No limitations
- Readable, concise, specific

How do we provide the MotoGP rider with the perfect grip?

How can we make sure the rider doesn't slide of their foot pegs?

How can we prevent the outer sole of the MotoGP rider boot from wearing?

How can we match the functionality of the sole with the wishes of the MotoGP rider?

How do we create the perfect balance between the wear and the grip of the outer sole of the boot of a MotoGP rider?

Design the best outer sole for a MotoGP rider boot.

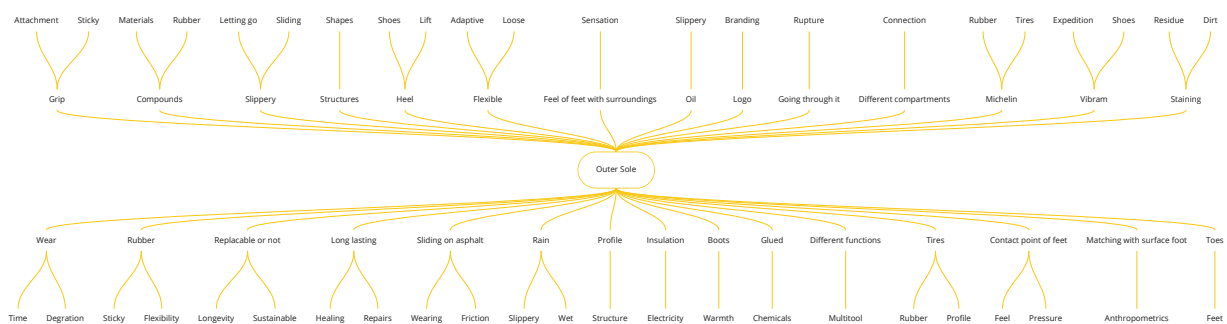


5 min

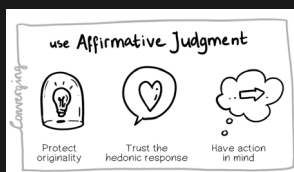


FLOWER ASSOCIATION

- What do you associate it with?
- What does it remind you of?
- What type of aspects does it consist of?



What does the ideal outer sole of a motorcycle racing boot for the MotoGP rider look like?



10 min

SPARKING

- SPARK the PAG to create the PAP

SPARK

Specific: Essence, concrete

Positive: no denials nor criteria

Ambitious: energizing, immersive

Relevant: feasible, important

Keep it simple: easy to understand, no jargon, no abbreviations

PARTS/REQUIREMENTS

MotoGP rider	Motorcycle boots	Outer Sole	Perfect grip with motorcycle and road	Sliding when crashing and putting feet to the ground	Longlasting	Feel with the bike	Not reacting in the movement of the foot	Not heating up through friction
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How do we provide the MotoGP rider with the perfect grip?	How can we make sure the rider doesn't slide of their foot pegs?	How can we prevent the outer sole of the MotoGP rider boot from wearing?	How can we match the functionality of the sole with the wishes of the MotoGP rider?	How do we create the perfect balance between the wear and the grip of the outer sole of the boot of a MotoGP rider?	Design the best outer sole for a MotoGP rider boot.
---	--	--	---	---	---

How can we create the perfect connection between the bottom of the foot of a MotoGP rider and their motorcycle?	What does the ideal connection between the sole of a MotoGP rider and their surroundings look like?	How can we create the perfect connection between sole of a MotoGP rider and their motorcycle?	How can we create the perfect connection between sole of a MotoGP rider and their surroundings?
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NEW PROBLEM STATEMENT

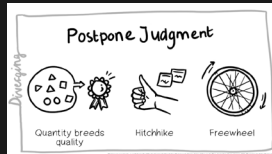
How can we create the perfect connection between the sole of a MotoGP rider and their surroundings?



IDEA GENERATION - OUTER SOLE

PROBLEM STATEMENT

How can we create the perfect connection between the sole of a MotoGP rider and their surroundings?



5 min

- Write down any solution that comes to mind
- No limitations
- Readable, concise, specific

FIRST IDEAS

Hovering shoes

Suction cups

Glue underneath the sole

Magnetic sole

Shapeshifting material - sometimes grippy sometimes sliding

Special rubber compounds at the perfect spot

All kinds of special rubber structures/textures

Gecko feet

Composite of different materials 2k moulding

Combination of attracting and repelling pieces

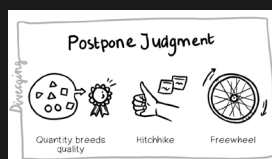
Spider web

Sole with the pegs carved out - shaped to motorcycle

Play-doh/clay

Shapeshifting material

Pins that come out to change the shape of the surface



10 min



- Note down any criminal/illegal idea that will put you in jail

CRIMINAL ROUND

How can we create the perfect connection between the sole of a MotoGP rider and their surroundings?

Replace the feet of the riders with robot feet that can make a mechanical connection with the bike

Replace feet with replaceable (in case of crash) soft robotics

Breed the largest gecko feet with all protective features inside to replace the feet of riders, so that they can ride barefoot

Create a drug that makes the riders very aware of their surroundings and the feeling in their feet - for the perfect feel

Steal information from all the known outer sole makers to figure out the best designs

Blackmail the designers of all outer sole production companies to design the perfect one for racing boots

Steal old tires to melt them into new soles

Alter the DNA of the riders to have the perfect foot soles, so that they won't need an extra external layer



5 min

- Took an excursion to loosen up the mind for out of the box ideas
- Now select an option/direction
- What does this option suggest for the problem statement?
- What does this option make you think in relation to the problem statement?

FORCE FITTING

My thought: the perfect connection provides sliding and gripping properties at the same time while providing feedback of the surroundings to the rider, that lasts at least a race

A gecko sole

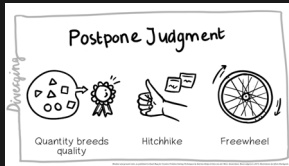
An outer sole that is shaped according to the bike of the rider (cut outs for foot pegs, angled surfaces, sliding piece where they touch the ground) (customizable)

A high-tech material that provides all properties

A normal rubber sticky sole that has an appearing protective layer once the sliding is necessary

A "living" outer sole material that adapts to the needs of the rider (different properties in different zones)

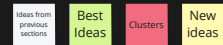
A sliding material that comes out of the sole when it's triggered by the heat of the friction



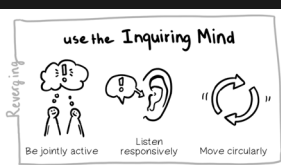
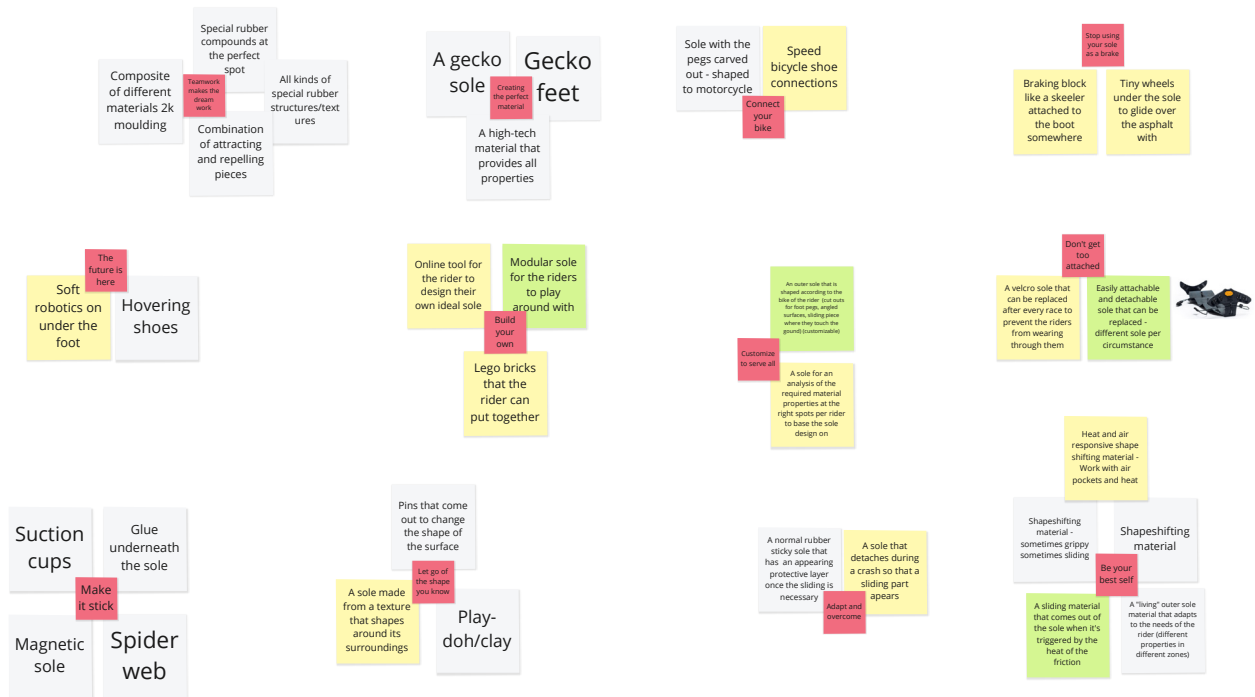
15 min

BRAINWRITING WITH POST-ITS

- Note down any option that comes to mind.
- One option per post-it
- Readable, concise, specific



How can we create the perfect connection between the sole of a MotoGP rider and their surroundings?

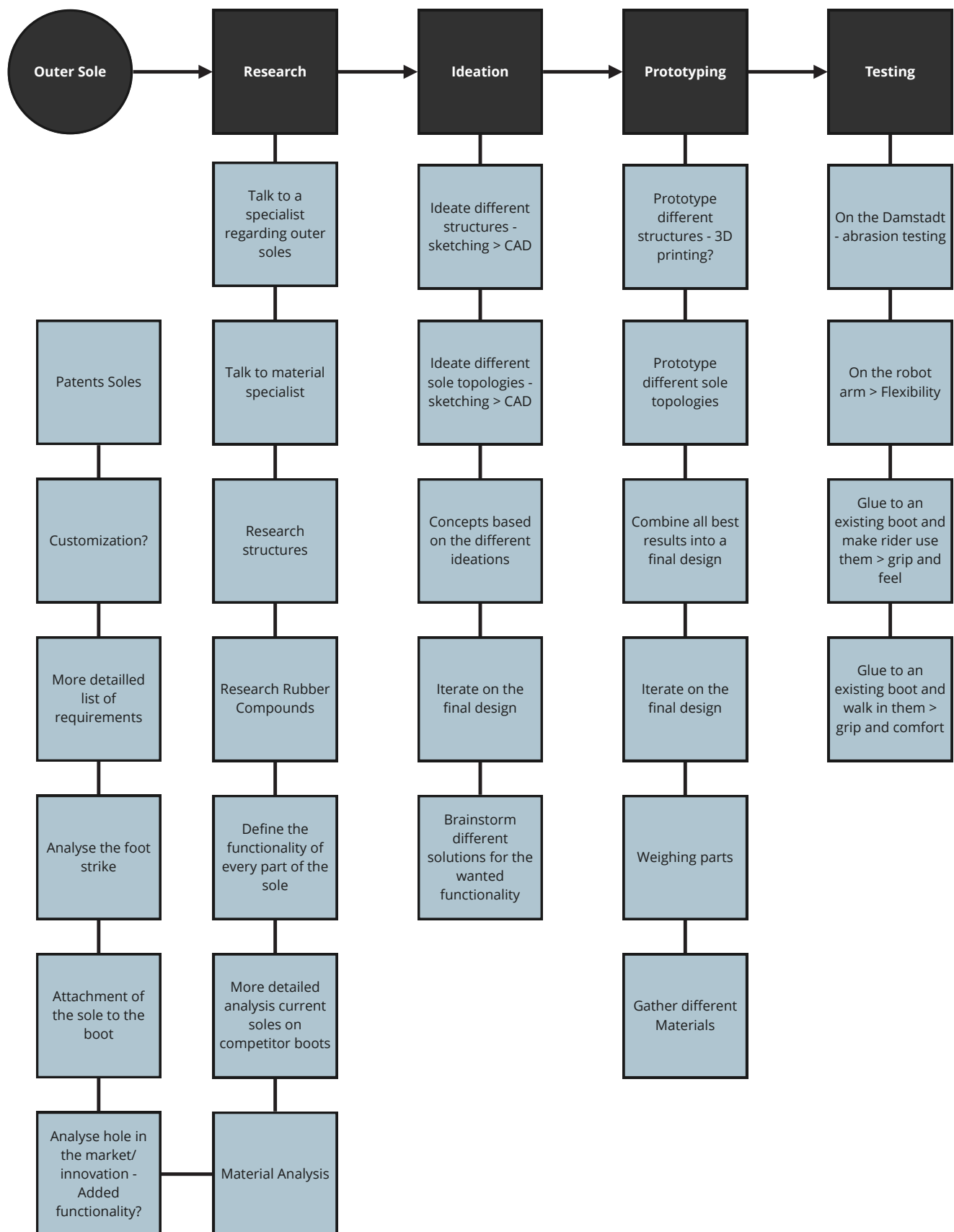


5 min

SPONTANEOUS CLUSTERING

- Group similar options based on similarities of any kind (feeling & intuition)
- Name the cluster with a catchy and metaphorical title (with a verb)

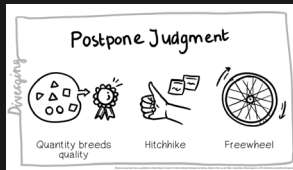
Expected Following Process



PROBLEM FINDING - TEMPERATURE

PROBLEM STATEMENT

How do we protect the feet of the MotoGP rider against the heat of their motorcycle?



5 min



- Write down any statements that come to mind
- No limitations
- Readable, concise, specific

FIRST IDEAS

How do we protect the feet of MotoGP riders from burns?

How can we keep the temperature of MotoGP boots at an ideal level?

How do we protect the feet of MotoGP riders from discomfort caused by overheating?

How do we cool the feet of MotoGP riders?

How do we keep the feet of MotoGP riders cool whilst not compromising their safety?

How do we keep the feet of MotoGP riders cool?

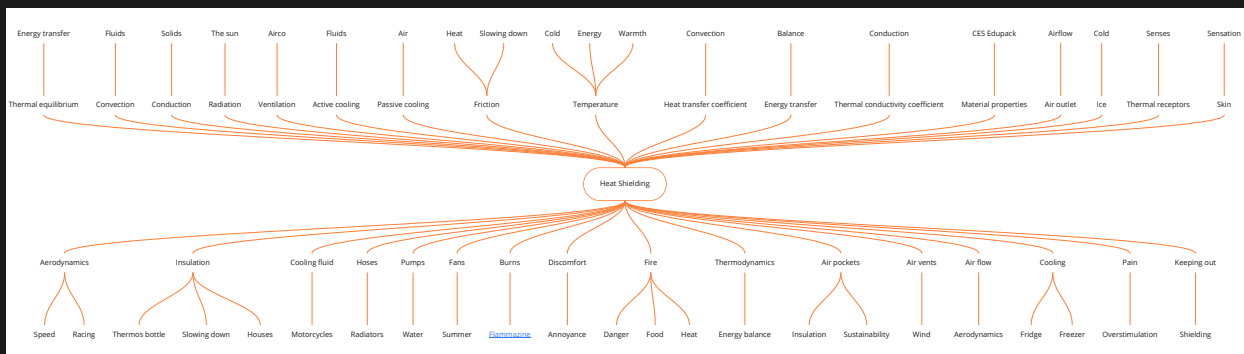


5 min



- What do you associate it with?
- What does it remind you of?
- What type of aspects does it consist of?

FLOWER ASSOCIATION



How do we protect the feet of the MotoGP rider against the heat of their motorcycle?



10 min

SPARKING

- SPARK the PAG to create the PAP

SPARK

SPECIFIC, ESSENCE, CONCRETE

POSITIVE: NO DENIALS, NO CRITERIA

AMBITIOUS: ENERGIZING, IMMERISVE

RELEVANT: FEASIBLE, IMPORTANT

KEEP IT SIMPLE: EASY TO UNDERSTAND, NO JARGON, NO ABBREVIATIONS

PARTS/REQUIREMENTS



How do we keep the heat out of the boots of MotoGP riders?

How do we keep the heat from reaching the feet of MotoGP riders?

How do we keep the heat out of the feet of MotoGP riders?

How do we protect the feet of MotoGP riders from the heat?

How do we create the perfect barrier between the hot surroundings and the feet of MotoGP riders?

How do we create the perfect temperature around the foot of a MotoGP rider?

How do we make the temperature of the feet unnoticeable for a MotoGP rider?

How do we make MotoGP riders unaware of temperature of their feet?

NEW PROBLEM STATEMENT

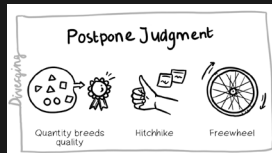
How do we make MotoGP riders unaware of temperature of their feet?



IDEA GENERATION - TEMPERATURE

PROBLEM STATEMENT

How do we make MotoGP riders unaware of temperature of their feet?



5 min

- Write down any solution that comes to mind
- No limitations
- Readable, concise, specific

FIRST IDEAS

Cooling sole with thermostat	Fan with ice on the front of the shoes	Air bubble between materials	Super insulation material	Super heat shield	Putting the boots in the freezer before racing	Thickest boots ever
Completely perforated boot	Leaf blower in front	Aerogel layer	Fridge system	Airco	Layer of ice inside the boot	Fireman clothing socks



10 min



- Note down any criminal/illegal idea that will put you in jail

CRIMINAL ROUND

How do we make MotoGP riders unaware of temperature of their feet?

Hack the producer of the best insulating material to steal their info	Steal NASA IP about insulating materials	Shoot clouds into the sky to make the area really cold	Steal the boots of firemen	Steal the boots of astronauts	Freeze or burn the feet of the riders beforehand	Blackmail the organizers of the events to have the races in colder climates
Blackmail the engineers working on the bike to have the bikes be designed in such a way that they don't burn the feet of riders	Breed thermal resistant people to race	Numb the heat receptors in the skin of the riders with drugs	Force the riders to cut off the nerves connected to the heat receptors in their skin			



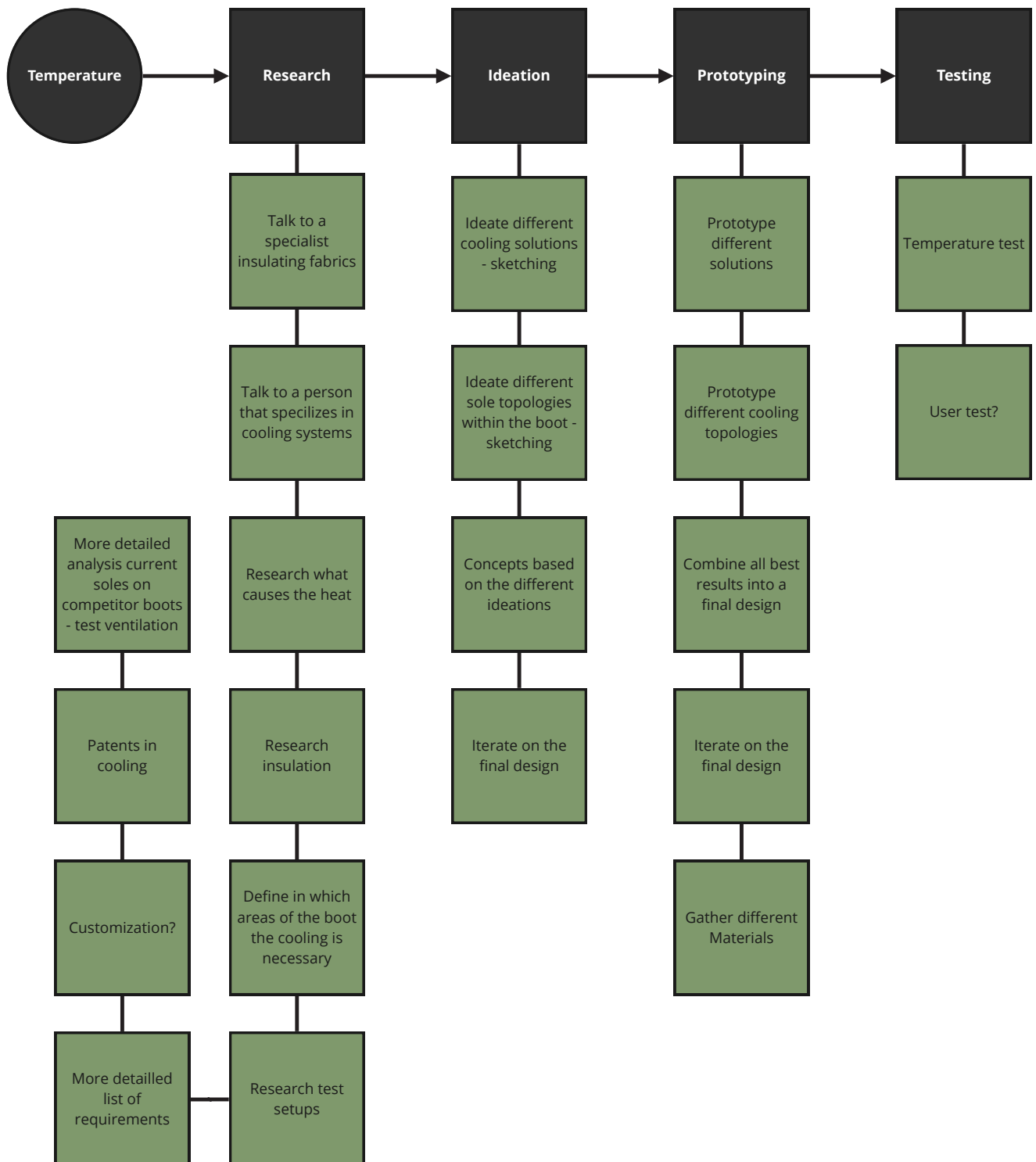
5 min

- Took an excursion to loosen up the mind for out of the box ideas
- Now select an option/direction
- What does this option suggest for the problem statement?
- What does this option make you think in relation to the problem statement?

FORCE FITTING

My thought: making them unaware would mean a perfect temperature, so a perfect protection against heat build up	Perfect insulating boot material	Cooling fabric around the feet - mint?	Better bike designs keeping the temperature of the feet in mind	Changing surroundings - Adapting system with sensors or a thermostat for measuring the temperatures and adapting its strategy	Promoting the natural ability of the body to keep itself cool - breathability & sweat
---	----------------------------------	--	---	---	---

Expected Following Process



APPENDIX 9. INTERVIEW RACING SERVICE COÖRDINATOR REV'IT!

See Confidential Appendix



APPENDIX 10. INTERVIEW PRODUCT EXPERT MKC MOTO [DUTCH]

'Wij zijn verkopers, geen ontwikkelaars, maar hebben wel de nodige kennis'

De eerste motorrijlaarzen waren paardrijlaarzen van leer zonder bescherming; alleen een slijtvaste buitenlaag en geen protectie die rekening hield met de houding van de voet, gewoon rechtoe, rechtaan. De laatste jaren is er steeds verder ontwikkeld en de enkelbrace is een van de nieuwste innovaties die high-end-merken in de racerij tegenwoordig hebben. Alpinestars is daar oorspronkelijk mee begonnen en is qua laarzen een van de meest ervaren fabrikanten wat dat betreft. Andere fabrikanten zijn daar min of meer in gevolgd. Dainese heeft heel veel zelf ontwikkeld en die kijken heel erg naar wat er in de natuur gebeurt. Wij hebben niet echt een voorbeeld van wat ze daarin hebben bedacht, maar bij de samenstelling van de rugprotectoren gebruiken ze wel een beetje de honingraatstructuur zoals je die in de natuur ziet en van planten of de bladeren. Op die manier kijken ze van de natuur af wat goede samenstellingen of structuren zijn om te kunnen toepassen in producten. Dainese is de enige die een in-suit laars hebben, de rest heeft dat niet. Dainese heeft dat daadwerkelijk ontwikkeld en ze hebben er echt geloof in dat dat goed functioneert. Daar maken ze echt een verschil mee. Het is goed te merken in gewicht en het geeft veel minder bulk. Het is een glad ontwerp dat in de broekspijp komt en daardoor is er veel minder materiaal, eigenlijk externe bulk dat ook weer ergens achter kan blijven hangen of wat ook. Dat is in de racerij van belang. Als je gaat glijden, moet je blijven glijden en dus niet dat er iets op je weg komt waardoor je in het asfalt 'hapt' en meer kans op letsel hebt dan als je doorglijdt en als het ware van het asfalt afglijdt. Naast dit doorglijden is ook de flexibiliteit een voordeel. Het is een hele compacte laars met heel veel gevoel met de motor en dan ook nog de zitpositie waarvan je weet dat die goed is.

Waarom heeft Alpinestars dan nog het oude systeem? Hun laars is onlangs herontwikkeld, dat is voornamelijk een update geweest in het design. Het eerdere design stamt uit 2015 en daar hebben ze de afgelopen jaren weinig mee gedaan. Ik denk dat een bepaalde traditie die Alpinestars er altijd in heeft. Het zijn Italianen en die zijn altijd een beetje trots op wat ze op de markt brengen en daar hebben ze allemaal hun eigen beeld bij. De laars van Alpinestars heeft een andere samenstelling dan zo'n Axial maar biedt ook uitstekende bescherming. Alleen heeft Dainese iets gedaan, dit is voor hen de ultieme laars, goed gewicht, minder bulk aan het been en het is zo dat de enkelbrace van Dainese direct op de enkel wordt geplaatst zonder dat er veel materiaal tussen zit. Bij Alpinestars is dat minder; je hebt een binnenlaars die uitneembaar is en aan de buitenkant daarvan zit de enkelbrace. Die is aan de buitenkant niet zozeer zichtbaar. Deze zal van thermoplastic of TPU zijn, waarbij die van Dainese is gemaakt van carbon en dat scheelt gewicht.

Bij Dainese is het ook vaak zo dat hun pakken zijn voorzien van klittenband aan de binnenkant en is het dus echt een samenspel van pak en laars. Bij Alpinestars heeft de laars een harde scheenbeenprotector. Bij Dainese is dat niet het geval en is de laars veel korter, minder richting het scheenbeen of daar net iets onder en gebruiken ze iets langere protectoren op de knieën van de racepakken. Omdat die al zo ver doorlopen wordt de scheenbeenprotector opgevangen door het kniestuk in het pak. Dus uiteindelijk komen ze dan op hetzelfde neer als bij Alpinestars op het moment dat je alles samenstelt. Dat zie je over het algemeen wel terug in de hele collectie als je niet alleen naar de laars kijkt, maar naar alle producten in de racerij, dat Dainese daar net iets geavanceerder mee omgaat dan Alpinestars en iets creatiefs op technisch vlak heeft bedacht.

Bij Sidi zie je inderdaad dat de constructie meer naar de buitenkant gaat, terwijl je zo'n constructie zo dicht mogelijk op je enkel wil hebben zodat er zo minimaal mogelijke ruimte ontstaat om te bewegen op een manier die je eigenlijk niet wil. Op het moment dat je het op de buitenkant plaatst, zitten er nog wat lagen stof tussen en heb je minder contact en dus meer kans op beweging. Dat kan inderdaad obstructies veroorzaken en dat is een van de grote

redenen van die Axial dat alles zo geplaatst is dat alles in de broek verdwijnt, zodat bijvoorbeeld niet met je straps achter je motor blijft haken. Dat kan daar allemaal aan bijdragen.

Dainese is in die markt gestapt, geldt dat ook voor andere merken? Ik weet niet precies de tijdslijn, maar je hebt natuurlijk merken van oudsher die je zelf al hebt genoemd. Dainese, Alpinestars, TCX en Sidi zijn ook een van de grondleggers. TCX dat vroeger XPD heette en uiteindelijk tot een merk is samengevoegd. En dan nog kleinere motormerken zoals Stylmartin en ook nog in Engeland iets. Dan heb je denk ik wel het grootste gedeelte gehad van de laarzen en de fabrikanten die het meest in de ontwikkeling ervan stoppen en voor jou het meest interessant zijn. Op het circuit zie je Dainese, Alpinestars en TCX ook wel, is ook afhankelijk van de sponsors. Als je een Alpinestars pak draagt, draag je ook de laarzen en dat geldt hetzelfde bij Dainese. Maar er zijn ook merken als REV'IT! die je op het circuit ziet en die hebben geen eigen laarzen en dan zie je vaak dat er of een Sidi of een TCX wordt gedragen.

In het topsegment is er dus niet heel veel keuze, omdat je veel in de ontwikkeling moet stoppen en er dan dus veel budget gaat in een relatief kleine markt. Je ziet bij ons ook in de verkoop aan consumenten dat het minimaal is wat we aan racelaarzen verkopen. Het zijn voornamelijk sportlaarzen die daarvan afgeleid zijn of touringlaarzen voor dagelijks verkeer naar je werk of voor professionals die bij de motorpolitie zitten of dat soort zaken. Daarom zit er ook zo lang tussen de verschillende versies, soms 6 of 8 jaar. Het is puur op de racerij gericht, maar de laars die op het circuit wordt gedragen wordt bij ons 1-op-1 aan de consument verkocht. Dat geldt voor alle merken. Het is een identieke laars, waarbij materialen of technieken om laarzen beter of veiliger te maken in het topmodel naar de betaalbare modellen worden doorgesluisd, eventueel op een lichtere, kleinere of compactere manier, zodat bijvoorbeeld een enkelbrace op een andere manier wordt opgebouwd, maar wel dezelfde werking heeft. Dat is voor hen in hun productontwikkeling van groot belang, dat ze alles wat ze in de motorracerij en de GP ontwikkelen ook in andere producten kunnen toepassen, of het nu gaat om sportlaarzen of laarzen voor dagelijks gebruik. Er valt verder vrij weinig te ontwikkelen. Er worden steeds ontwikkelingen gedaan die ook daadwerkelijk weggezet moeten worden, om het commercieel interessant te maken moet het product dat je ontwikkelt wel een bepaalde levenscyclus hebben van een aantal jaren. Als je dat maar twee jaar kunt verkopen rendeert het niet, dat doet het wel als je het 6 jaar kunt verkopen. Juist met zo'n investering in de racerij. Het is wel een redelijk traditionele markt, die niet echt openstaat voor veel innovatie. Bij de Alpinestars uit 2015 of uit 2009 zijn geen grote aanpassingen gedaan en dat geeft aan dat er op dat vlak niet zo heel veel innovatie wordt toegepast.

Een van de nieuwste innovaties van de afgelopen jaren zijn de Airbagsystemen voor de rijder zelf die standalone werken. Buiten dat zie je wel nieuwe technologieën qua materialen ontstaan maar geen totaal nieuwe innovaties waarvan je denkt dat ze schokkende wijzigingen zijn. Er wordt grotendeels en vooral voortgeborduurd op wat er al was en dat wordt met hele kleine stapjes verbeterd. Mensen zijn vaak ook niet klaar voor veel heftigere dingen en dat kan ook hier het geval zijn. Je ziet dat de consumenten naar bekende samenstellingen of producten vragen en bij nieuwe innovaties niet direct bereid zijn daarvoor te gaan. Als iets al bewezen goed is, waarom zou je dat dan veranderen?

In de racerij ontwikkelde innovatie gaat door naar de consumentenmarkt, dat zag je met racelaarzen en airbagsystemen die voor consumenten beschikbaar komen, dus ontwikkelingen op het circuit vinden hun weg naar de consument. De racerij, MotoGP of WSBK zijn de proeftuin voor de consumentenproducten.

Wat zijn belangrijke factoren in de keuze van de consument? Als je dat toespitst op de racerij, dan zijn het vooral pasvorm en het gevoel van bescherming. Dus ze kopen als ze gaan racen eerder een stuggere laars omdat dat veiliger voelt dan een laars die misschien veiliger is maar wat comfortabeler of flexibeler voelt.

De Axial D1 scoort qua CE-keuring lager dan Supertech en Sidi's terwijl mensen in de reviews aangeven dat die superveilig zijn. Hoe kan dat? Ik weet niet exact hoe die keuring specifiek op laarzen gaat. Maar ik kan me ook voorstellen dat Supertech die wat meer versteviging heeft op het scheenbeen, dat dat onderdelen zijn die ze meenemen in de test, maar dat de Axial daar zelfstandig niet zo heel goed op scoort omdat die dan geen bescherming heeft, maar combineer je hem met het pak zoals je zou moeten doen dan wordt dat opgeheven, dus dan biedt deze laars wel de juiste bescherming. Ik kan me indenken dat het daarmee te maken heeft.

Maar de consument kijkt niet zozeer naar de normering, zeker niet de gemiddelde consument en dat geldt ook voor de racerij, dat mensen niet zo heel veel affiniteit hebben met de bekleding of wat het ook is dat hen beschermt, als het maar goed beschermt waarvoor ze het kopen en dat het comfortabel zit. Dat geldt ook voor andere professionals. Als je een motoragent vraagt wat hij op zijn hoofd heeft, dan wat hij dat ook vaak niet en die heeft de helm de hele dag op zijn hoofd. Mensen hebben gewoon affiniteit met het product.

Veiliger betekent een stuggere laars, maar dat is wel afhankelijk van het type rijder. Iemand die sportief motor wil rijden op de straat zal een sportief ogende laars die comfortabel zit kopen. Mensen die voor het eerst in de winkel komen, zijn gewend om sneakers te dragen. Als die zo'n laars aantrekken hebben ze het gevoel dat ze een harnas aandoen. Dus het niveau waarop mensen binnenkomen verschilt. Buiten pasvorm en bescherming maakt het niet zoveel uit. De consumenten, de gemiddelde motorrijders, zijn niet zo bezig met welk materiaal er op de neus of in de zool zit. Ze willen een product waarvan ze het gevoel hebben dat het veilig is en dat als ze hun voet uitsteken op het asfalt ze grip hebben. Als dat zo is, is het goed en maakt de samenstelling niet uit.

Is er sprake van een identity voor Dainese of Alpinestars? Alpinestars is wat meer marketing-gedreven en zet meer in op design en veiligheid, terwijl Dainese veiligheid daadwerkelijk bovenaan heeft staan en daarna volgt design. Alpinestars is meer 'likeable', valt meer in de smaak op uiterlijk, waar Dainese het vooral van veiligheid moet hebben. Soms maakt het ook uit van wie in de racerij je fan bent. Het is vergelijkbaar met Nike en Adidas, het zijn soms twee verschillende kampen, maar er is niet echt een typische Dainese of Alpinestars persoon, dat is niet haarscherp aan te geven, zit vertroebeling in.

Wat betreft het verschil tussen laarzen in het topsegment en van lagere kwaliteit: dat kun je zo breed nemen als je wil, op allerlei verschillende facetten. Het is een totaal andere laars als je van Supertech gaat naar bijvoorbeeld een instaplaars van Alpinestars, dat is echt niet te vergelijken. Dat begint al bij de buitenzool waar een ander materiaal voor wordt gebruikt en de binnenlaars geen enkelbrace of iets van versteviging heeft. Het is de totale laars die afwijkt. De laars is wel afgeleid van het topmodel, die vind je daar wel in terug, bijvoorbeeld in de toeslider. Dus je ziet wel invloeden van het topmodel terug, maar op een heel ander niveau. Dat geldt ook voor andere merken. Dat is puur om geld te besparen. Je kunt een laars van 220 of 240 euro aanbieden, voeg je een brace toe dan komt er 100 euro bij, een binnenlaars maakt 100 euro duurder. Het gros van de mensen vindt de basis wel genoeg.

Alpinestars heeft een aparte schoen, een binnenlaars terwijl Dainese die structuur heeft vastzitten. De Axial vormt een soort binnenlaars van zichzelf omdat je die heel nauw aantrekt en je hebt dan die Torque 3's, dan is dan zeg maar wat meer vergelijkbaar met het Alpinestars model en die heeft dan wel wat meer binnenlaars die je dan ook wel kunt aantrekken, die je kunt stellen. En Alpinestars is de enige binnenlaars die echt uitneembaar is. Maar uiteindelijk is die functie wel enigszins vergelijkbaar. Bij Alpinestars ligt het voordeel erin dat de enkelbrace wat dichter op de voet, op het been zit waardoor die wat stijver kan aansluiten. Net als bij de Axials.

Of ze bij schade aan de buitenlaars de binnenlaars kunnen behouden durf ik niet te zeggen. Je ziet dat die laarzen afzonderlijk van elkaar worden aangetrokken en ze wel op een betere manier de binnenlaars afstellen en dat dat echt nauw je voet omsluit ten opzichte van de laars die eromheen vastzit. Bij Alpinestars zie je dat de hele laars geperforeerd is zodat die optimaal kan ademen.

Een hitteschild is bedoeld om de warmte van de motor buiten te houden, maar ook om op het moment dat je gaat glijden en er veel warmte vrijkomt dat je die moet zien op te vangen. Het gaat dus om een combinatie van die twee. De temperaturen die een warmteschild kan hebben variëren. Bij Alpinestars wordt Kevlar gebruikt en dat kan temperaturen rond de 700 tot 800 graden hebben.

In het pak zelf zit leer. Ook dat is goed bestand tegen hitte en slijtvast. In laarzen zijn het altijd microfibers, synthetisch leer, en daar zit een extra hitteschild in omdat microfibers minder bestand zijn tegen smelten of tegen hitte die vrijkomt. Waarom er geen microfiber in het pak zit en leer in de laars? Microfiber is bewerkelijker en stijver dan leer. Leer rekt en dat wil je niet bij je voeten hebben, daar moet het maatvast zijn. Je ziet vaak perforatie in de laars en dat moet je nauwkeuriger doen als je microfiber hebt dan bij leer. Motorrijders geven echt om die perforatie. Vooral op het parcours heb je alleen maar geperforeerde laarzen en pakken, omdat het topsport is. Je moet het in perspectief zien. Laarzen die niet geperforeerd zijn, zie je vaak toch wel terug bij mensen die op straat rijden. Iemand die op een circuit rijdt, is drie kwartier tot een uur aan het racen. Rijd je een hele dag, dan heb je een andere inspanning en warmteopname. Dus motorrijders die in Nederland rijden maken vandaar vaak de keuze voor niet geperforeerd. Ook ventilatiegaten met grote stukken leer erachter werken, want daar gaat een soort luchtkanaal doorheen, door het mesh of langs het wreefgedeelte. Bij Alpinestars hebben ze vaak een geperforeerde scheenbeenprotector en dat loopt daar doorheen, door de voering, richting de geperforeerde binnenlaars. Dat zorgt wel degelijk voor ventilatie, heeft zeker een effect. Het is een soort grote luchthapper die zorgt dat er actieve luchtstroming in de laars komt waardoor je koele voeten hebt. Mensen zeggen dat het lijkt alsof je sokken aan hebt als je rijdt met geperforeerde laarzen aan. Dus het werkt. Bij de Axial is weinig perforatie, maar ze zijn er wel in geperforeerd leer. Je hebt minder oppervlakte om perforatie toe te passen en uiteindelijk wil je een goede mix hebben van veiligheid en ventilatie. Heb je een hele open structuur, dan wordt het minder slijtvast. Dat heb je natuurlijk ook in het pak, dat loopt langer door. Je hebt dezelfde lengte. Maar meer op het been of onderbeen wat vrij toegankelijk is, dus op het onderbeen wordt wat meer perforatie toegepast. Maar er zijn geen klachten dat het bij Dainese minder goed zou ventileren. Er zijn niet echt dingen waarin Dainese of Alpinestars beter is, is Nike vs Adidas, waar geloof je in, welk merk vind je sympathieker, maar ik ga dat mijn collega vragen.

Wat is de ideale racelaars, wat zijn de designaspecten waarmee rekening moet worden gehouden? Het gaat om performance tegenover safety/protectie. Daar een optimale mix in vinden, die optimaal veilig is, maar technisch kan voldoen aan flexibiliteit om optimaal te kunnen presteren. Dat vond ik interessant aan je vragenlijst, waarom de linker- en rechterschoen identiek zijn. Dat is puur kostentechnisch, want dan hoef je maar één laars te ontwerpen en die te spiegelen. Maar je kunt je voorstellen dat het wenselijk is om af te wijken in de vorm of materialen om te zorgen dat je remvoet, je remlaars anders is opgebouwd dan de voet, de laars waarmee je schakelt om alleen daar protectie op te zetten waar je de kracht op zet. Gewicht is superbelangrijk, maar ook daar is het weer de mix van minder materiaal en veiligheid. Ik denk dat de Axial nu de meest geavanceerde laarzen zijn.

Wat betreft de toekomst verwacht ik dat er slimmere materialen komen die lichter zijn en dezelfde bescherming bieden als de huidige materialen en ook dat er materialen komen die zelfhelend zijn, die dus als er iets stuk gaat zichzelf kunnen herstellen. Airbags om de voet, daar geloof ik niet in.

Het zou goed zijn als je inzage kunt krijgen in de MotoGP; hoeveel zijn er gecrasht, bij welke laarzen, hoeveel enkels gebroken. Op het circuit kom je denk ik weinig mensen tegen die

daadwerkelijk hun voet ofzo breken. Als dat minimaal is, heb je je doel bereikt en zitten we qua safety op de juiste hoogte.

Wat nog beter kan, is de afstelling van de laars, dat die op maat gemaakt kan worden. De wens van maatwerk geldt voor de laars en de kleding. Bij Alpinestars hebben ze vaak net niet de maat die mensen hebben en het is nu heel beperkt mogelijk om iets in te stellen zodat het wel goed zit bij de binnenlaars aantrekken en de sluiting op de zijkant. Het racegebeuren is allemaal redelijk eenzijdig, als het maar snel gaat. Bij de touringlaars waarmee je op straat wil rijden, gehard, ongehard, en op weg wil kunnen landen is meer technologie nodig. Dat luistert nauwer dan een racelaars die is ontwikkeld om op hoge snelheden te beschermen.

Een enkelbrace heeft zeker effect. De enkel kan niet meer zijdelings bewegen, dus de enkel verzwikken kan niet meer, die wordt in een natuurlijke houding gehouden waarop je 'm kunt bewegen op een natuurlijke manier als je zo'n laars aantrekt. Je overbelast of forceert niets, maar de verdere beweging is eruit gehaald. Dat zie je bij elk type laars wel terug. Het is best een kleine structuur die toch zoveel voorkomt op zo'n snelheid.

Wat betreft de zolen: ze zijn allemaal hittebestendig en kunnen tegen olie en zo om grip te houden. Elke fabrikant heeft daar zijn eigen invloed op. Bij Dainese zie je dan weer de meest geavanceerde zool met verschillende typen patronen. Dat heeft te maken met de manier waarop je je voet neerzet; als je laag hangt, zet je je voet op het stepje en daar zit dan ook weer een ander patroon in om zo optimaal grip te hebben. Dat geldt ook voor de andere kant, als je volledig op je stepje staat, ook daar worden bepaalde patronen toegepast zodat als je je voet naar voren beweegt of zijdelings je optimale grip hebt. Wat dat betreft heeft Dainese de meest geavanceerde zool. Bij Dainese noemen ze dat D-Tech technologie. Bij Alpinestars hebben ze één eigen patroon op de zool, is gevulkaniseerd rubber is hittebestendig, maar er is minder onderscheid gemaakt op welke manier je je voet neerzet, welke toepassing en wat dan het beste is. Materialen die zachter zijn, slijten sneller, maar bieden wel meer grip. Maar mensen kijken daar niet naar. Ze vinden Dainese het mooist om hoe erover is nagedacht in de verschillende situaties en de manier waarop je de laars kunt neerzetten. Maar als je dat niet hebt of er geen last van hebt, dan letten mensen daar niet op.

De sliders zien er verschillend uit. Bij Dainese hebben ze een lange toeslider die helemaal naar de voorkant gaat en nog iets kleins op de enkel. Je hebt aan beide kanten van de enkels ook nog wel een slider. Doel is om zo min mogelijk wrijving te creëren zodat als je gaat glijden, je blijft glijden en je daardoor minder impact op je voet hebt. De energie moet er zo vanaf worden geleid en dat zie je bij elke laars wel terug. Altijd van metaal, titanium, aluminium of magnesium. Bij Dainese zijn ze overgegaan van titanium naar aluminium. De prestaties zijn hetzelfde, maar het is prijstechnisch interessanter. Magnesium heeft een hoger smeltpunt. Het is voor als je gaat glijden op de weg, bij crashen, bij voet te ver van het pedaal of stepje, dat je laars niet in het asfalt hapt maar er overheen glijdt. Vandaar dat ze ook altijd afneembaar zijn zodat je ze bij slijtage kunt vervangen. Ze zitten op de enkel en hiel zodat ze zo min mogelijk weerstand geven.

Na een crash is het goed kijken naar de staat van de laars aan de buitenkant. Bij Dainese gaat het ook om de staat van het carbon. Dat is heel stijf en daardoor enigszins kwetsbaar. Het is afhankelijk van hoe je crasht, maar in het algemeen valt de schade aan een laars na een crash mee en kan je deze weer gebruiken. Het kan zijn dat een coureur zijn eigen voorkeuren heeft en een slider weghaalt of vervangt door een stukje plastic.

Het is een hele bijzondere wereld.

De manier van aantrekken van een laars is per persoon verschillend. Heb je een hoge wreef, dan is het fijn om de laars iets te kunnen stellen. Sidi heeft veel buckles en die laars valt vaak wat smaller. Het is maar net hoe je qua voet zit. Smalle of brede voet, hoge of lage wreef; het

heeft invloed op je keuze. Als je een productconcept hebt waarbij je dat soort variabelen kunt tackelen, door ze verstelbaar te maken, dan heb je wel een plus.

APPENDIX 11. CRASH ANALYSIS

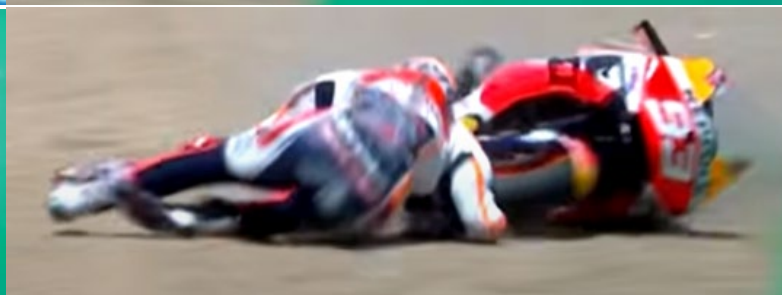


A small crash analysis was done to investigate the need for the toe and heel box and sliders. On top of that, it was useful to see whether any more protection is needed in certain areas and what would be a good location for the closure system (as keeping this out of the abrasion zone is ideal for the longevity of the boot). For this analysis screenshots were taken of the video “Top 10 Crashes of the Decade.” (MotoGP, 2022). The number of crashes was limited to six as this already provided some useful insights and the analysis was mainly done to confirm other findings.

Results

Crash 1



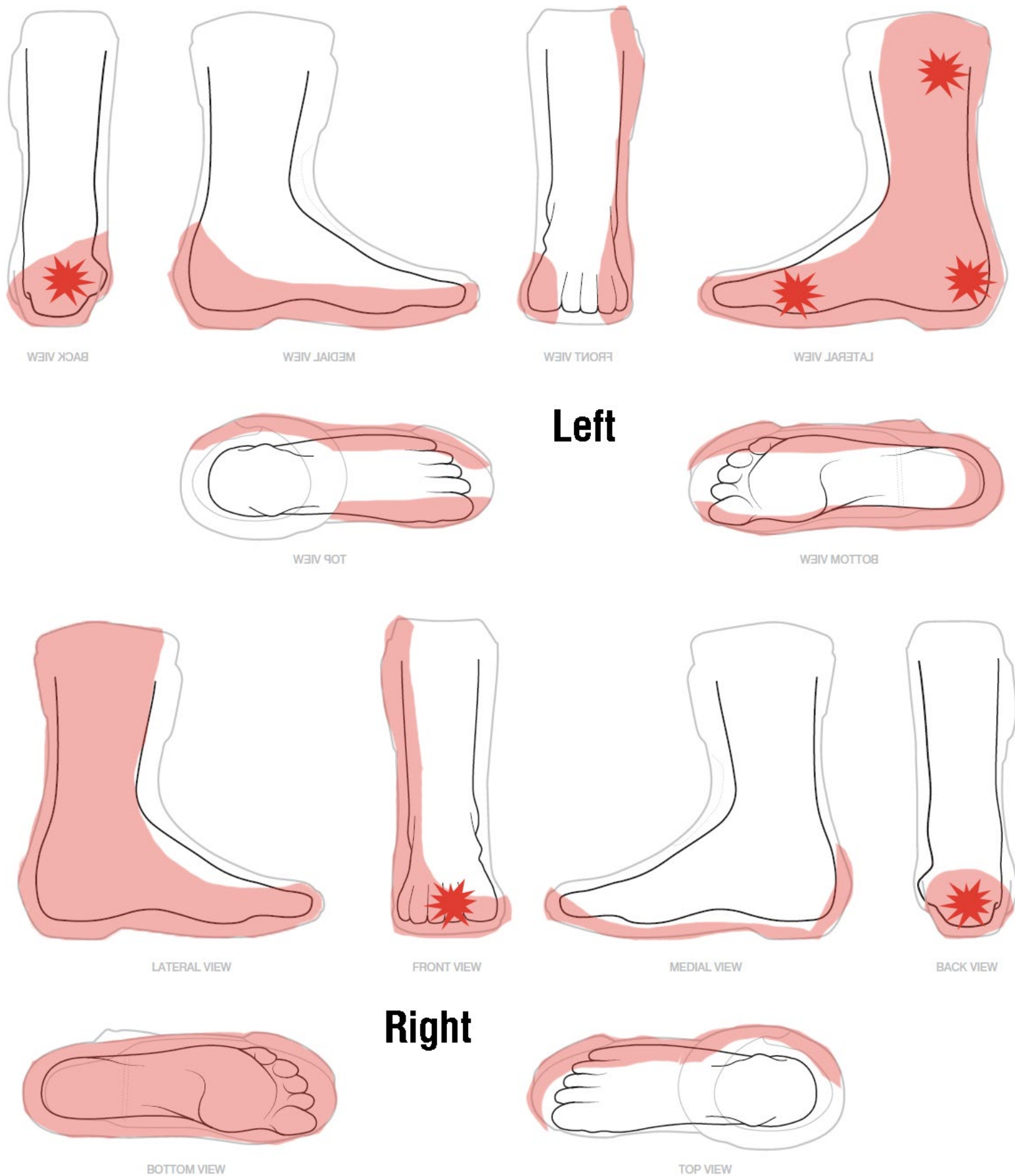






- Lowsider with Alpinestars Supertech R boots
- Starts sliding and ends up tumbling
- At multiple points the rider is at risk for hyper-inversion.

- The following areas were used for sliding and absorbed impact:

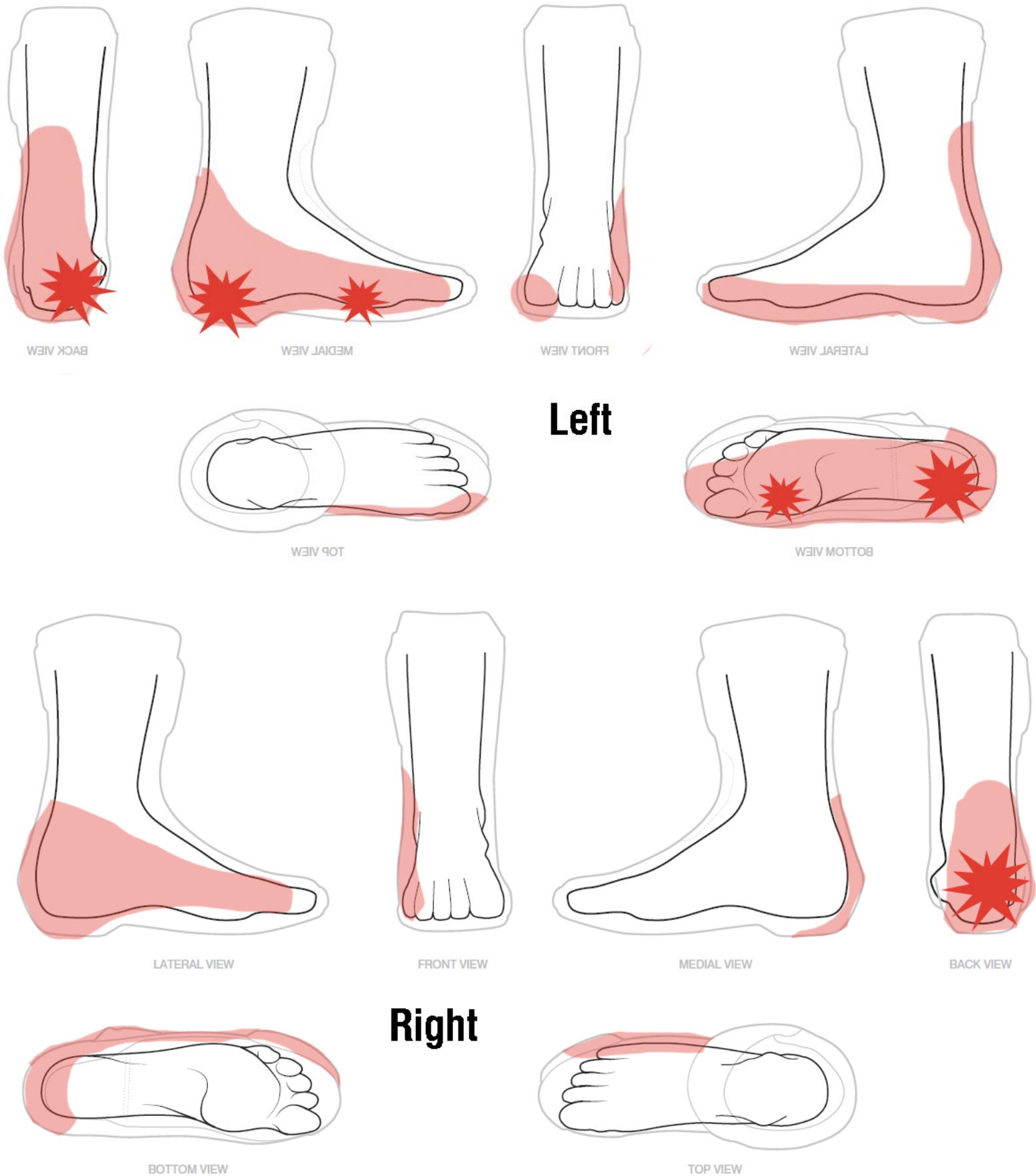




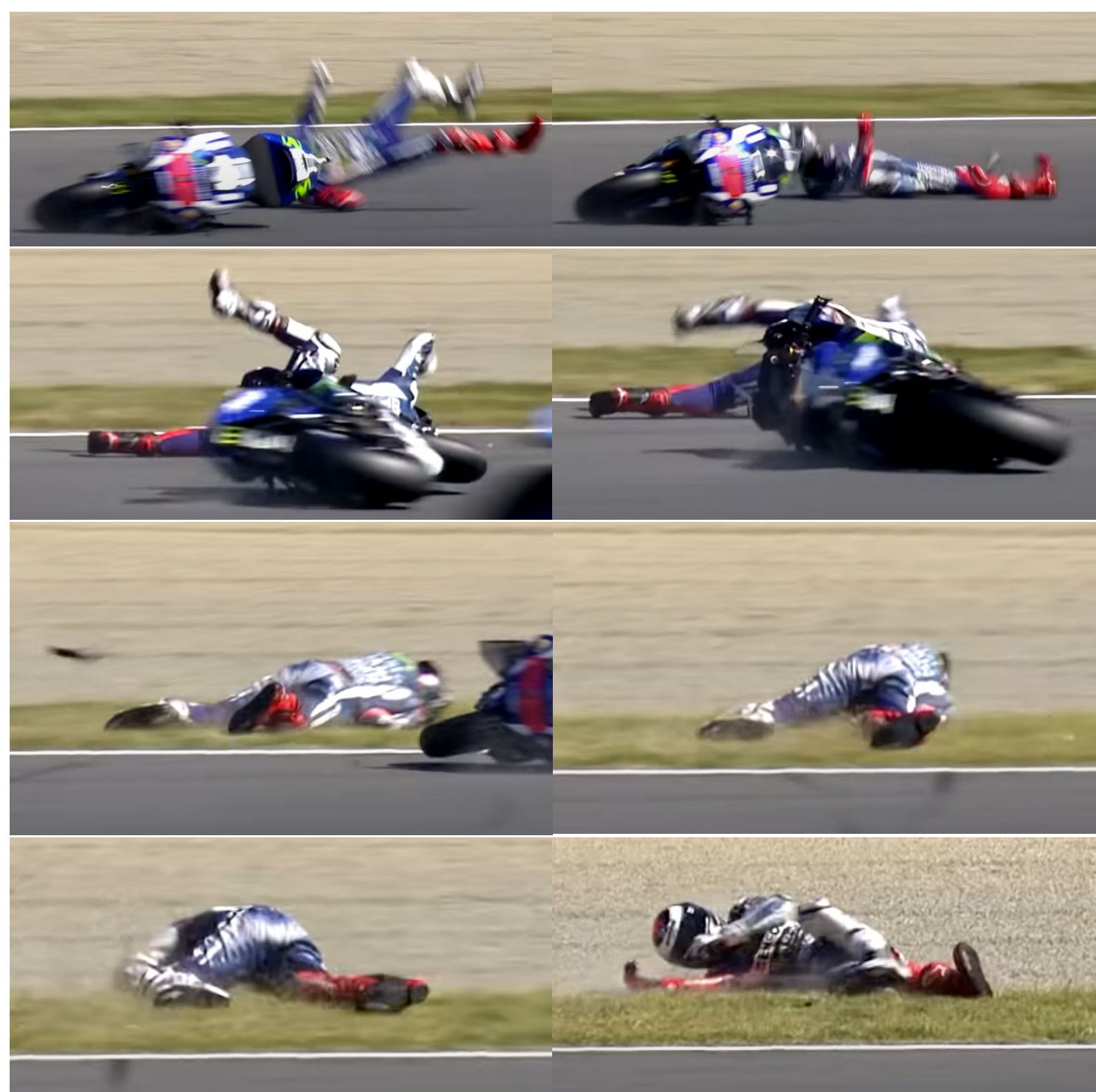


- Topsider with Dainese Axial D1 boots
- Flies up into the air and starts thumbling and then sliding and turning
- At multiple points the rider is at risk for hyper-eversion.

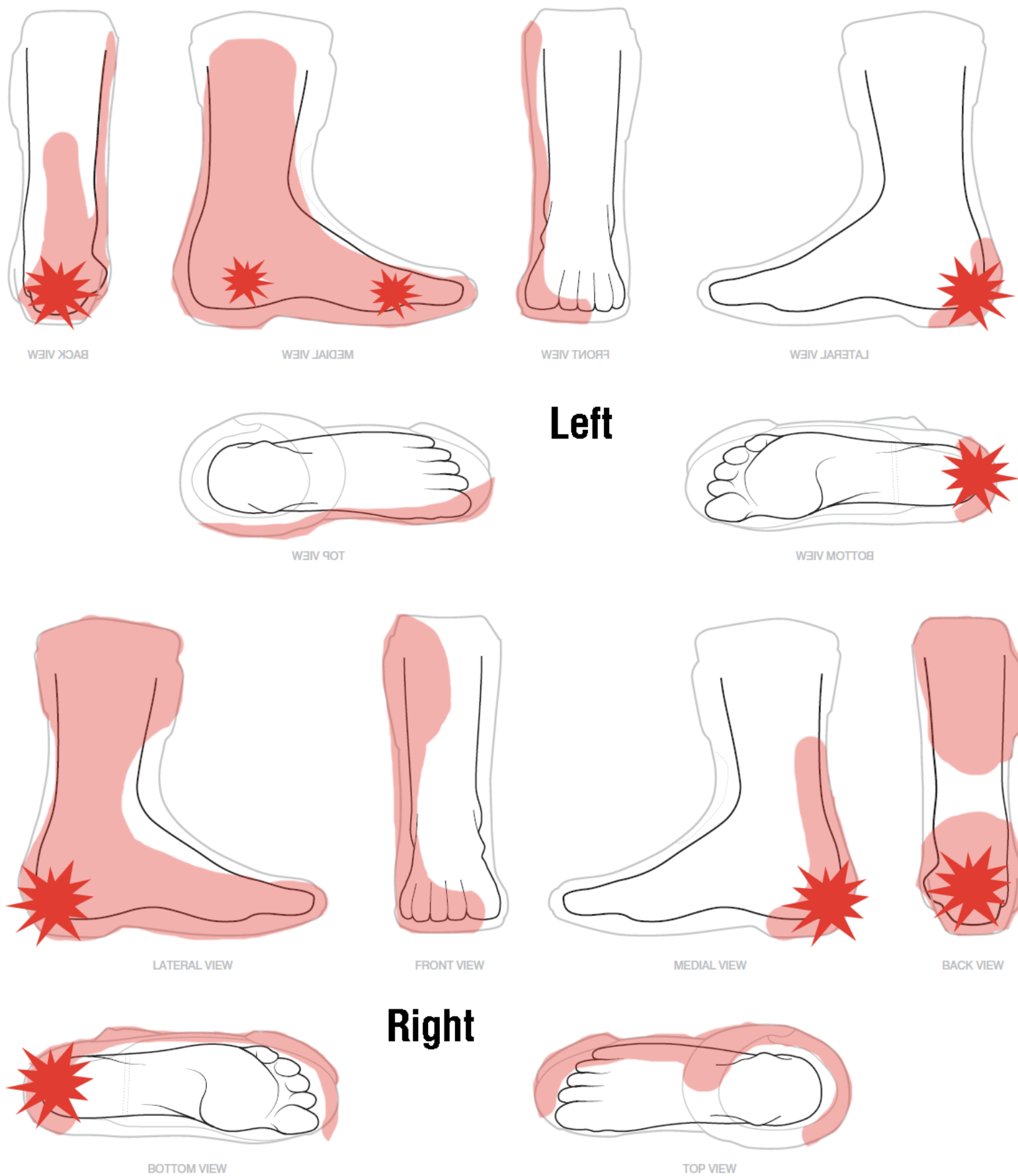
- The following areas were used for sliding and absorbed impact:



Crash 3



- Lowsider with Alpinestars Supertech R boots
- High bike slides away, he gets launched a little and then he start sliding and tumbling
- At multiple points the rider is at risk for hyper-abduction and adduction.



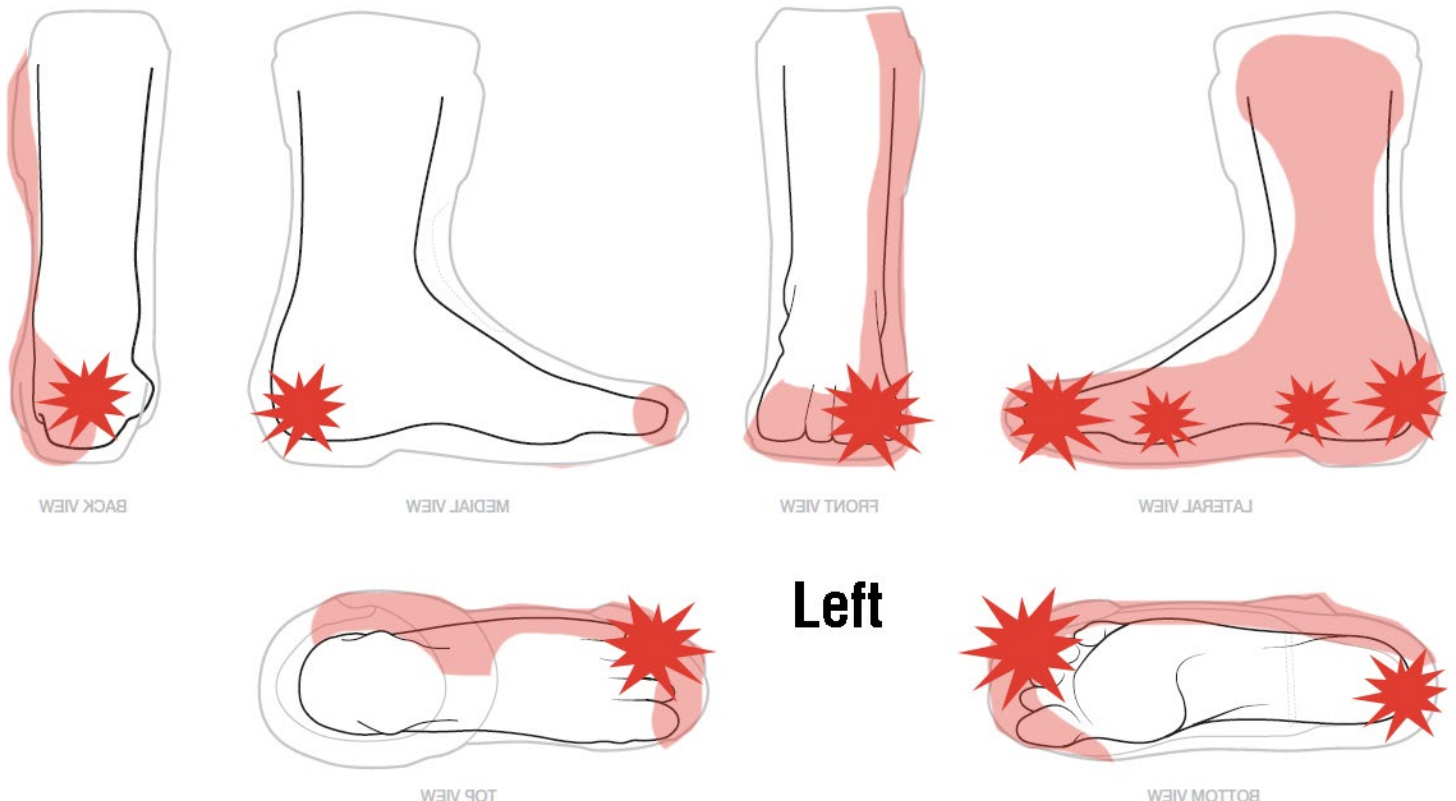


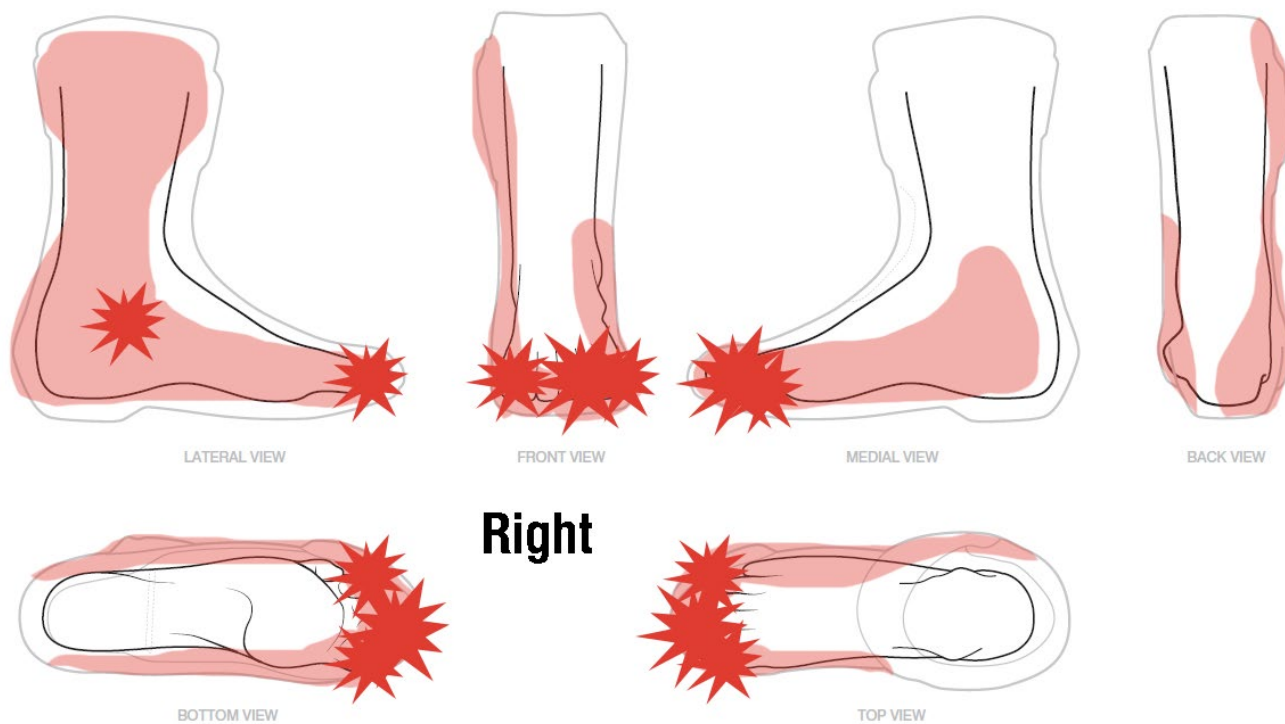






- Hightsider Alpinestars Supertech R boots
- Flies up into the air and starts thumbling and then sliding and turning
- At multiple points the rider is at risk for hyper-adduction, hyper-abduction, hyper-flexion, hyper-inversion.
- The following areas were used for sliding and absorbed impact:





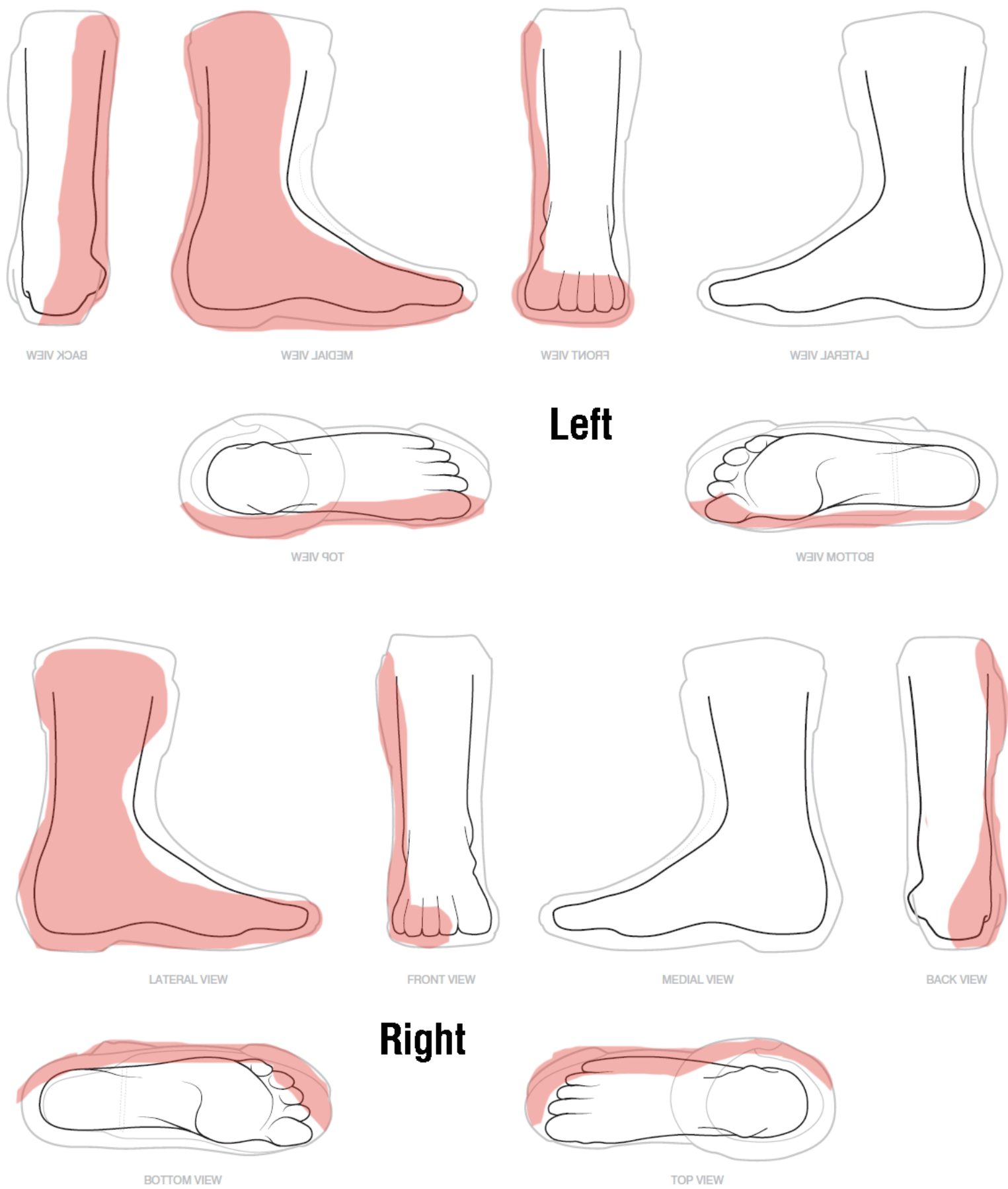
Crash 5





- Lowsider with Alpinestars Supertech R boots
- Flies up into the air and starts thumbling and then sliding and turning
- At multiple points the rider is at risk for hyper-inversion.

- The following areas were used for sliding and absorbed impact:









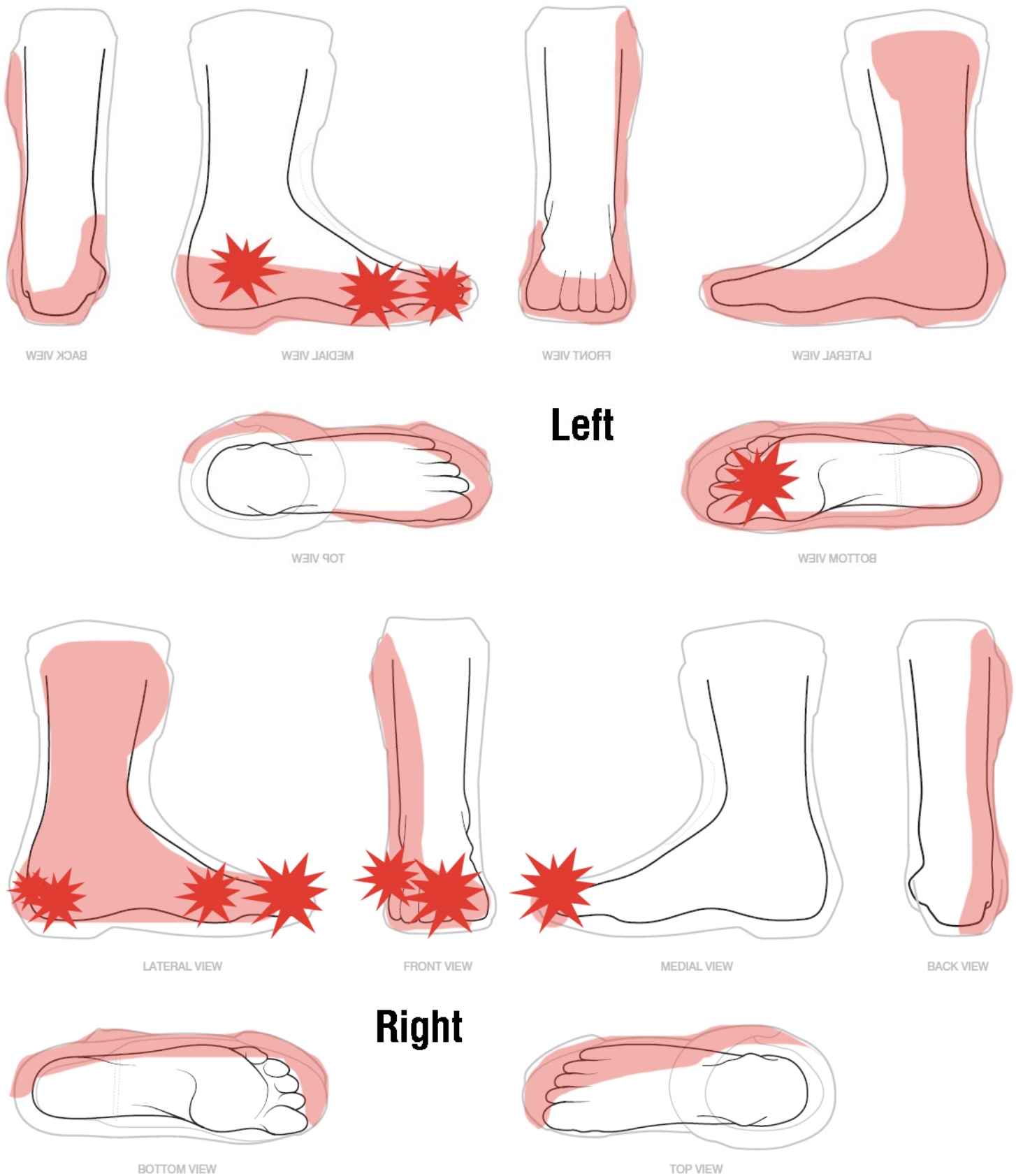






- Highsider with Alpinestars Supertech R boots
- Flies up into the air and starts thumbling and then sliding and turning
- At multiple points the rider is at risk for everything but hyper-flexion.

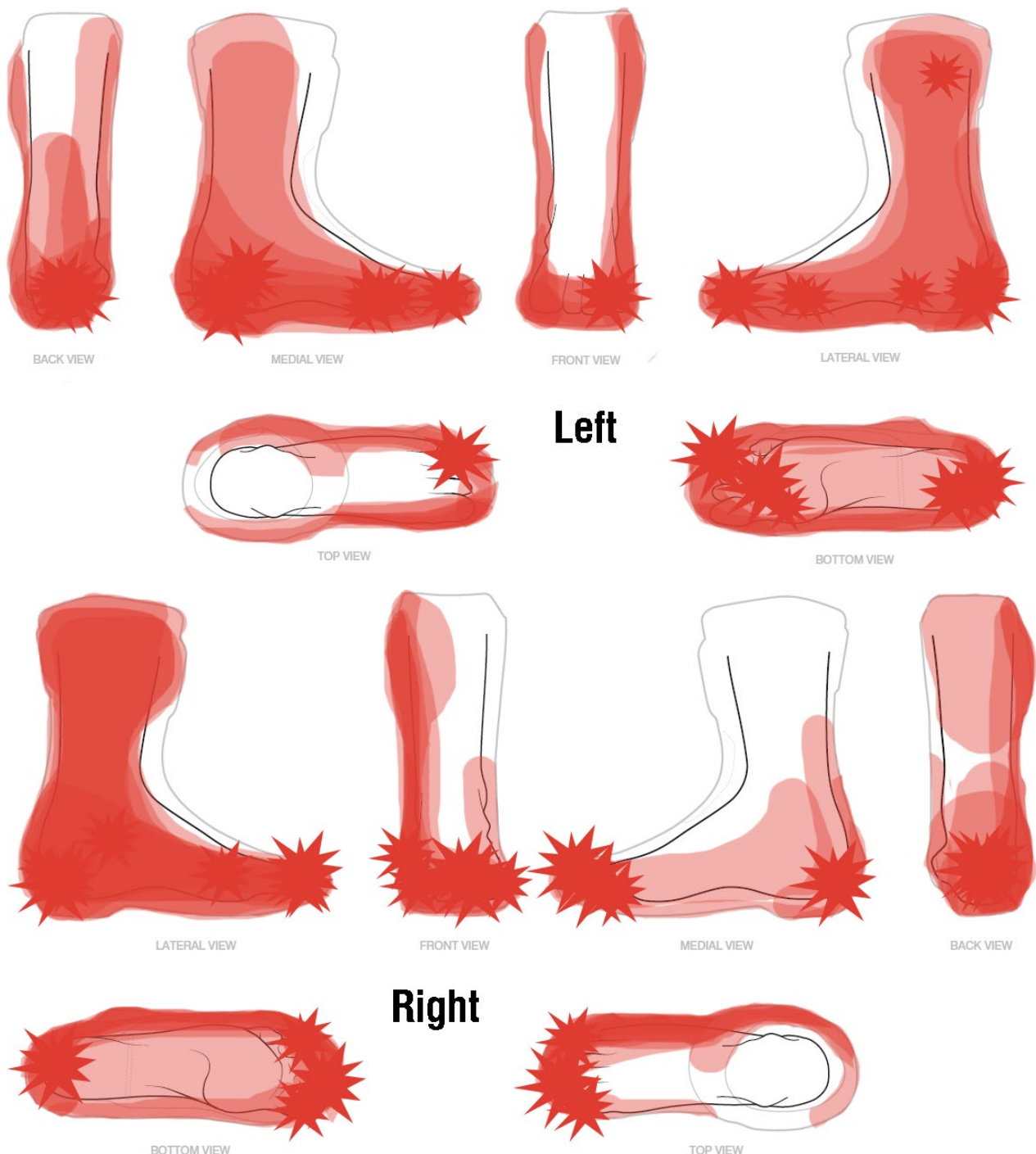
- The following areas were used for sliding and absorbed impact:



Conclusion

- The toe box and heel box are there for a reason. Almost all impacts where in these locations.
- The shin protector remained fairly unused.
- The flex area remained out of the abrasion zone. It might be interesting to consider this area for the closure system (zipper/buckles), to keep it intact.
- The edges of the outer sole endure a lot of abrasion.
- The sample size was too small to conclude anything regarding the difference per boot.
- The sliders on the lateral side of the boot (toe, ankle, shin) and the heel fulfil a function and are not just there for show.

This is what a combination off all the crashes looks like for both boots:



APPENDIX 12. LIST OF ADDITIONAL REQUIREMENTS

See Confidential Appendix

APPENDIX 13. RESEARCH KNITTING PATTERNS

With knitting a very stiff thread can be used to make a stretchy strap (Plaude, 2023). For the application of the ankle brace, movement up onto a certain point should be allowed and then be block it after that. Thus, we want a range of stretch followed by stiffness. That is why knitting the straps with a very stiff and strong fibre like Kevlar would be a solution for this application. A knit structure keeps the fibres bound together and flat upon compression. If you would directly attach the fibres from one hard part to another, they would move around, potentially get caught and buckle when unstretched. There are different knitting patterns that could be applied, that result in different amounts of stretch, making some more suitable than others. As no research is available regarding this topic, tests were done to find the best suitable structures for this application. As Kevlar fibre is more difficult to work with due to it being difficult to cut, the following tests were performed with another stiff thread, polyamide rope. The conclusions form the base for the development of the Kevlar straps and makes it so that less Kevlar straps need to be made and tested for the final prototype. For the ankle brace it is important that the straps remain as thin as possible, respond uniformly to stretch (decreases the chance of breakage under great force), do not curl up and have a minimal chance of getting caught behind a structure within the boot. These wishes stem from the boot design drivers: slim profile, protective and freedom of movement.

Method

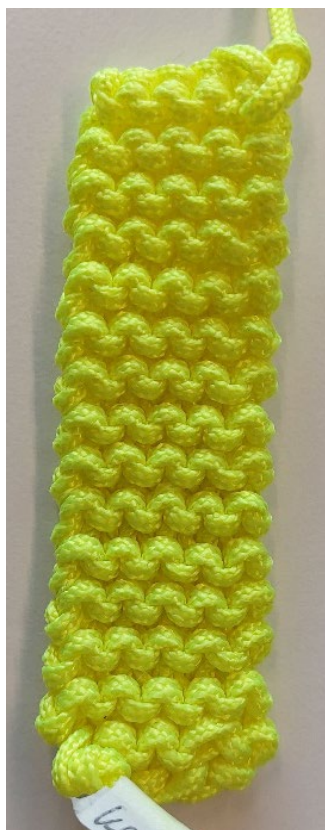
All samples were hand-knitted with straight bamboo knitting needles. A few different variables were created, sample with a different: needle size (2.5, 4, 2.5 & 4 combined and 8 mm needles), knitting pattern (knit, rib, stockinette and seed stitches) and knitting method (loose and tight). The samples were made to be about 2.5 by 8 cm. When finished the length of the sample was measured in neutral state. Then the sample would be stretch out by hand until no more stretch could be obtained by hand, as at this point the stretch is no longer provided by the structure, but by the material. In this state the length of the sample would be measured again. See the figure below for an overview of the measurement method.



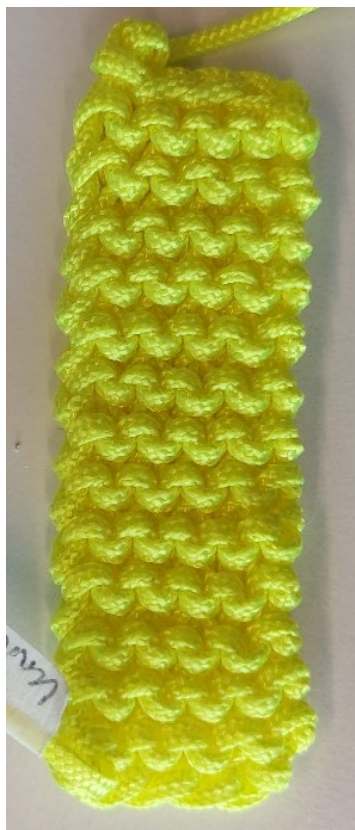
Results

Created Knitting Patterns

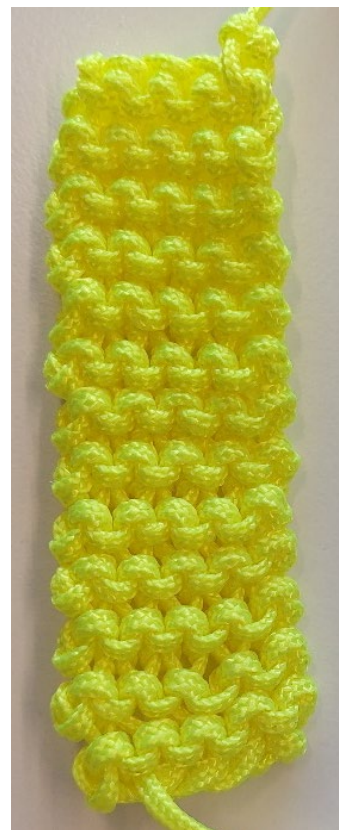
Knit Stitch Pattern in Length
Direction (Tightly Knitted) |
Needle Size: 2.5 mm



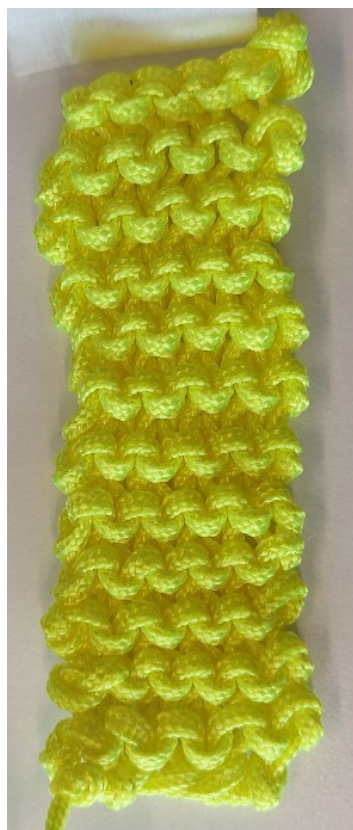
Knit Stitch Pattern in Length
Direction (Loosely Knitted) |
Needle Size: 2.5 mm



Knit Stitch Pattern in Length
Direction | Needle Size: 2.5
and 4 mm Combined



Knit Stitch Pattern in Length
Direction | Needle Size: 4 mm



Knit Stitch Pattern in Length
Direction | Needle Size: 8 mm



Knit Stitch Pattern in Width
Direction | Needle Size: 4 mm



Single Rib Stitch
Pattern in Length
Direction | Needle
Size: 4 mm



Double Rib Stitch
Pattern in Length
Direction | Needle
Size: 4 mm



Stockinette Stitch
Pattern in Length
Direction | Needle
Size: 4 mm



Seed Stitch Pattern in
Length Direction |
Needle Size: 4 mm



Stretch Measurement

Different Stitching Patterns

Knitting Pattern (4 mm)	L0 (cm)	L1 (cm)	Delta (cm)	Elongation (%)	Comparison
Knit - Length	8,5	11,5	3,0	35,3	Norm: 1,00
Stockinette - Length	7,6	9,2	1,6	21,1	0,60
Knit - Width	7,7	9,3	1,6	20,8	0,59
1x Rib - Width	8,2	11,6	3,4	41,5	1,17
2x Rib - Width	9,4	11,7	2,3	24,5	0,69
Seed - Width	9,7	11,6	1,9	19,6	0,55

Different Needle Sizes

Needle Size (Knit Stitch in Length)	L0 (cm)	L1 (cm)	Delta (cm)	Elongation (%)	Comparison
2,5 mm (Tight)	7,6	8,7	1,1	14,5	0,41
2,5 mm (Loose)	7,1	8,9	1,8	25,4	0,72
2,5 & 4 mm	7,5	9,5	2,0	26,7	0,76
4 mm	8,5	11,5	3,0	35,3	Norm: 1,00
8 mm	7,2	12,0	4,8	66,7	1,89

During the making of the different samples, it became apparent that some of the options curled up (the stockinette stitch) when stretched or did not stretch uniformly (the rib stitches and the seed stitch), making them unsuitable for the application.

APPENDIX 14. OVERVIEW IDEATION RESULTS

Based on the norm in both tables, which is the same sample (4 mm Knit Stitch in Length Direction), translations can be made calculating the stretch of a certain knitting pattern with a different needle size. Besides the knit stitch in the length direction, the knit stitch in the width direction is the only knitting pattern that is suitable for the ankle brace. That is why only for this pattern the influence of the different needle sizes was calculated:

Knit - Width	Factor	%
4 mm	1,0	20,8
2,5 mm (Tight)	0,41	8,5
2,5 mm (Loose)	0,72	14,9
2,5 & 4 mm	0,76	15,7
8 mm	1,89	39,2

Conclusion

The knitting pattern made of knit stitches in both the length and width direction are the best suitable for the application of straps for the ankle brace system.

Based on the found elongations, in theory, the following knit structures would be best suitable for the steps for the following movements:

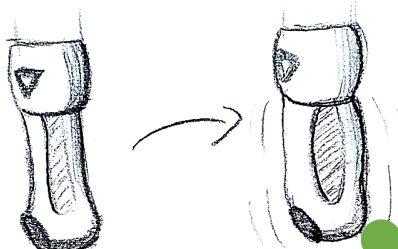

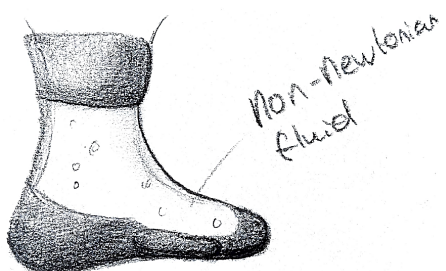
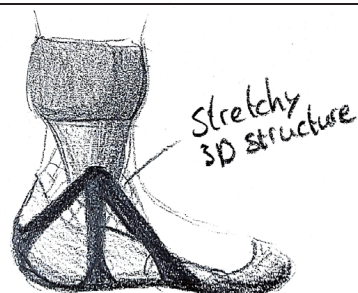

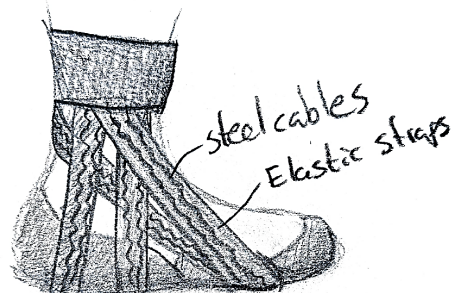
- **Inversion:** the maximal wanted elongation is 19.6 %, so a knit stitch in width direction with a 2.5 and 4 mm needle (15.7 %).
- **Eversion:** the maximal wanted elongation is 13.0 %, so a tight knit stitch in width direction with a 2.5 mm needle (8.5 %).
- **Supination:** the maximal wanted elongation is 25.9 %, so a loose knit stitch in length direction with a 2.5 mm needle (25.4 %).
- **Pronation:** the maximal wanted elongation is 12.0 %, so a tight knit stitch in width direction with a 2.5 mm needle (8.5 %).
- **Adduction:** the maximal wanted elongation is 6 %, so no knitting structure is suitable, and the fibres should directly be connected from hard part to hard part.
- **Abduction:** the maximal wanted elongation is 5 %, so no knitting structure is suitable, and the fibres should directly be connected from hard part to hard part.

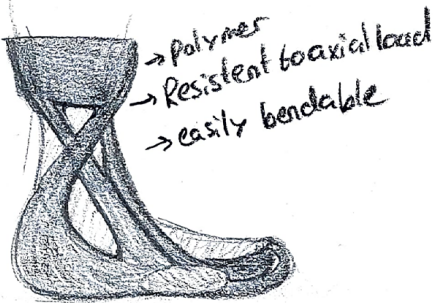


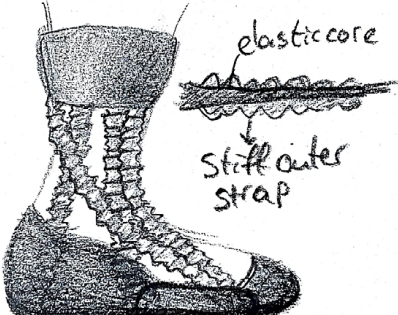
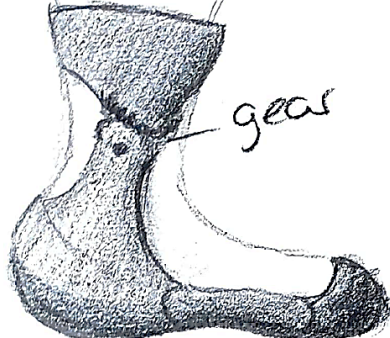
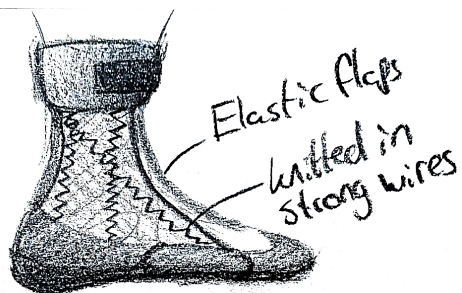

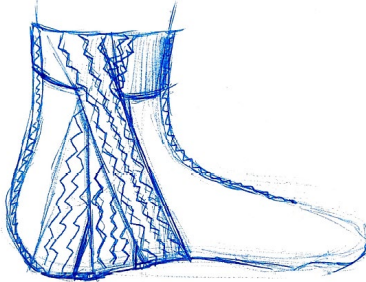
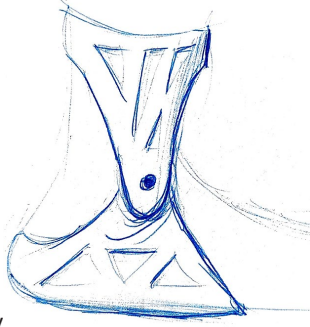
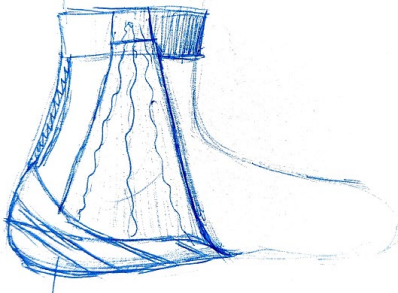
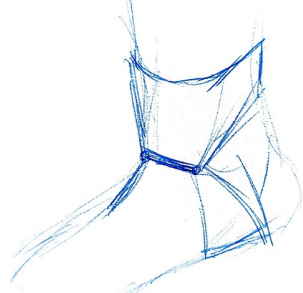

These types of knit structures should be made with out of Kevlar fibre too and then tested in practice.



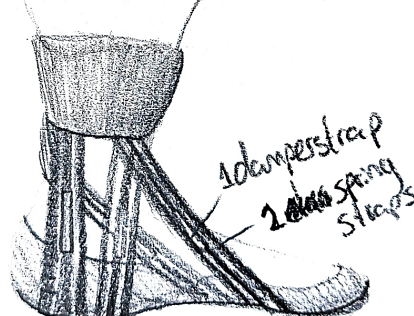
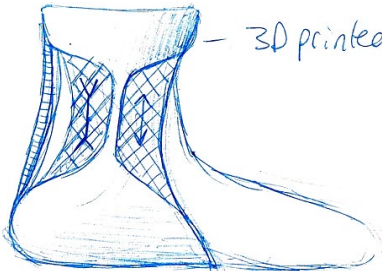
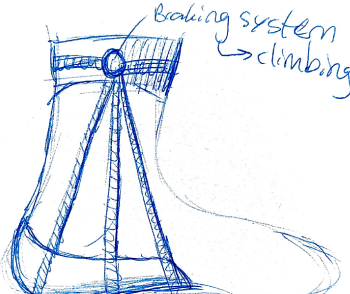
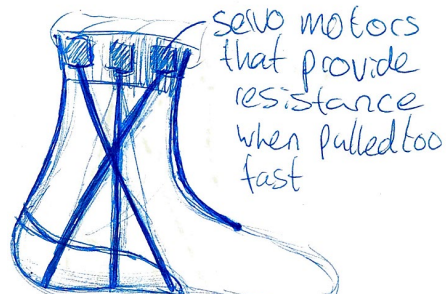
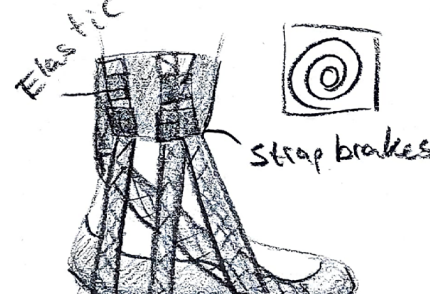
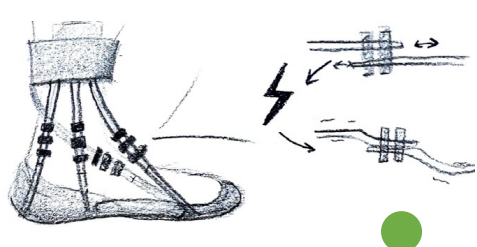
14.1. General Concept Generation

Based on the initial Brainwriting session of Appendix 8 with the following problem statement: “How to make an ankle joint and its supporting structures survive any MotoGP crash?”, a next step was taken to turn these ideas into concepts applied to a boot. The method of Brain Drawing (Van Boeijsen et al., 2013) was applied to take this step and to diverge. With Brain Drawing ideas are not written down in words, but as the name suggests they are drawn and the goal is to create quantity in terms of ideas to generate quality. This allows for better communication of the generated ideas. Naturally, some ideas jump out to you more than others, but to make sure no interesting ideas are tossed, reverging, and spending some time with all ideas is important. To reverage and so consider all the presented ideas, the method of “Clustering” was used (Heijne & Van der Meer, 2019). The clusters were made and named according to shared characteristics. Not all ideas can and should be turned into concepts. Choosing the one that best fits the design drivers is the goal. Therefore, converging is necessary. So, a first purge was done to select the most promising concepts. This initial selection was done with the “Hits and Dots”-method (Heijne & Van der Meer, 2019). A graduated Integrated Product Design Student was asked to help in the selection. The discussion resulted in the choice of six concepts, as we chose to allow the vote of one dot per cluster. To make a final choice between the concepts, the “Harris Profile”-method was applied (Van Boeijsen et al., 2013). From the stated design drivers and requirements, the most important and differentiating wishes were selected. These wishes were ranked in terms of importance and the concepts were rated per wish based on personal insight. From this comparison the concept that came out best was the one with a structure of stiff straps that mimic the ligamentous structures around the ankle, to support the already present ankle support of the human body.

Results – Braindrawing, Clustering, Hits & Dots

#	Idea	Cl.	#	Idea	Cl.
1		Fu	14		St
2	 Non-Newtonian fluid		15	 Stretchy 3D structure	
3	 Suit zipper viscoelastic fibers		16	 steel cables Elastic straps	

4	 <p>→ Polymer → Resistent to axial load → easily bendable</p>	0	17	 <p>suit knitted to allow for stretch dyneema straps</p>
5	 <p>counter-movng motorized joint</p>	M	18	 <p>elastic core stiff outer strap</p>
6	 <p>gear</p>		19	 <p>Elastic flaps knitted in strong wires</p>
7	 <p>non-newtonian circular sliding joint damping material</p>		20	
8	 <p>v</p>		21	
9			22	 <p>quick release lacing Hard parts kevlar reinforcement</p>

10	 damper strap	B	23		O
11	 damper strap 2 spring straps		24	 3D printed	
12	 braking system climbing		25	 servo motors that provide resistance when pulled too fast	S ie E
13	 Elastic strap brakes		26		

Concept Choice – Harris Profile

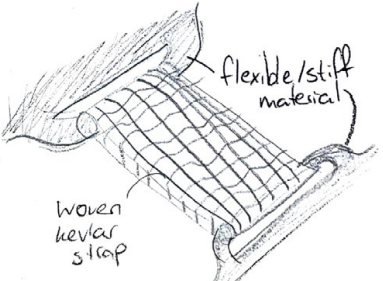
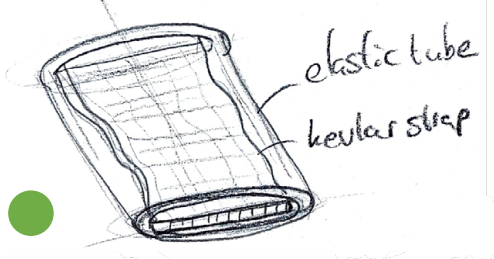
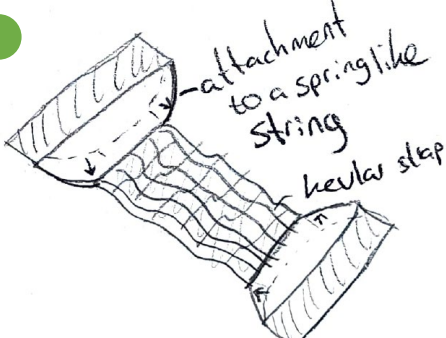
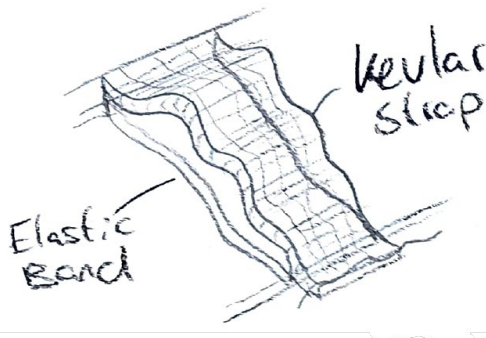
Idea:	1: Airbag	4: Art	7: New Joint	10: Dampers	14: Ligament	26: Volts
Wish	-2 -1 +1 +2	-2 -1 +1 +2	-2 -1 +1 +2	-2 -1 +1 +2	-2 -1 +1 +2	-2 -1 +1 +2
Protection						
Freedom of Movement						
Weight						
Bulk						
Manufacturability						
Complexity						

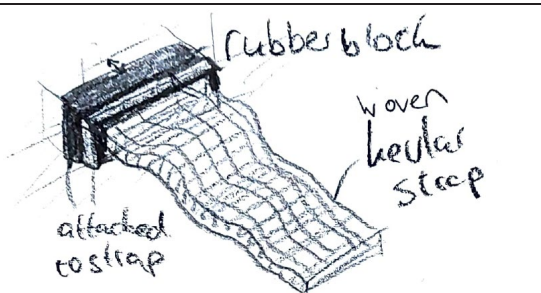
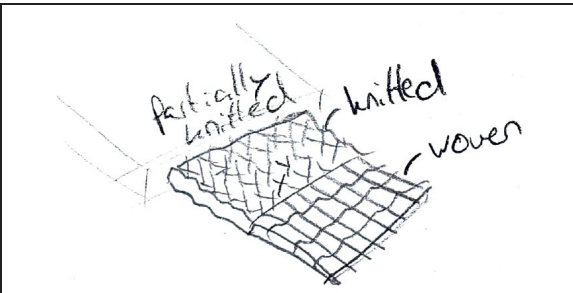
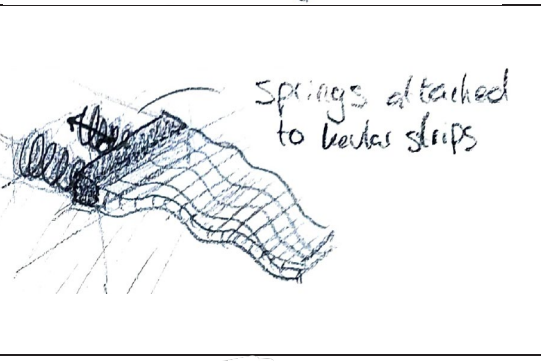
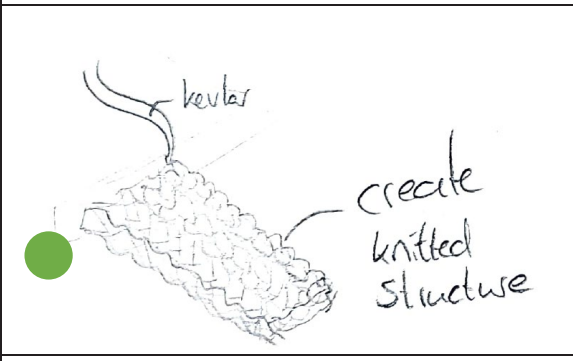
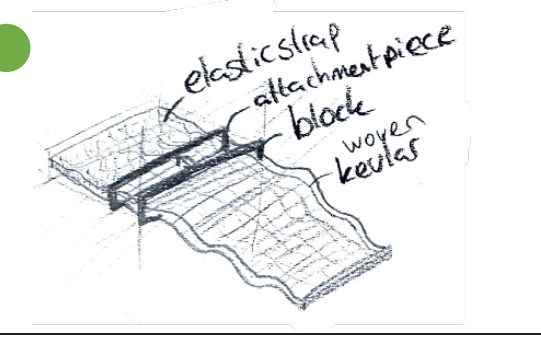
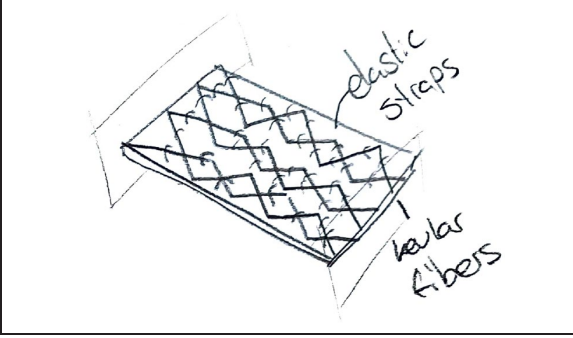
Looking at the little block towers idea 14 comes out best, then idea 7 and then idea 10. Idea 14 will be the starting point of the development of the concept.

14.2. Ideation Sub-Problem: How to make a stiff strap a little stretchy.

Based on calculations and material research the choice was made to select Kevlar as the optimal material for the straps. A woven Kevlar strap, however, is very stiff and will buckle when not put under tension. Furthermore, it does not provide any support to the ankle within the active range of motion. As the riders value feeling safe and would like to feel the presence of the ankle brace, it is important that the straps offer some counteracting force when the ankle is moved into a certain direction. Not so much that it feels limiting, but enough to make it feel like something is there to catch you, when necessary. Just like a seat belt.

For this ideation round the following problem statement was defined: “How to make a stiff strap a little stretchy?” Also here the method of Brain Drawing (Van Boeijen et al., 2013) was applied to diverge and create fluency, so a larger quantity of ideas. Reverging was done with the method of “Clustering” (Heijne & Van der Meer, 2019). The clusters were made and named according to shared characteristics. The initial selection was done with the “Hits and Dots”-method (Heijne & Van der Meer, 2019), which resulted in the choice of four ideas. To make a final choice between these ideas, the “Weighted Objectives”-method was applied (Van Boeijen et al., 2013). From the stated design drivers and requirements, the most important and differentiating wishes were selected. These wishes were ranked in terms of importance and rated with a weight factor. Then the ideas were rated on a scale from 1 to 10 and multiplied with the weight factor of the wish. Summing up all these multiplied scores per wish results in a final score. The higher this score, the better the idea fits with the stated design drivers. Looking at the scores the idea that came out best was the one where the Kevlar yarn is knitted into a structure, as a knitted structure allows for stretch up onto a certain point depending on the structure. After that point the flexibility of the strap is defined by the Young’s Modulus of the material. Furthermore, a knitted structure would allow for the freedom of movement in a sideways direction, which on the boot would be the movement of plantar- and dorsi flexion. To check whether this finding was correct an expert meeting was arranged with the textile expert of the faculty of Industrial Design Engineering. She, Plaude (2022), confirmed this finding, showed different types of knitting patterns, and provided instructions to make these knitting structures for the creation of prototypes.

#	Idea	Cl.	#	Idea	Cl.
1		Flexible	6		Flexible
2			7		

3		Fl	8		Fl
4			9		
5			10		

Weighted Objectives

		2: Spring String		5: Elastic Lock		6: Elastic Tube		9: Knitted Kevlar	
Wish	Weight	Score	Total	Score	Total	Score	Total	Score	Total
Strength	30	6	180	7	210	8	240	9	270
Reliability	20	7	140	6	120	9	180	9	180
Manufacturability	20	6	120	5	100	8	160	7	140
Sturdy look (Sense of safety)	15	6	90	6	90	7	105	9	135
Longevity	10	8	80	6	60	9	90	9	90
Bulk	5	7	35	5	25	7	35	7	35
Total	100		645		605		810		850

Looking at the resulting scores, the most fitting concept would be idea 9, then idea 6 and then idea 5. Idea 9 will be implemented in the overall design.

14.3. Ideation: Keeping the Kevlar straps in place on the lower limb.

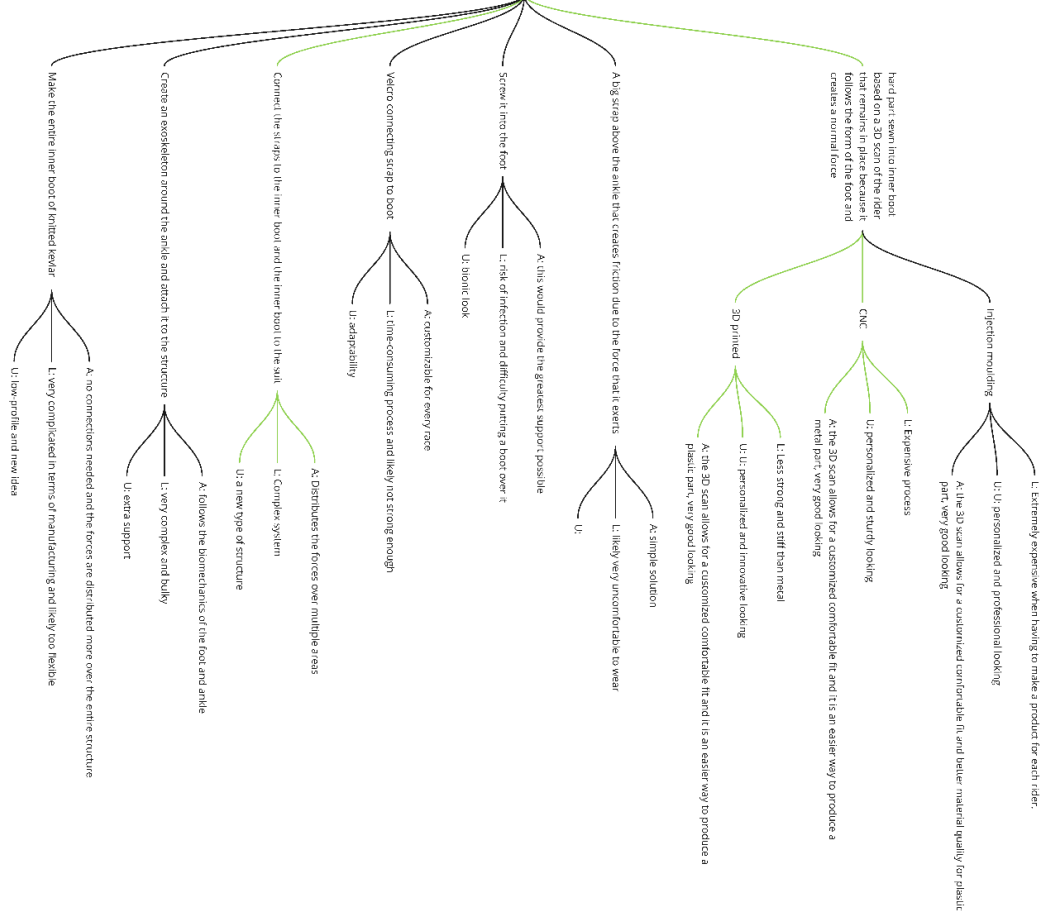
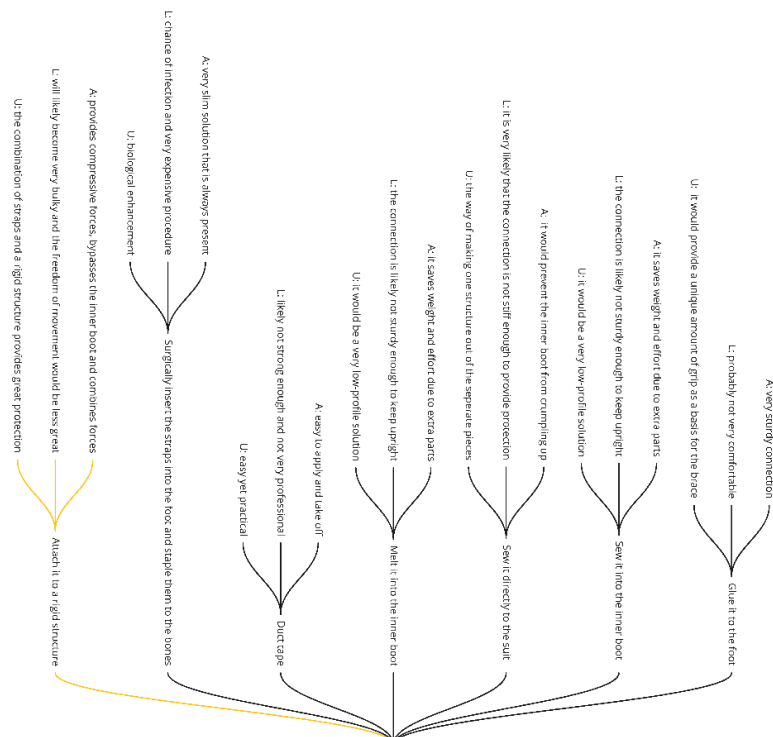
For the straps to do their job, they need to have a stable support structure that keeps them in place. This support structure needs to be stiff and strong.

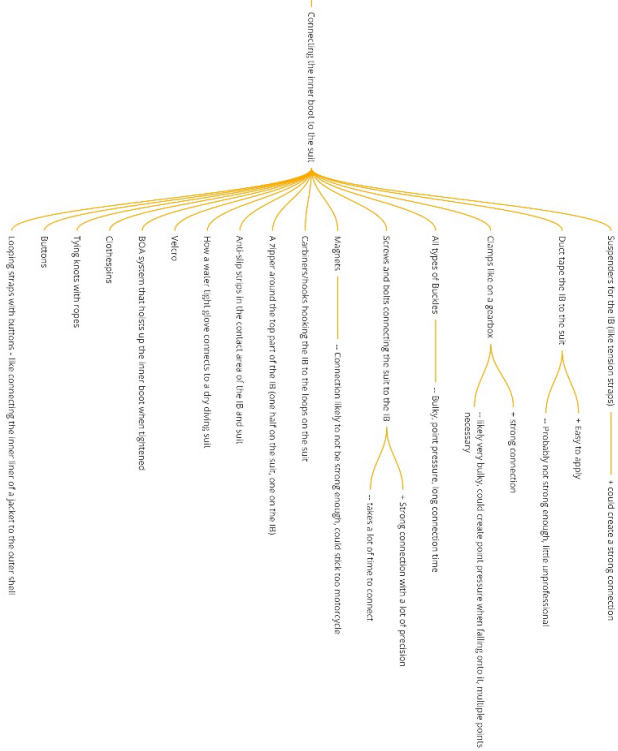
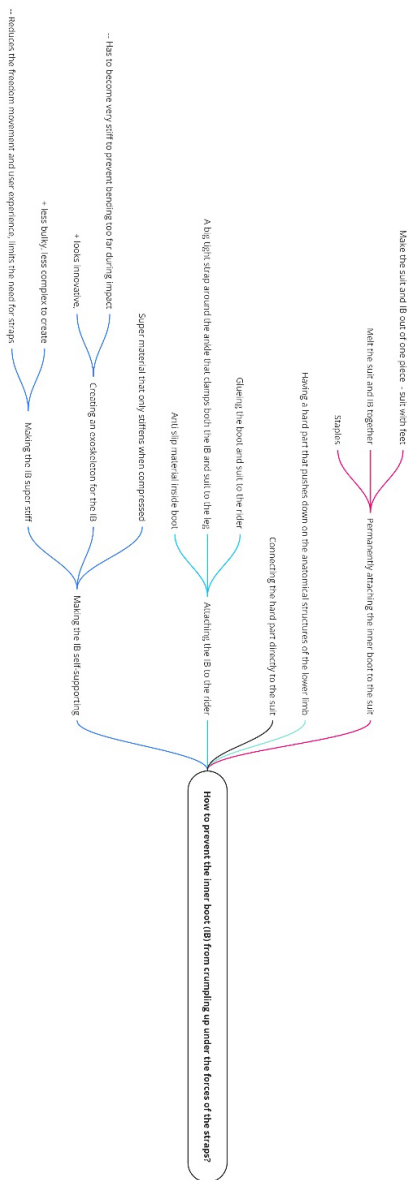
For this ideation round the following problem statement was defined: “How to keep the Kevlar straps in place on the lower limb?” The method of How To combined with Brainwriting (Van Boeijen et al., 2013) was applied to diverge. The reverging step was done with the “vALUe”-method (Van Boeijen et al., 2013), stating the advantages, limitations, and unique findings. To make a final choice between these ideas, the “Hits and Dots”-method was applied (Heijne & Van der Meer, 2019). The final choice was made for making a 3D printed or CNC’ed shape based on a 3D scan of the rider that is strapped to the rider’s leg and connected to the inner boot. The structures of the leg would divide the force over the leg and keep the base part that connects to the straps in place. An interesting note was connecting the straps to the inner boot and the inner boot to the suit. This formed the basis for the next ideation round.

14.3. Ideation: How to prevent the inner boot (IB) from crumpling up under the forces of the straps?

As mentioned an interesting idea arose to connect the straps to the inner boot and the inner boot to the suit. This would allow the straps to stay in place even better and to alleviate some of the pressure caused by the great forces put on the straps and create more stability.

For this ideation round the following problem statement was defined: “How to prevent the inner boot (IB) from crumpling up under the forces of the straps?” The method of How To combined with Brainwriting (Van Boeijen et al., 2013) was applied to diverge. The reverging step was done with the “PMI”-method (Van Boeijen et al., 2013), stating the advantages, limitations, and unique findings. To make a final choice between these ideas, the “Hits and Dots”-method was applied (Heijne & Van der Meer, 2019). The final choice was made for attaching the inner boot to the suit via a zipper. This distributes the forces evenly over the protective structures and is already a principle that is applied for connecting the upper and lower parts of two-piece suits.

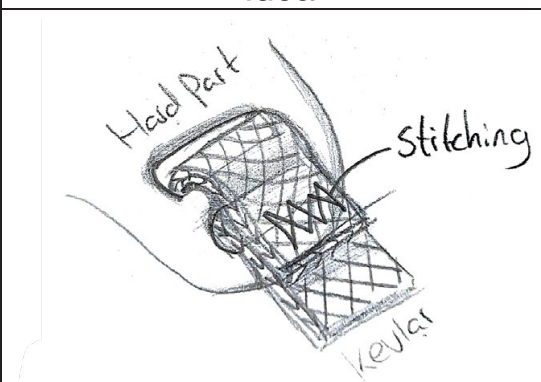
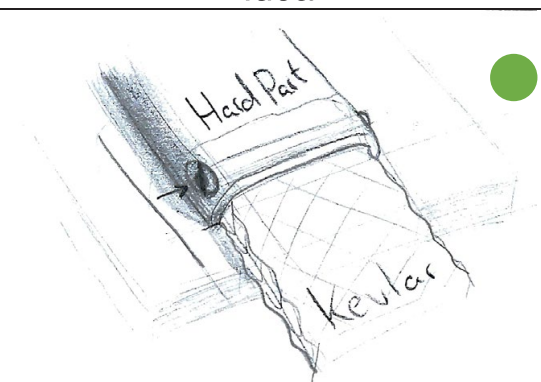
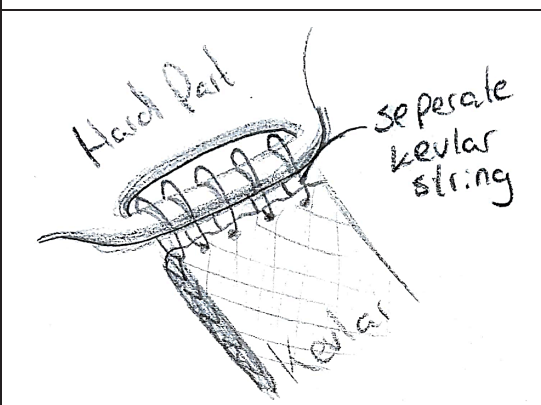
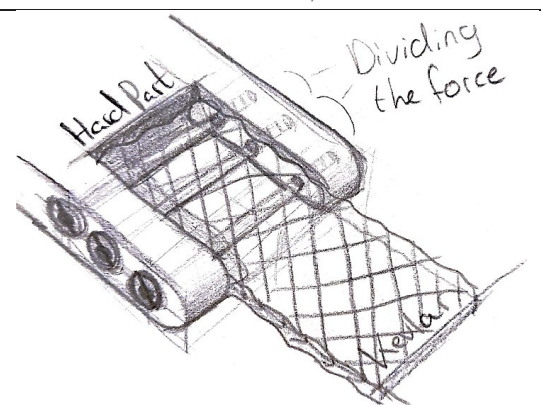
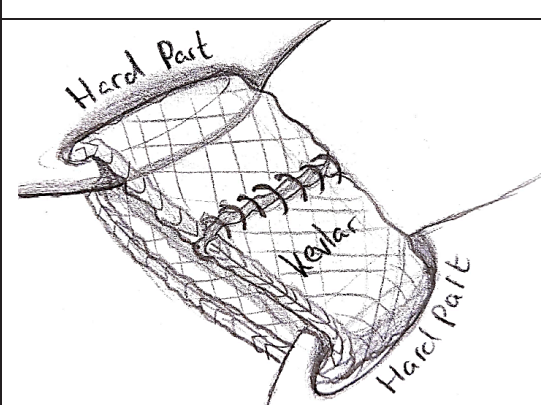
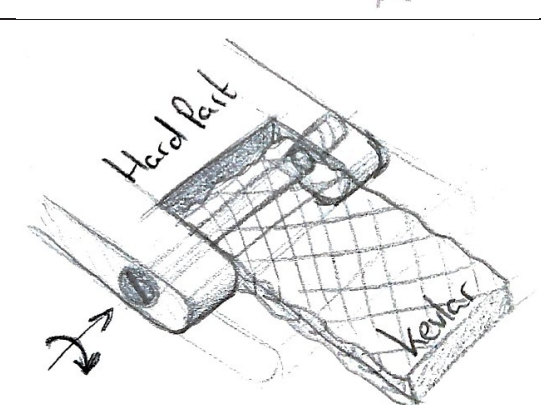


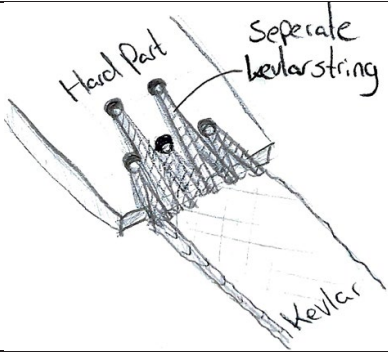
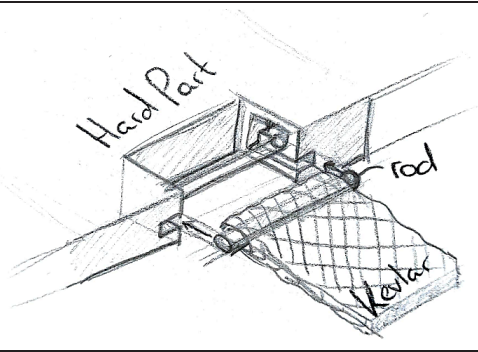
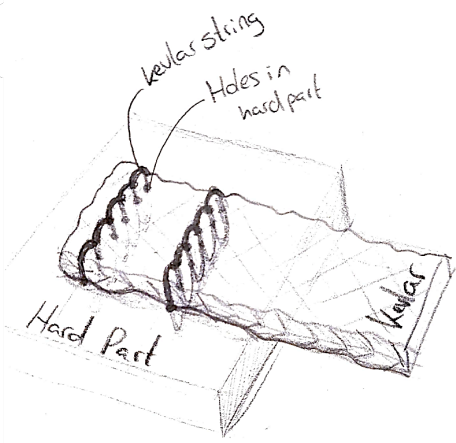
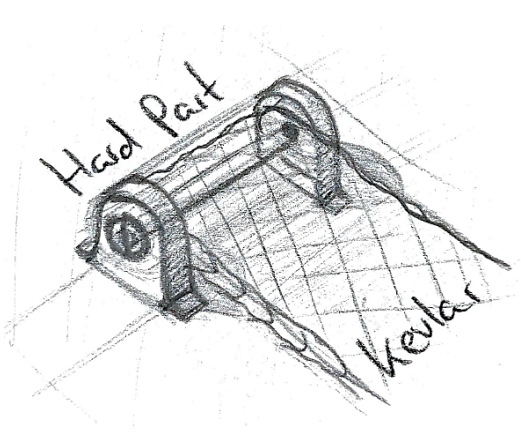
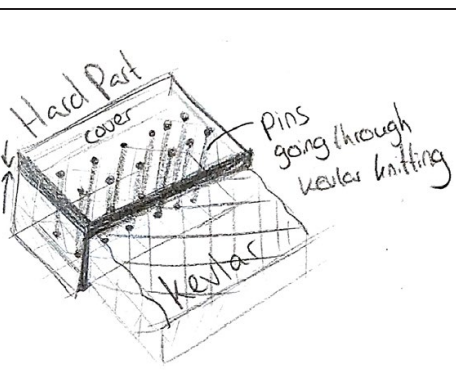
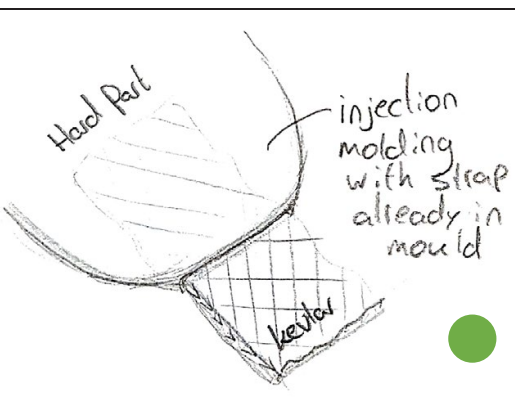
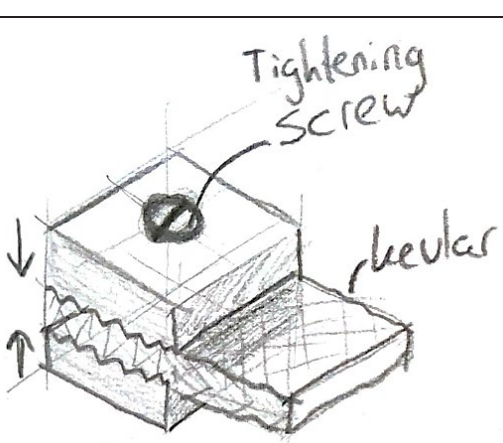
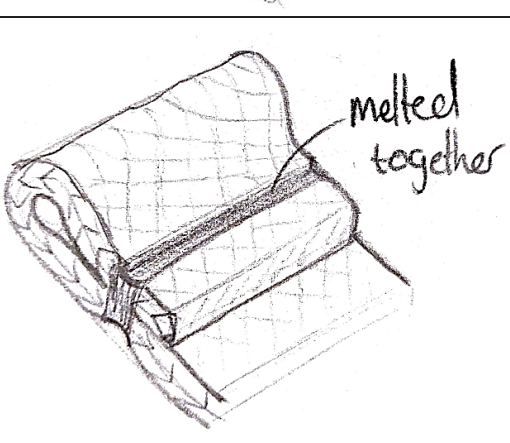
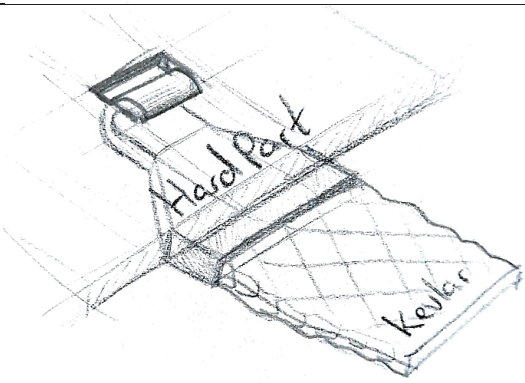
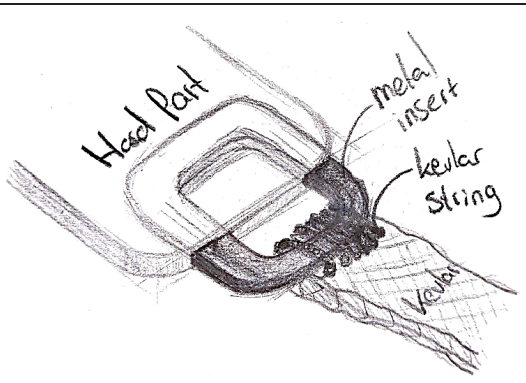


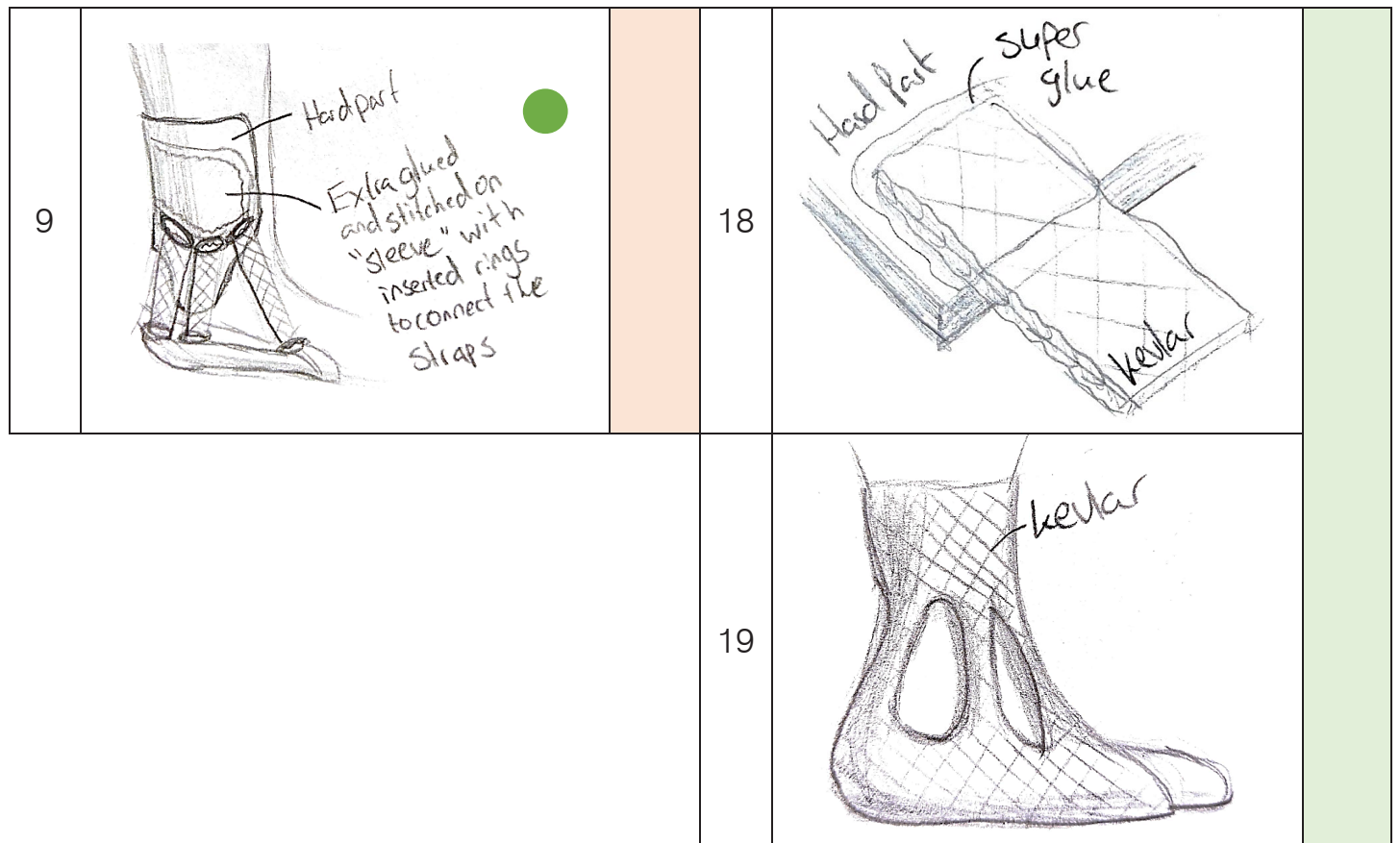
14.5. Ideation: Connecting the Kevlar straps to the hard parts.

Naturally the straps have to be connected to the hard part that connects to the inner boot. Important for this connection is that it is strong and stiff. No extra stretch should come from the connection as this makes it hard to predict the behaviour of the strap. Furthermore, the strap should stay in place and the hard part should be able to handle the forces that are applied to it through the straps.

For this ideation round the following problem statement was defined: “How to connect a knitted Kevlar strap to a rigid hard part?” The method of Brain Drawing (Van Boeijen et al., 2013) was applied to diverge. Reverging was done with the method of “Clustering” (Heijne & Van der Meer, 2019). The initial selection was done with the “Hits and Dots”-method (Heijne & Van der Meer, 2019), which resulted in the selection of four ideas. To make a final choice between these ideas, the “Weighted Objectives”-method was applied (Van Boeijen et al., 2013). Looking at the scores the idea that came out best was the one where the Kevlar yarn is stitched through small holes at the edge of the hard part. Another expert meeting with Plaude (2022) indicated this to be the best solution. To get a better feel for the manufacturability and the look and feel of the connections, multiple prototypes were made. These can be found in Appendix 16.

#	Idea	Cl.	#	Idea	Cl.
1		for Cl.	10		Ba
2			11		
3			12		

4		13	
5		14	
6		15	
7		16	
8		17	

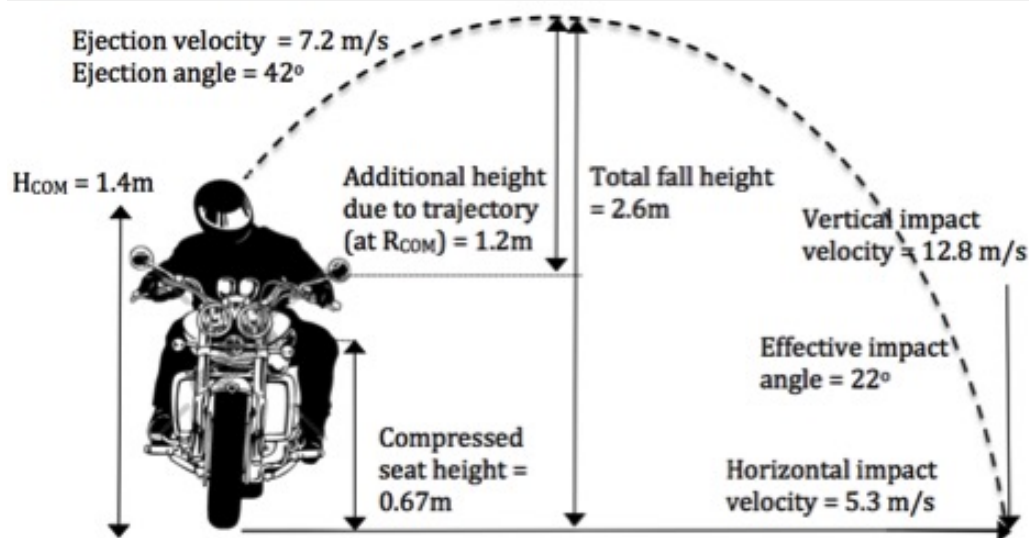
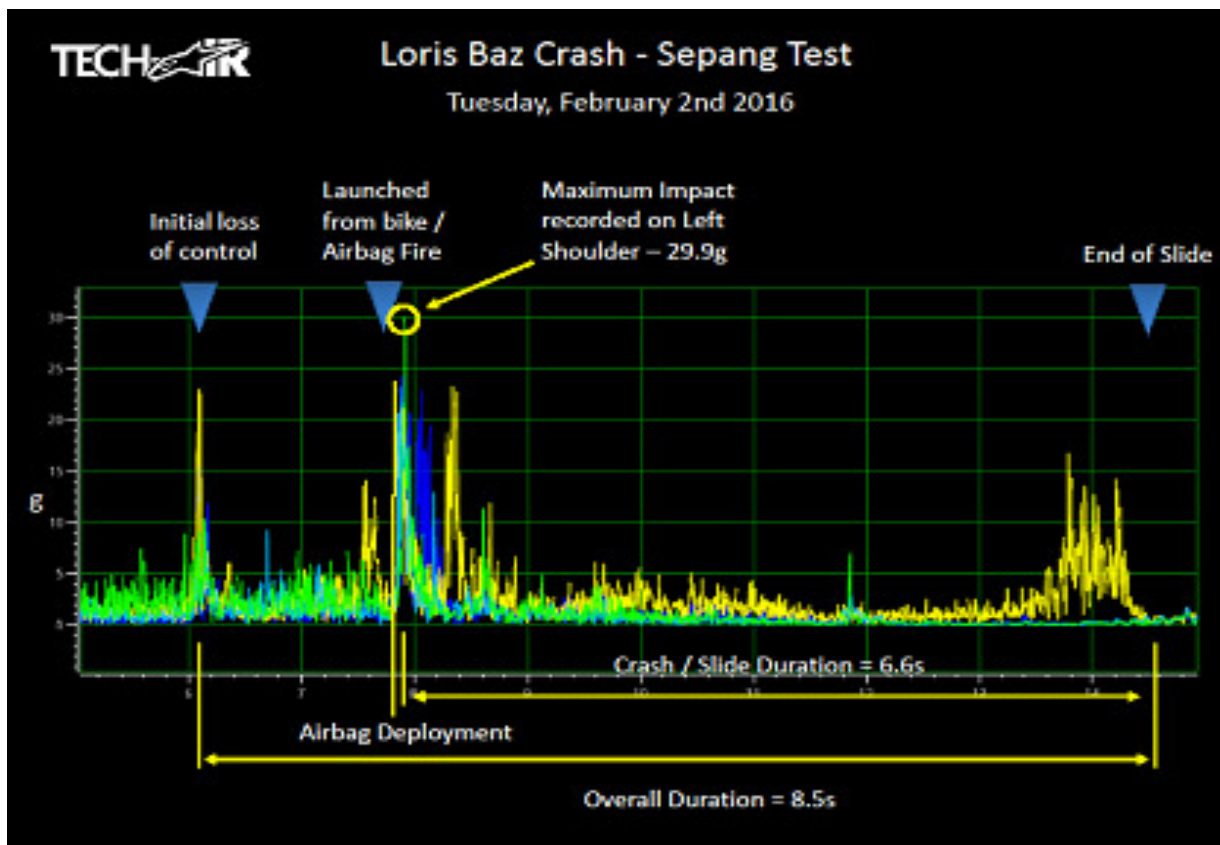


Weighted Objectives

	Weight	4: Small hole stitching		9: Added Structure		10: The Tunnel		15: Mould inserts	
		Score	Total	Score	Total	Score	Total	Score	Total
Strength	30	9	270	7	210	7	210	9	270
Longevity	25	8	200	7	175	7	175	8	200
Manufacturability	20	8	160	7	140	6	120	6	120
Sturdy look (Sense of safety)	15	7	105	6	90	7	105	8	120
Bulk	10	8	80	7	70	5	50	9	90
Total	100		815		685		660		800

Looking at the resulting scores, the most fitting concept would be idea 4, then idea 15 and then idea 9. With idea 4 as a basis, prototypes were created to get a better understanding of the advantages and disadvantages of the solution and to improve the idea, see Appendix 16.

APPENDIX 15. CALCULATIONS ANKLE BRACE

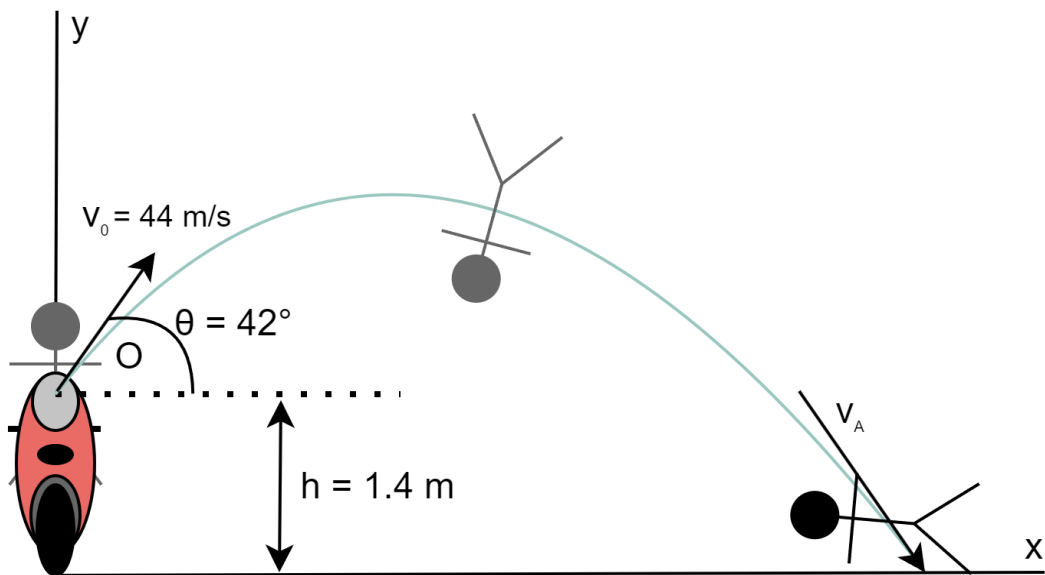


<https://www.roadracingworld.com/news/bazs-alpinestars-suit-recorded-299-g-impact-in-180-mph-crash-at-sepang/>

<https://drbiomechanics.com/motorcycle-accident-reconstruction-2/>

[> restart;

Kinematics



```
> mass := 77 ; massfoot := mass · 0.0145 ; Massminfoot := mass · (1 - 0.0145) ; tair := 0.6 :
  launchangle := 42 :
```

$$\begin{aligned} \text{massfoot} &:= 1.1165 \\ \text{Massminfoot} &:= 75.8835 \end{aligned} \quad (1.1)$$

```
> VelocityRider := 160 : LinVel := VelocityRider · \left( \frac{1000}{3600} \right) : AngularVelAnkle :=
  \frac{LinVel}{\left( \frac{r}{100} \right)} ; t1 := \frac{200}{(9.81 \cdot 7.7)} ; t2 := \frac{200}{(9.81 \cdot 29.9)} ; a1 := -\frac{200}{t1} ; a2 := -\frac{200}{t2} ;
  LinVel := evalf(LinVel) ;
```

$$\begin{aligned} \text{AngularVelAnkle} &:= \frac{40000}{9r} \\ t1 &:= 2.647709070 \\ t2 &:= 0.6818514996 \\ a1 &:= -75.53700000 \\ a2 &:= -293.3190000 \\ \text{LinVel} &:= 44.44444444 \end{aligned} \quad (1.2)$$

```
> vOx := LinVel · \cos\left(\frac{\text{launchangle}}{\left(\frac{180}{\text{Pi}}\right)}\right) : vOy := LinVel · \sin\left(\frac{\text{launchangle}}{\left(\frac{180}{\text{Pi}}\right)}\right) : vOx :=
  evalf(vOx) ; vOy := evalf(vOy) ;
```

$$\begin{aligned} vOx &:= 33.02865891 \\ vOy &:= 29.73913805 \end{aligned} \quad (1.3)$$

```
> vAx := vOx ; vAy := vOy + -9.81 · tair ; ya := 1.4 + (vOy · tair) - 0.5 · 9.81 · tair^2 ; x :=
  \frac{vAx}{\left(\frac{1000}{3600}\right)} ; \frac{vAy}{\left(\frac{1000}{3600}\right)}
```

$$vAx := 33.02865891$$

$$vAy := 23.85313805$$

$$ya := 17.47768283$$

$$x := 118.9031721$$

$$85.87129698$$

(1.4)

$$> \text{xrider} := 0 + vOx \cdot \text{tair} : \text{distanceflight} := \text{evalf}(\text{xrider});$$

$$\text{distanceflight} := 19.81719535$$

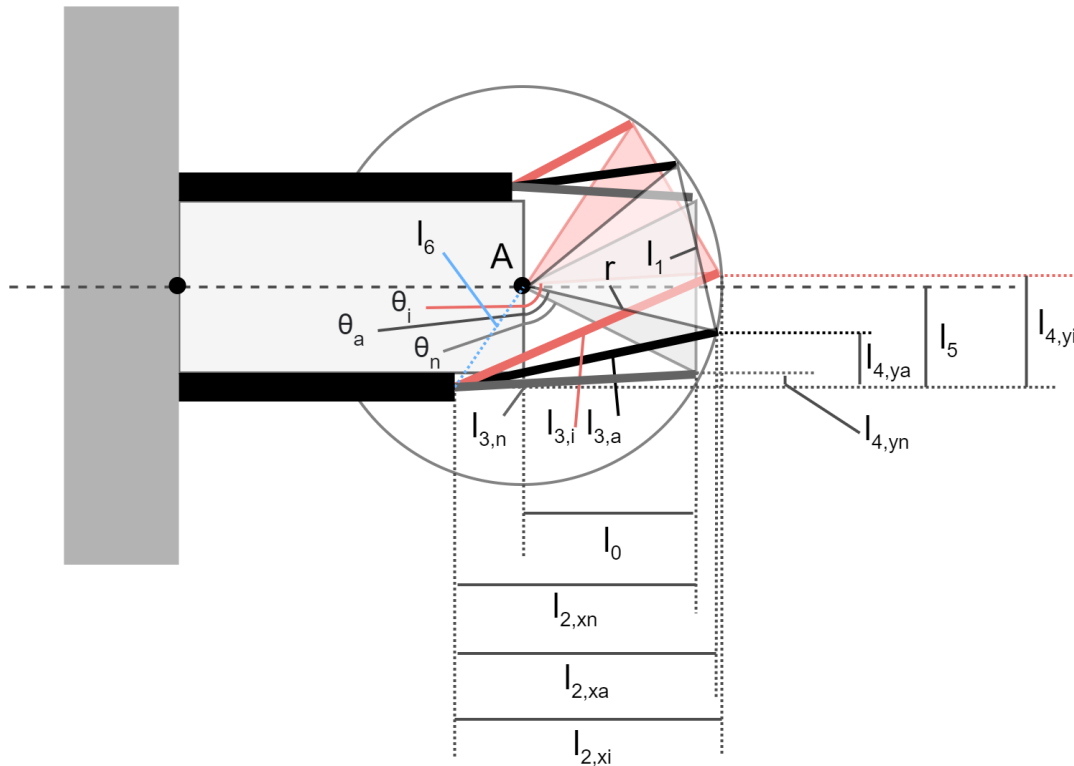
(1.5)

Eversion

Assumptions: all forces are translated in to movement.

The friction coefficient of the asphalt is 1 when the foot grips, so there will be no sliding.

Degrees to Elongation



$$> \text{heelwidth} := 7 + 0.5 : \text{malleoliwidth} := 7.6 + 0.5 : \text{lateral malleolus height} := 8.2 + 1 : \\ \text{CORSubtalarJointHeight} := 7.1 + 1 : \Theta_{\text{activerangeofmotion}} := 12.6 : \Theta_{\text{injury}} := 30 :$$

$$> l_{2x\text{neutral}} := \text{lateral malleolus height} : l_0 := \text{CORSubtalarJointHeight} : l_1 := \text{heelwidth} : \\ l_5 := \frac{\text{malleoliwidth}}{2} : l_{4y\text{neutral}} := l_5 - \frac{l_1}{2} : l_6 := \text{sqrt}((l_{2x\text{neutral}} - l_0)^2 + l_5^2);$$

$$l_5 := 4.050000000$$

$$l_{4y\text{neutral}} := 0.300000000$$

(2.1.1)

$$> \text{ElonNeutraltoactive} := \frac{l_{\text{neutraltoactive}}}{l_{3\text{neutral}}} \cdot 100;$$

$$\text{ElonActivetoinjury} := \frac{l_{\text{activetoinjury}}}{l_{3\text{active}}} \cdot 100;$$

$$\text{ElonNeutraltoinjury} := \frac{l_{\text{neutraltoinjury}}}{l_{3\text{neutral}}} \cdot 100;$$

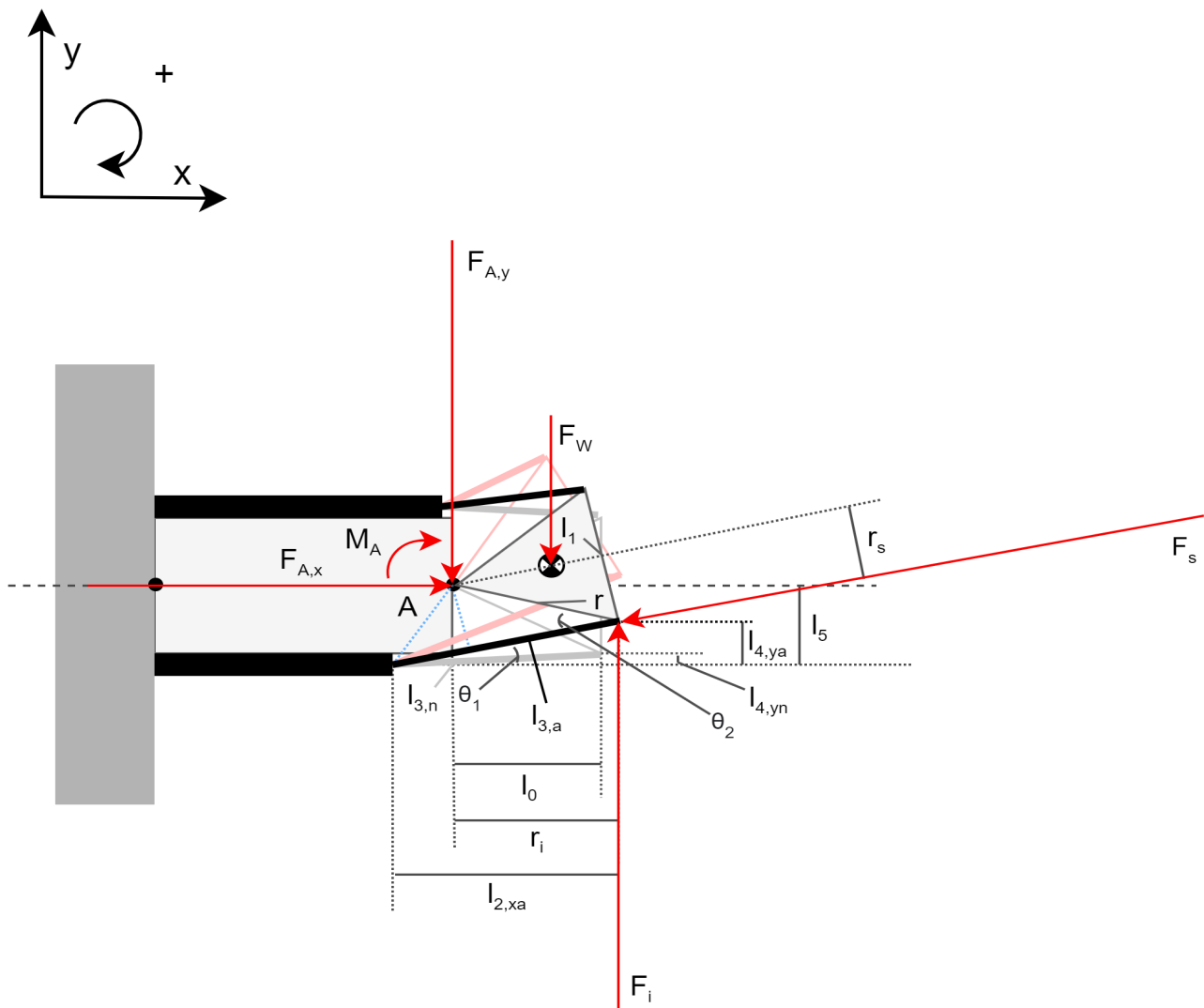
$$\text{ElonNeutraltoactive} := 9.257779882$$

$$\text{ElonActivetoinjury} := 10.42937350$$

$$\text{ElonNeutraltoinjury} := 20.65268182$$

(2.1.6)

Forces & Moments



$$> r_i := x_{act}, G := 29.9 : a := 9.81 : M_a := 0.0583 \cdot \Theta_{\text{activerangeofmotion}}^2 : \\ r_i := 8.722962928$$

(2.2.1)

$$\begin{aligned}
 &> Fi := G \cdot a \cdot mass; Fw := massfoot \cdot 9.81; \\
 &\quad \quad \quad Fi := 22585.563 \\
 &\quad \quad \quad Fw := 10.952865 \quad (2.2.2)
 \end{aligned}$$

$$\begin{aligned}
 &> \Theta l := \tan^{-1} \left(\frac{l4yneutral}{l2xneutral} \right) \cdot \left(\frac{180}{\text{Pi}} \right) + \Theta active range of motion; \\
 &\quad \quad \quad \Theta l := 14.46767884 \quad (2.2.3)
 \end{aligned}$$

$$\begin{aligned}
 &> \Theta 2 := \cos^{-1} \left(\frac{(l3active^2 + r^2 - l6^2)}{2 \cdot l3active \cdot r} \right) \cdot \left(\frac{180}{\text{Pi}} \right); \\
 &\quad \quad \quad \Theta 2 := 24.62877877 \quad (2.2.4)
 \end{aligned}$$

$$\begin{aligned}
 &> rs := \frac{\sin \left(\frac{\Theta 2 \cdot \text{Pi}}{180} \right) \cdot r}{\sin \left(\frac{90 \cdot \text{Pi}}{180} \right)}; Fsx := \frac{\sin \left(\frac{\Theta l \cdot \text{Pi}}{180} \right)}{\sin \left(\frac{90 \cdot \text{Pi}}{180} \right)} \cdot Fs; Fsy := \\
 &\quad \quad \quad \frac{\sin \left(\frac{(180 - 90 - \Theta l) \cdot \text{Pi}}{180} \right)}{\sin \left(\frac{90 \cdot \text{Pi}}{180} \right)} \cdot Fs; \\
 &\quad \quad \quad rs := 3.719775559 \\
 &\quad \quad \quad Fsx := 0.2498338219 Fs \\
 &\quad \quad \quad Fsy := 0.9682887284 Fs \quad (2.2.5)
 \end{aligned}$$

$$\begin{aligned}
 &> Ekin11 := 0.5 \cdot massfoot \cdot vAy^2; Ekin12 := 0.5 \cdot massfoot \cdot vAx^2; Ekin13 := 0.5 \cdot massfoot \\
 &\quad \quad \quad \cdot LinVel^2; \\
 &\quad \quad \quad Ekin11 := 317.6287278 \\
 &\quad \quad \quad Ekin12 := 608.9906315 \\
 &\quad \quad \quad Ekin13 := 1102.716050 \quad (2.2.6)
 \end{aligned}$$

$$\begin{aligned}
 &> U := Fs \cdot \cos \left(\frac{\Theta l}{\frac{180}{\text{Pi}}} \right) \cdot \left(\frac{lactive to injury}{100} \right); Ekin2 := 0 : \\
 &\quad \quad \quad U := 0.01015626612 Fs \quad (2.2.7)
 \end{aligned}$$

$$\begin{aligned}
 &> Energy1 := Ekin11 - U = Ekin2; Energy2 := Ekin12 - U = Ekin2; Energy3 := Ekin13 \\
 &\quad \quad \quad - U = Ekin2; \\
 &\quad \quad \quad Energy1 := 317.6287278 - 0.01015626612 Fs = 0 \\
 &\quad \quad \quad Energy2 := 608.9906315 - 0.01015626612 Fs = 0 \\
 &\quad \quad \quad Energy3 := 1102.716050 - 0.01015626612 Fs = 0 \quad (2.2.8)
 \end{aligned}$$

$$\begin{aligned}
 &> Fs1 := solve(Energy1, Fs); Fs2 := solve(Energy2, Fs); Fs3 := solve(Energy3, Fs); \\
 &\quad \quad \quad Fs1 := 31274.16356 \\
 &\quad \quad \quad Fs2 := 59962.05931 \\
 &\quad \quad \quad Fs3 := 108574.9464 \quad (2.2.9)
 \end{aligned}$$

$$\begin{aligned}
 &> Fx := Fsx - FAx; \\
 &\quad \quad \quad Fx := 0.2498338219 Fs - FAx \quad (2.2.10)
 \end{aligned}$$

$$\begin{aligned}
 &> \text{Sum}(F_x) = 0 : \\
 &> F_y := F_i - F_{sy} - F_{Ay} - F_w; \\
 &\quad F_y := 22574.61014 - 0.9682887284 F_s - F_{Ay}
 \end{aligned} \tag{2.2.11}$$

$$\begin{aligned}
 &> \text{Sum}(F_y) = 0 : \\
 &> M := F_i \cdot \left(\frac{r_i}{100} \right) - F_s \cdot \left(\frac{r_s}{100} \right) + M_a - F_w \cdot 0.5 \cdot \left(\frac{l_0}{100} \right); \\
 &\quad M := 1978.942405 - 0.03719775559 F_s
 \end{aligned} \tag{2.2.12}$$

$$\begin{aligned}
 &> \text{Sum}(M) = 0 : \\
 &> F_s := \text{fsolve}(M, F_s); \\
 &\quad F_s := 53200.58626
 \end{aligned} \tag{2.2.13}$$

$$\begin{aligned}
 &> F_{Ay} := \text{fsolve}(F_y, F_{Ay}); \\
 &\quad F_{Ay} := -28938.91788
 \end{aligned} \tag{2.2.14}$$

$$\begin{aligned}
 &> F_{Ax} := \text{fsolve}(F_x, F_{Ax}); \\
 &\quad F_{Ax} := 13291.30579
 \end{aligned} \tag{2.2.15}$$

Material Properties

$$\begin{aligned}
 &> \text{Width1} := \frac{2}{100} : \text{Thickness1} := \frac{0.3}{100} : A := \text{Width1} \cdot \text{Thickness1}; \delta := \\
 &\quad \text{lactivetoinjury}; \\
 &\quad A := 0.00006000000000
 \end{aligned} \tag{2.2.1.1}$$

$$\begin{aligned}
 &> E_{min1} := \frac{F_{s1} \cdot \left(\frac{l_{3active}}{100} \right)}{\left(\frac{\delta}{100} \right) \cdot 10^9 \cdot A}; E_{min2} := \frac{F_{s2} \cdot \left(\frac{l_{3active}}{100} \right)}{\left(\frac{\delta}{100} \right) \cdot 10^9 \cdot A}; E_{min3} := \\
 &\quad \frac{F_{s3} \cdot \left(\frac{l_{3active}}{100} \right)}{\left(\frac{\delta}{100} \right) \cdot 10^9 \cdot A}; \\
 &\quad E_{min1} := 4.997769610 \\
 &\quad E_{min2} := 9.582240535 \\
 &\quad E_{min3} := 17.35082592
 \end{aligned} \tag{2.2.1.2}$$

$$\begin{aligned}
 &> \sigma_{min1} := \frac{F_{s1}}{A \cdot 10^6}; \sigma_{min2} := \frac{F_{s2}}{A \cdot 10^6}; \sigma_{min3} := \frac{F_{s3}}{A \cdot 10^6}; \\
 &\quad \sigma_{min1} := 521.2360593 \\
 &\quad \sigma_{min2} := 999.3676552 \\
 &\quad \sigma_{min3} := 1809.582440
 \end{aligned} \tag{2.2.1.3}$$

$$\begin{aligned}
 &> \text{Elongationmax} := \frac{\text{delta}}{l_{3active}} \cdot 100; \\
 &\quad \text{Elongationmax} := 10.42937350
 \end{aligned} \tag{2.2.1.4}$$

Kevlar - Minimal Surface Area

> $ElongationKevTh := 2.8 : EKevTheory := 100 : \sigma KevTheory := 2880 :$
 $EKevTest := 4.5333 : \sigma Kev := 160 :$

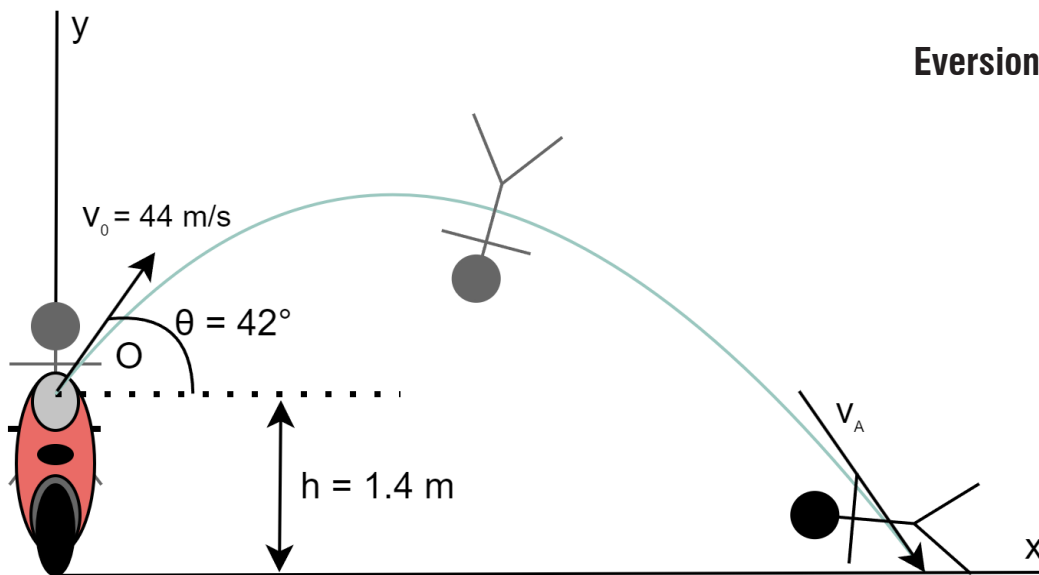
> $\delta Kev := \frac{ElongationKevTh}{100} \cdot l3active;$
 $\delta Kev := 0.2815976369$ (2.2.1.2.1)

> $Amin1 := \frac{Fs \cdot l3active}{\delta Kev \cdot 10^9 \cdot EKevTest};$
 $Amin1 := 0.0004191253475$ (2.2.1.2.2)

> $Amin2 := \frac{Fs}{\sigma Kev \cdot 10^6};$
 $Amin2 := 0.0003325036641$ (2.2.1.2.3)

> $WidthMax := \frac{2}{100} :$

> $ThicknessMin := \frac{Amin1}{WidthMax} \cdot 100;$
 $ThicknessMin := 2.095626738$ (2.2.1.2.4)



```
> mass := 77 ; massfoot := mass · 0.0145 ; Massminfoot := mass · (1 - 0.0145) ; tair := 0.6 :
  launchangle := 42 :
```

$$\text{massfoot} := 1.1165$$

$$\text{Massminfoot} := 75.8835$$

(1.1)

```
> VelocityRider := 160 : LinVel := VelocityRider · \left( \frac{1000}{3600} \right) : AngularVelAnkle :=
  \frac{LinVel}{\left( \frac{r}{100} \right)} ; t1 := \frac{200}{(9.81 \cdot 7.7)} ; t2 := \frac{200}{(9.81 \cdot 29.9)} ; a1 := -\frac{200}{t1} ; a2 := -\frac{200}{t2} ;
  LinVel := evalf(LinVel) ;
```

$$\text{AngularVelAnkle} := \frac{40000}{9 \cdot r}$$

$$t1 := 2.647709070$$

$$t2 := 0.6818514996$$

$$a1 := -75.53700000$$

$$a2 := -293.3190000$$

$$\text{LinVel} := 44.44444444$$

(1.2)

```
> vOx := LinVel · \cos\left(\frac{\text{launchangle}}{\left(\frac{180}{\text{Pi}}\right)}\right) : vOy := LinVel · \sin\left(\frac{\text{launchangle}}{\left(\frac{180}{\text{Pi}}\right)}\right) : vOx :=
  evalf(vOx) ; vOy := evalf(vOy) ;
```

$$vOx := 33.02865891$$

$$vOy := 29.73913805$$

(1.3)

```
> vAx := vOx ; vAy := vOy + -9.81 · tair ; ya := 1.4 + (vOy · tair) - 0.5 · 9.81 · tair^2 ; x :=
  \frac{vAx}{\left(\frac{1000}{3600}\right)} ; \frac{vAy}{\left(\frac{1000}{3600}\right)}
```

$$vAx := 33.02865891$$

$$vAy := 23.85313805$$

$$ya := 17.47768283$$

$$x := 118.9031721$$

$$85.87129698$$

(1.4)

$$> \text{xrider} := 0 + vOx \cdot \text{tair} : \text{distanceflight} := \text{evalf}(\text{xrider});$$

$$\text{distanceflight} := 19.81719535$$

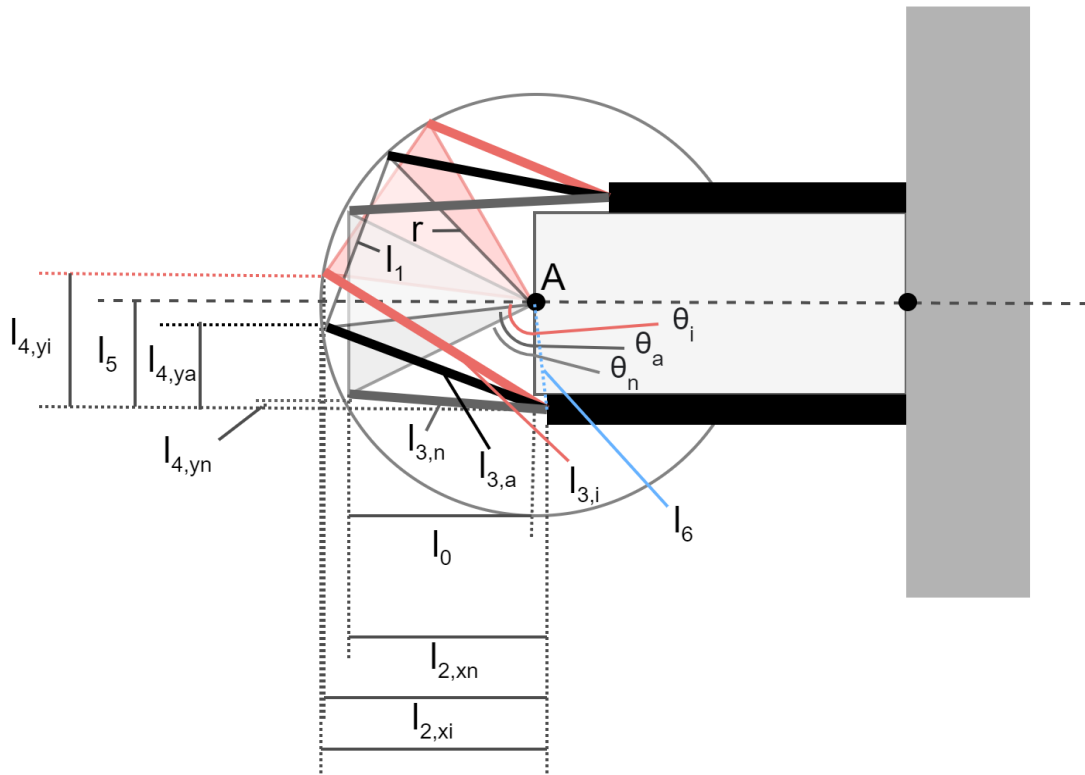
(1.5)

Inversion

Assumptions: all forces are translated in to movement.

The friction coefficient of the asphalt is 1 when the foot grips, so there will be no sliding.

Degrees to Elongation



$$> \text{heelwidth} := 7 + 0.5 : \text{malleoliwidth} := 7.6 + 0.5 : \text{lateral malleolus height} := 7.1 + 1 : \\ \text{CORSubtalarJointHeight} := 7.1 + 1 : \text{Oactiverangeofmotion} := 19.8 : \text{Oinjury} := 34 :$$

$$> \text{l2xneutral} := \text{lateral malleolus height} : \text{l0} := \text{CORSubtalarJointHeight} : \text{l1} := \text{heelwidth} : \\ \text{l5} := \frac{\text{malleoliwidth}}{2} ; \text{l4yneutral} := \text{l5} - \frac{\text{l1}}{2} ; \text{l6} := \text{sqrt}((\text{l2xneutral} - \text{l0})^2 + \text{l5}^2);$$

$$\text{l5} := 4.050000000$$

$$\text{l4yneutral} := 0.300000000$$

(2.11)

$$l6 := 4.050000000$$

(2.1.1)

$$\begin{aligned} &> l3neutral := \text{sqrt}(l4yneutral^2 + l2xneutral^2); r := \text{sqrt}\left(\left(\frac{l1}{2}\right)^2 + l0^2\right); \Theta neutral := \\ &\quad \tan^{-1}\left(\frac{l0}{0.5 \cdot l1}\right) \cdot \left(\frac{180}{\text{Pi}}\right); \Theta active := \Theta neutral + \Theta activerangeofmotion; \Theta injury := \\ &\quad \Theta neutral + \Theta injury; \end{aligned}$$

$$l3neutral := 8.105553652$$

$$r := 8.925945328$$

$$\Theta neutral := 65.15761090$$

$$\Theta active := 84.95761090$$

$$\Theta injury := 99.15761090$$

(2.1.2)

$$\begin{aligned} &> yact := \cos\left(\frac{(\Theta active)}{\left(\frac{180}{\text{Pi}}\right)}\right) \cdot r; xact := \sin\left(\frac{(\Theta active)}{\left(\frac{180}{\text{Pi}}\right)}\right) \cdot r; \\ &yinj := \cos\left(\frac{(\Theta injury)}{\left(\frac{180}{\text{Pi}}\right)}\right) \cdot r; xinj := \sin\left(\frac{(\Theta injury)}{\left(\frac{180}{\text{Pi}}\right)}\right) \cdot r; \\ &l4yactive := l5 - yact; l2xactive := (l2xneutral - l0) + xact; l4yinjury := l5 - yinj; \\ &l2xinjury := (l2xneutral - l0) + xinj; \end{aligned}$$

$$yact := 0.7845257273$$

$$xact := 8.891401430$$

$$yinj := -1.420571625$$

$$xinj := 8.812177725$$

$$l4yactive := 3.265474273$$

$$l2xactive := 8.891401430$$

$$l4yinjury := 5.470571625$$

$$l2xinjury := 8.812177725$$

(2.1.3)

$$\begin{aligned} &> l3n := l3neutral; l3active := \text{sqrt}(l4yactive^2 + l2xactive^2); l3injury := \text{sqrt}(l4yinjury^2 \\ &\quad + l2xinjury^2); \end{aligned}$$

$$l3n := 8.105553652$$

$$l3active := 9.472082222$$

$$l3injury := 10.37215649$$

(2.1.4)

$$\begin{aligned} &> lneutraltoactive := l3active - l3neutral; \\ &lactivetoinjury := l3injury - l3active; \\ &lneutraltoinjury := l3injury - l3neutral; \end{aligned}$$

$$lneutraltoactive := 1.366528570$$

$$lactivetoinjury := 0.900074268$$

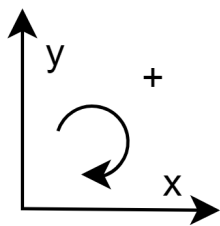
$$lneutraltoinjury := 2.266602838$$

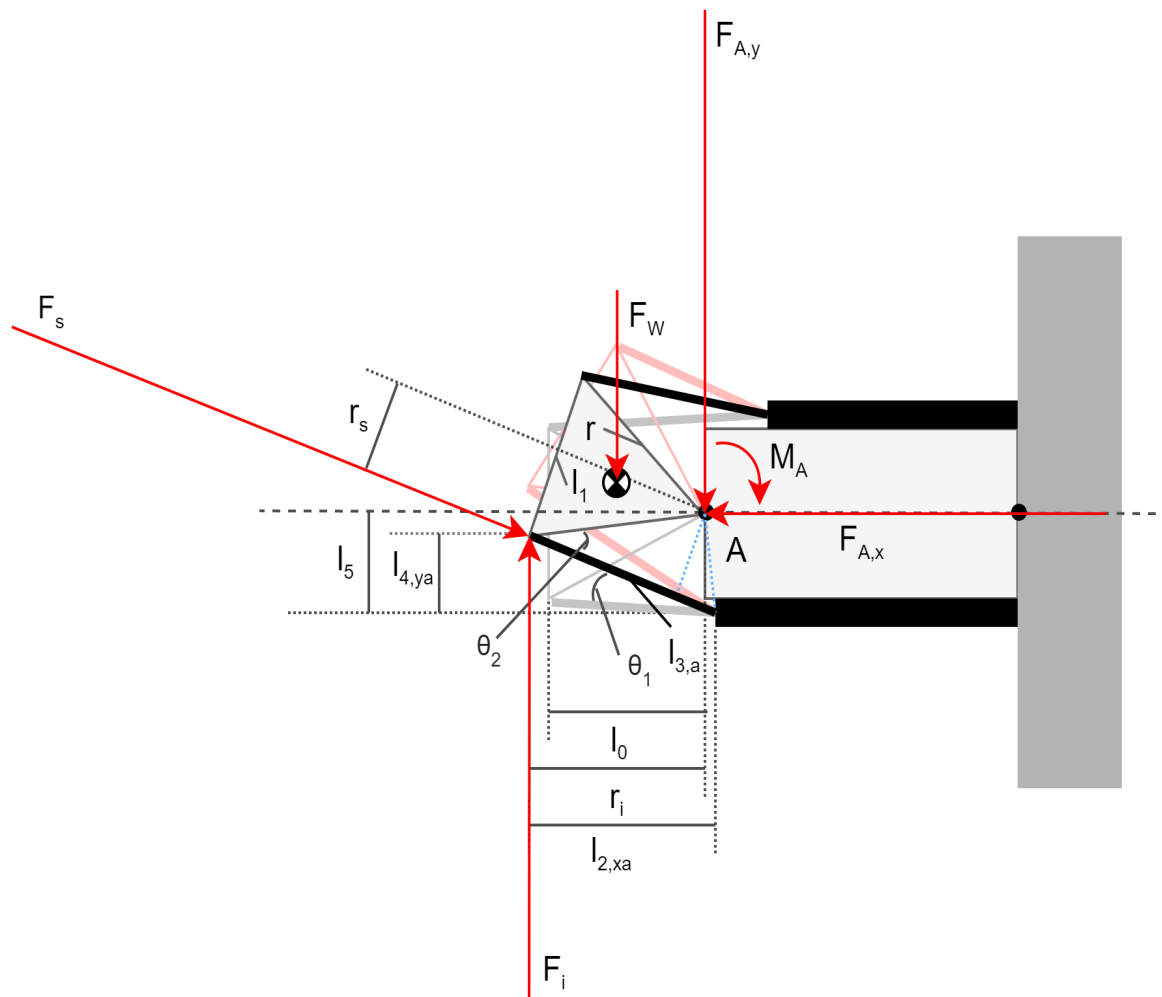
(2.1.5)

$$\begin{aligned}
 &> \text{ElonNeutraltoactive} := \frac{l_{\text{neutraltoactive}}}{l_{3\text{neutral}}} \cdot 100; \\
 &\text{ElonActivetoinjury} := \frac{l_{\text{activetoinjury}}}{l_{3\text{active}}} \cdot 100; \\
 &\text{ElonNeutraltoinjury} := \frac{l_{\text{neutraltoinjury}}}{l_{3\text{neutral}}} \cdot 100; \\
 &\text{ElonNeutraltoactive} := 16.85916384 \\
 &\text{ElonActivetoinjury} := 9.502390783 \\
 &\text{ElonNeutraltoinjury} := 27.96357825
 \end{aligned}
 \tag{2.1.6}$$

Forces & Moments

The equation of subtalar joint stiffness (inversion/eversion) is $y = 0.0583 \cdot x^2$, with x being the angle in degrees (Kjaersgaard-Andersen et al, 1988).





$$\begin{aligned} & \triangleright ri := xact; G := 29.9; a := 9.81; Ma := 0.0583 \cdot \Theta_{activerangeofmotion}^2; \\ & ri := 8.891401430 \end{aligned} \quad (2.2.1)$$

$$\begin{aligned} & \triangleright Fi := G \cdot a \cdot mass; Fw := massfoot \cdot 9.81; \\ & Fi := 22585.563 \\ & Fw := 10.952865 \end{aligned} \quad (2.2.2)$$

▼ Trial

$$\begin{aligned} & \triangleright Fm1 := mass \cdot a1; Fm2 := mass \cdot a2; Fv1 := massfoot \cdot a1; Fv2 := massfoot \cdot a2; \\ & Ekinbody := 0.5 \cdot mass \cdot LinVel^2; Ekinfoot := 0.5 \cdot massfoot \cdot LinVel^2; Ekinfoot := 0.5 \\ & \cdot massminfoot \cdot LinVel^2; On := \frac{r}{2} \cdot massfoot \cdot AngularVelAnkle - (massfoot \cdot 9.81); \\ & Ot := massfoot \cdot \left(\frac{r}{2} \right); \\ & Fm1 := -5816.349000 \\ & Fm2 := -22585.56300 \\ & Fv1 := -84.33706050 \\ & Fv2 := -327.4906635 \\ & Ekinbody := 76049.38270 \end{aligned}$$

$$l6 := 4.196724914$$

(2.1.1)

$$\begin{aligned} &> l3neutral := \text{sqrt}(l4yneutral^2 + l2xneutral^2); r := \text{sqrt}\left(\left(\frac{l1}{2}\right)^2 + l0^2\right); \Theta neutral := \\ &\quad \tan^{-1}\left(\frac{l0}{0.5 \cdot l1}\right) \cdot \left(\frac{180}{\text{Pi}}\right); \Theta active := \Theta neutral + \Theta activerangeofmotion; \Theta injury := \\ &\quad \Theta neutral + \Theta injury; \end{aligned}$$

$$l3neutral := 9.204890005$$

$$r := 8.925945328$$

$$\Theta neutral := 65.15761090$$

$$\Theta active := 77.75761090$$

$$\Theta injury := 95.15761090$$

(2.1.2)

$$\begin{aligned} &> yact := \cos\left(\frac{(\Theta active)}{\left(\frac{180}{\text{Pi}}\right)}\right) \cdot r; xact := \sin\left(\frac{(\Theta active)}{\left(\frac{180}{\text{Pi}}\right)}\right) \cdot r; \\ &yinj := \cos\left(\frac{(\Theta injury)}{\left(\frac{180}{\text{Pi}}\right)}\right) \cdot r; xinj := \sin\left(\frac{(\Theta injury)}{\left(\frac{180}{\text{Pi}}\right)}\right) \cdot r; \\ &l4yactive := l5 - yact; l2xactive := (l2xneutral - l0) + xact; l4yinj := l5 - yinj; \\ &l2xinjury := (l2xneutral - l0) + xinj; \end{aligned}$$

$$yact := 1.892727598$$

$$xact := 8.722962928$$

$$yinj := -0.8024047407$$

$$xinj := 8.889805770$$

$$l4yactive := 2.157272402$$

$$l2xactive := 9.822962928$$

$$l4yinj := 4.852404741$$

$$l2xinjury := 9.989805770$$

(2.1.3)

$$\begin{aligned} &> l3n := l3neutral; l3active := \text{sqrt}(l4yactive^2 + l2xactive^2); l3injury := \text{sqrt}(l4yinj^2 \\ &\quad + l2xinjury^2); \end{aligned}$$

$$l3n := 9.204890005$$

$$l3active := 10.05705846$$

$$l3injury := 11.10594665$$

(2.1.4)

$$\begin{aligned} &> lneutraltoactive := l3active - l3neutral; \\ &lactivetoinjury := l3injury - l3active; \\ &lneutraltoinjury := l3injury - l3neutral; \end{aligned}$$

$$lneutraltoactive := 0.852168455$$

$$lactivetoinjury := 1.04888819$$

$$lneutraltoinjury := 1.901056645$$

(2.1.5)

$$E_{kinfoot} := 1102.716050$$

$$E_{kinfoot} := 987.6543210 \text{ massminfoot}$$

$$O_n := 2470.158247$$

$$O_t := 4.982908980$$

(2.2.1.1)

$$> \text{rad} := (\Theta_{injury} - \Theta_{activerangeofmotion}) \cdot \left(\frac{\pi}{180} \right); \text{tankle} := \frac{\text{rad}}{\text{AngularVelAnkle}};$$

$$\text{Test} := 0.5 \cdot \left(\frac{(0 - \text{AngularVelAnkle})}{\text{trad}} \right) \cdot \text{trad}^2 + \text{AngularVelAnkle} \cdot \text{trad} - \text{rad};$$

$$\text{rad} := 1.385051597$$

$$\text{tankle} := 0.002781651337$$

$$\text{Test} := 248.9621144 \text{ trad} - 1.385051597$$

(2.2.1.2)

$$> \text{trad1} := \text{fsolve}(\text{Test}, \text{trad}); \text{arad} := \frac{(0 - \text{AngularVelAnkle})}{\text{trad1}};$$

$$\text{trad1} := 0.005563302675$$

$$\text{arad} := -89501.55294$$

(2.2.1.3)

$$> \Theta_l := \tan^{-1} \left(\frac{l_{4yneutral}}{l_{2xneutral}} \right) \cdot \left(\frac{180}{\text{Pi}} \right) + \Theta_{activerangeofmotion};$$

$$\Theta_l := 21.92109640$$

(2.2.3)

$$> \Theta_2 := \cos^{-1} \left(\frac{(l_{3active}^2 + r^2 - l_6^2)}{2 \cdot l_{3active} \cdot r} \right) \cdot \left(\frac{180}{\text{Pi}} \right);$$

$$\Theta_2 := 25.20875666$$

(2.2.4)

$$> r_s := \frac{\sin \left(\frac{\Theta_2 \cdot \text{Pi}}{180} \right) \cdot r}{\sin \left(\frac{90 \cdot \text{Pi}}{180} \right)}; F_{sx} := \frac{\sin \left(\frac{\Theta_l \cdot \text{Pi}}{180} \right)}{\sin \left(\frac{90 \cdot \text{Pi}}{180} \right)} \cdot F_s; F_{sy} :=$$

$$\frac{\sin \left(\frac{(180 - 90 - \Theta_l) \cdot \text{Pi}}{180} \right)}{\sin \left(\frac{90 \cdot \text{Pi}}{180} \right)} \cdot F_s;$$

$$r_s := 3.801716977$$

$$F_{sx} := 0.3733293882 F_s$$

$$F_{sy} := 0.9276988563 F_s$$

(2.2.5)

$$> E_{kin11} := 0.5 \cdot \text{massfoot} \cdot v_{Ay}^2; E_{kin12} := 0.5 \cdot \text{massfoot} \cdot v_{Ax}^2; E_{kin13} := 0.5 \cdot \text{massfoot} \cdot \text{LinVel}^2;$$

$$E_{kin11} := 317.6287278$$

$$E_{kin12} := 608.9906315$$

$$E_{kin13} := 1102.716050$$

(2.2.6)

$$\begin{aligned} &> U := F_s \cdot \cos\left(\frac{\Theta l}{180}\right) \cdot \left(\frac{l_{active} to injury}{100}\right); E_{kin2} := 0 : \\ &U := 0.008349978690 F_s \end{aligned} \quad (2.2.7)$$

$$\begin{aligned} &> Energy1 := E_{kin11} - U = E_{kin2}; Energy2 := E_{kin12} - U = E_{kin2}; Energy3 := E_{kin13} \\ &\quad - U = E_{kin2}; \\ &Energy1 := 317.6287278 - 0.008349978690 F_s = 0 \\ &Energy2 := 608.9906315 - 0.008349978690 F_s = 0 \\ &Energy3 := 1102.716050 - 0.008349978690 F_s = 0 \end{aligned} \quad (2.2.8)$$

$$\begin{aligned} &> F_{s1} := solve(Energy1, F_s); F_{s2} := solve(Energy2, F_s); F_{s3} := solve(Energy3, F_s); \\ &F_{s1} := 38039.46568 \\ &F_{s2} := 72933.19589 \\ &F_{s3} := 132062.1394 \end{aligned} \quad (2.2.9)$$

$$\begin{aligned} &> F_x := F_{sx} - F_{Ax}; \\ &F_x := 0.3733293882 F_s - F_{Ax} \end{aligned} \quad (2.2.10)$$

$$\begin{aligned} &> Sum(F_x) = 0 : \\ &> F_y := F_i - F_{sy} - F_{Ay} - F_w; \\ &F_y := 22574.61014 - 0.9276988563 F_s - F_{Ay} \end{aligned} \quad (2.2.11)$$

$$\begin{aligned} &> Sum(F_y) = 0 : \\ &> M := F_i \cdot \left(\frac{r_i}{100}\right) - F_s \cdot \left(\frac{r_s}{100}\right) + M_a - F_w \cdot 0.5 \cdot \left(\frac{l_0}{100}\right); \\ &M := 2030.585413 - 0.03801716977 F_s \end{aligned} \quad (2.2.12)$$

$$\begin{aligned} &> Sum(M) = 0 : \\ &> F_s := fsolve(M, F_s); \\ &F_s := 53412.32462 \end{aligned} \quad (2.2.13)$$

$$\begin{aligned} &> F_{ay} := fsolve(F_y, F_{Ay}); \\ &F_{ay} := -26975.94232 \end{aligned} \quad (2.2.14)$$

$$\begin{aligned} &> F_{ax} := fsolve(F_x, F_{Ax}); \\ &F_{ax} := 19940.39047 \end{aligned} \quad (2.2.15)$$

Material Properties

$$\begin{aligned} &> Width1 := \frac{2}{100} : Thickness1 := \frac{0.3}{100} : A := Width1 \cdot Thickness1; \delta := \\ &\quad l_{active} to injury : \\ &A := 0.00006000000000 \end{aligned} \quad (2.2.2.1)$$

$$> E_{min1} := \frac{F_{s1} \cdot \left(\frac{l_{3active}}{100}\right)}{\left(\frac{\delta}{100}\right) \cdot 10^9 \cdot A}; E_{min2} := \frac{F_{s2} \cdot \left(\frac{l_{3active}}{100}\right)}{\left(\frac{\delta}{100}\right) \cdot 10^9 \cdot A}; E_{min3} :=$$

$$\frac{Fs3 \cdot \left(\frac{l3_{active}}{100} \right)}{\left(\frac{\delta}{100} \right) \cdot 10^9 \cdot A};$$

$$Emin1 := 6.671911408$$

$$Emin2 := 12.79207825$$

$$Emin3 := 23.16296717$$

(2.2.2.2)

$$> \sigma_{min1} := \frac{Fs1}{A \cdot 10^6}; \sigma_{min2} := \frac{Fs2}{A \cdot 10^6}; \sigma_{min3} := \frac{Fs3}{A \cdot 10^6};$$

$$\sigma_{min1} := 633.9910947$$

$$\sigma_{min2} := 1215.553265$$

$$\sigma_{min3} := 2201.035657$$

(2.2.2.3)

$$> Elongationmax := \frac{\delta}{l3_{active}} \cdot 100;$$

$$Elongationmax := 9.502390783$$

(2.2.2.4)

▼ *Bepalen kracht voor trektest*

$$> Ft1 := \frac{\left(Emin \cdot \delta \cdot 10^9 \cdot \left(\frac{2.5}{100} \cdot \frac{0.04}{100} \right) \right)}{l3_{active}};$$

$$Ft1 := 8902.054104$$

(2.2.2.1.1)

$$> A2 := \frac{(10000 \cdot l3_{active})}{\delta \cdot 10^9 \cdot Emin};$$

$$A2 := 0.00001123336242$$

(2.2.2.1.2)

$$> Ft := \sigma_{min} \cdot \left(\frac{0.5}{100} \cdot \frac{0.04}{100} \right) \cdot 10^6;$$

$$Ft := 1780.410821$$

(2.2.2.1.3)

$$> A1 := \frac{10000}{\sigma_{min} \cdot 10^6};$$

$$A1 := 0.00001123336242$$

(2.2.2.1.4)

▼ *Kevlar - Minimal Surface Area*

$$> ElongationKevTh := 2.8 : EKevTheory := 100 : \sigma_{KevTheory} := 2880 :$$

$$EKevTest := 4.5333 : \sigma_{Kev} := 160 :$$

$$> \delta_{Kev} := \frac{ElongationKevTh}{100} \cdot l3_{active};$$

$$\delta_{Kev} := 0.2652183022$$

(2.2.2.3.1)

$$> Amin1 := \frac{Fs \cdot l3_{active}}{\delta_{Kev} \cdot 10^9 \cdot EKevTest};$$

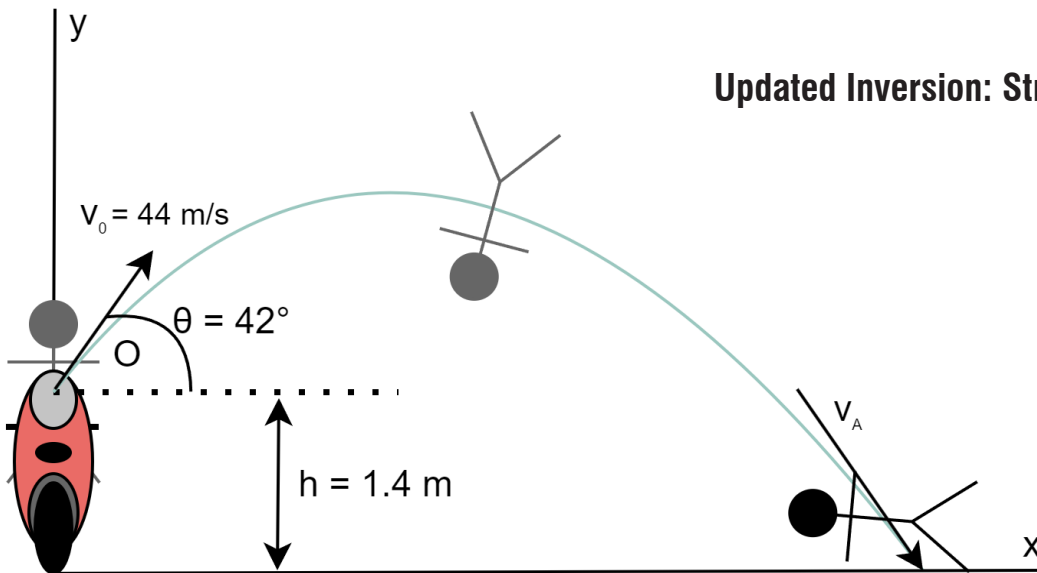
$$Amin1 := 0.0004207934666$$

(2.2.2.3.2)

$$\begin{aligned}
 & > \textit{Amin2} := \frac{Fs}{\sigma_{Kev} \cdot 10^6}; \\
 & \qquad \qquad \qquad \textit{Amin2} := 0.0003338270289 \qquad \qquad \qquad (2.2.2.3.3)
 \end{aligned}$$

$$\begin{aligned}
 & > \textit{WidthMax} := \frac{2}{100}; \\
 & > \textit{ThicknessMin} := \frac{\textit{Amin1}}{\textit{WidthMax}} \cdot 100; \\
 & \qquad \qquad \qquad \textit{ThicknessMin} := 2.103967333 \qquad \qquad \qquad (2.2.2.3.4)
 \end{aligned}$$

Updated Inversion: Straps & Brace



```
> mass := 77 ; massfoot := mass · 0.0145 ; Massminfoot := mass · (1 - 0.0145) ; tair := 0.6 :  
  launchangle := 42 :
```

$$\text{massfoot} := 1.1165$$

$$\text{Massminfoot} := 75.8835$$

(1.1)

```
> VelocityRider := 160 : LinVel := VelocityRider · \left( \frac{1000}{3600} \right) : AngularVelAnkle :=  
  \frac{LinVel}{\left( \frac{r}{100} \right)} ; t1 := \frac{200}{(9.81 \cdot 7.7)} ; t2 := \frac{200}{(9.81 \cdot 29.9)} ; a1 := -\frac{200}{t1} ; a2 := -\frac{200}{t2} ;  
  LinVel := evalf(LinVel) ;
```

$$\text{AngularVelAnkle} := \frac{40000}{9 \cdot r}$$

$$t1 := 2.647709070$$

$$t2 := 0.6818514996$$

$$a1 := -75.53700000$$

$$a2 := -293.3190000$$

$$\text{LinVel} := 44.44444444$$

(1.2)

```
> vOx := LinVel · cos\left( \frac{launchangle}{\left( \frac{180}{\text{Pi}} \right)} \right) : vOy := LinVel · sin\left( \frac{launchangle}{\left( \frac{180}{\text{Pi}} \right)} \right) : vOx :=  
  evalf(vOx) ; vOy := evalf(vOy) ;
```

$$vOx := 33.02865891$$

$$vOy := 29.73913805$$

(1.3)

```
> vAx := vOx ; vAy := vOy + -9.81 · tair ; ya := 1.4 + (vOy · tair) - 0.5 · 9.81 · tair^2 ; x :=  
  \frac{vAx}{\left( \frac{1000}{3600} \right)} ; \frac{vAy}{\left( \frac{1000}{3600} \right)}
```

$$vAx := 33.02865891$$

$$vAy := 23.85313805$$

$$ya := 17.47768283$$

$$x := 118.9031721$$

$$85.87129698$$

(1.4)

$$> \text{xrider} := 0 + vOx \cdot \text{tair} : \text{distanceflight} := \text{evalf}(\text{xrider});$$

$$\text{distanceflight} := 19.81719535$$

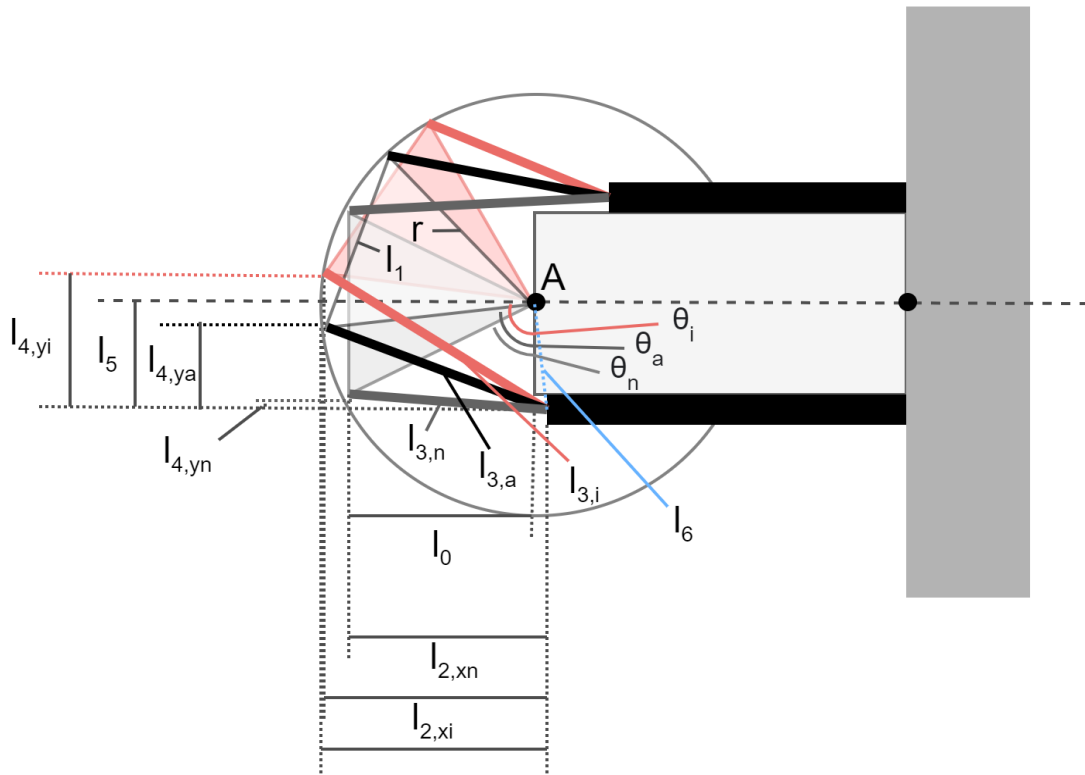
(1.5)

Inversion

Assumptions: all forces are translated in to movement.

The friction coefficient of the asphalt is 1 when the foot grips, so there will be no sliding.

Degrees to Elongation



$$> \text{heelwidth} := 7 + 0.5 : \text{malleoliwidth} := 7.6 + 0.5 : \text{lateralmalleolusheight} := 7.1 + 1 : \\ \text{CORSubtalarJointHeight} := 7.1 + 1 : \text{Oactiverangeofmotion} := 19.8 : \text{Oinjury} := 34 :$$

$$> \text{l2xneutral} := \text{lateralmalleolusheight} : \text{l0} := \text{CORSubtalarJointHeight} : \text{l1} := \text{heelwidth} : \\ \text{l5} := \frac{\text{malleoliwidth}}{2} : \text{l4yneutral} := \text{l5} - \frac{\text{l1}}{2} : \text{l6} := \text{sqrt}((\text{l2xneutral} - \text{l0})^2 + \text{l5}^2);$$

$$\text{l5} := 4.050000000$$

$$\text{l4yneutral} := 0.300000000$$

(2.11)

$$l6 := 4.050000000$$

(2.1.1)

$$\begin{aligned} &> l3neutral := \text{sqrt}(l4yneutral^2 + l2xneutral^2); r := \text{sqrt}\left(\left(\frac{l1}{2}\right)^2 + l0^2\right); \Theta neutral := \\ &\quad \tan^{-1}\left(\frac{l0}{0.5 \cdot l1}\right) \cdot \left(\frac{180}{\text{Pi}}\right); \Theta active := \Theta neutral + \Theta activerangeofmotion; \Theta injury := \\ &\quad \Theta neutral + \Theta injury; \end{aligned}$$

$$l3neutral := 8.105553652$$

$$r := 8.925945328$$

$$\Theta neutral := 65.15761090$$

$$\Theta active := 84.95761090$$

$$\Theta injury := 99.15761090$$

(2.1.2)

$$\begin{aligned} &> yact := \cos\left(\frac{(\Theta active)}{\left(\frac{180}{\text{Pi}}\right)}\right) \cdot r; xact := \sin\left(\frac{(\Theta active)}{\left(\frac{180}{\text{Pi}}\right)}\right) \cdot r; \\ yinj &:= \cos\left(\frac{(\Theta injury)}{\left(\frac{180}{\text{Pi}}\right)}\right) \cdot r; xinj := \sin\left(\frac{(\Theta injury)}{\left(\frac{180}{\text{Pi}}\right)}\right) \cdot r; \end{aligned}$$

$$\begin{aligned} l4yactive &:= l5 - yact; l2xactive := (l2xneutral - l0) + xact; l4yinj := l5 - yinj; \\ l2xinjury &:= (l2xneutral - l0) + xinj; yneutral := l5 - l4yneutral; displactoi := yact \\ &- yinj; displntoi := yneutral - yinj; displntoa := yneutral - yact; \end{aligned}$$

$$yact := 0.7845257273$$

$$xact := 8.891401430$$

$$yinj := -1.420571625$$

$$xinj := 8.812177725$$

$$l4yactive := 3.265474273$$

$$l2xactive := 8.891401430$$

$$l4yinj := 5.470571625$$

$$l2xinjury := 8.812177725$$

$$ynneutral := 3.750000000$$

$$displactoi := 2.205097352$$

$$displntoi := 5.170571625$$

$$displntoa := 2.965474273$$

(2.1.3)

$$\begin{aligned} &> l3n := l3neutral; l3active := \text{sqrt}(l4yactive^2 + l2xactive^2); l3injury := \text{sqrt}(l4yinj^2 \\ &\quad + l2xinjury^2); \end{aligned}$$

$$l3n := 8.105553652$$

$$l3active := 9.472082222$$

$$l3injury := 10.37215649$$

(2.1.4)

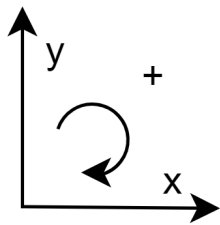
$$\begin{aligned} &> lneutraltoactive := l3active - l3neutral; \\ lactivetoinjury &:= l3injury - l3active; \end{aligned}$$

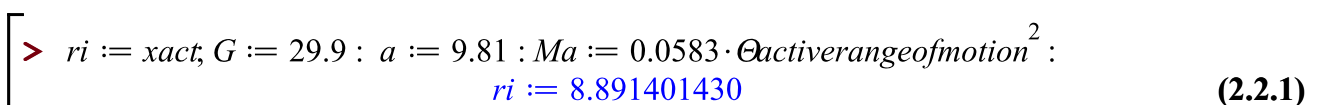
$$\begin{aligned}
 l_{\text{neutraltoinjury}} &:= l_{\text{injury}} - l_{\text{neutral}}, \\
 l_{\text{neutraltoactive}} &:= 1.366528570 \\
 l_{\text{activetoinjury}} &:= 0.900074268 \\
 l_{\text{neutraltoinjury}} &:= 2.266602838
 \end{aligned}
 \tag{2.1.5}$$

$$\begin{aligned}
 &> \text{ElonNeutraltoactive} := \frac{l_{\text{neutraltoactive}}}{l_{\text{neutral}}} \cdot 100; \\
 \text{ElonActivetoinjury} &:= \frac{l_{\text{activetoinjury}}}{l_{\text{active}}} \cdot 100; \\
 \text{ElonNeutraltoinjury} &:= \frac{l_{\text{neutraltoinjury}}}{l_{\text{neutral}}} \cdot 100; \\
 \text{ElonNeutraltoactive} &:= 16.85916384 \\
 \text{ElonActivetoinjury} &:= 9.502390783 \\
 \text{ElonNeutraltoinjury} &:= 27.96357825
 \end{aligned}
 \tag{2.1.6}$$

Forces & Moments

The equation of subtalar joint stiffness (inversion/eversion) is $y = 0.0583 \cdot x^2$, with x being the angle in degrees (Kjaersgaard-Andersen et al, 1988).





 Trial



$$Ekinfoot := 1102.716050$$

$$Ekinfoot := 987.6543210 \text{ massminfoot}$$

$$On := 2470.158247$$

$$Ot := 4.982908980$$

(2.2.1.1)

$$> \text{rad} := (\Theta_{injury} - \Theta_{activerangeofmotion}) \cdot \left(\frac{\pi}{180} \right); \text{tankle} := \frac{\text{rad}}{\text{AngularVelAnkle}};$$

$$\text{Test} := 0.5 \cdot \left(\frac{(0 - \text{AngularVelAnkle})}{\text{trad}} \right) \cdot \text{trad}^2 + \text{AngularVelAnkle} \cdot \text{trad} - \text{rad};$$

$$\text{rad} := 1.385051597$$

$$\text{tankle} := 0.002781651337$$

$$\text{Test} := 248.9621144 \text{ trad} - 1.385051597$$

(2.2.1.2)

$$> \text{trad1} := \text{fsolve}(\text{Test}, \text{trad}); \text{arad} := \frac{(0 - \text{AngularVelAnkle})}{\text{trad1}};$$

$$\text{trad1} := 0.005563302675$$

$$\text{arad} := -89501.55294$$

(2.2.1.3)

$$> \Theta l := \tan^{-1} \left(\frac{l4yneutral}{l2xneutral} \right) \cdot \left(\frac{180}{\text{Pi}} \right) + \Theta_{activerangeofmotion};$$

$$\Theta l := 21.92109640$$

(2.2.3)

$$> \Theta 2 := \cos^{-1} \left(\frac{(l3active^2 + r^2 - l6^2)}{2 \cdot l3active \cdot r} \right) \cdot \left(\frac{180}{\text{Pi}} \right);$$

$$\Theta 2 := 25.20875666$$

(2.2.4)

$$> rs := \frac{\sin \left(\frac{\Theta 2 \cdot \text{Pi}}{180} \right) \cdot r}{\sin \left(\frac{90 \cdot \text{Pi}}{180} \right)}; Fsx := \frac{\sin \left(\frac{\Theta l \cdot \text{Pi}}{180} \right)}{\sin \left(\frac{90 \cdot \text{Pi}}{180} \right)} \cdot Fs; Fsy :=$$

$$\frac{\sin \left(\frac{(180 - 90 - \Theta l) \cdot \text{Pi}}{180} \right)}{\sin \left(\frac{90 \cdot \text{Pi}}{180} \right)} \cdot Fs;$$

$$rs := 3.801716977$$

$$Fsx := 0.3733293882 Fs$$

$$Fsy := 0.9276988563 Fs$$

(2.2.5)

$$> Ekin11 := 0.5 \cdot \text{massfoot} \cdot vAy^2; Ekin12 := 0.5 \cdot \text{massfoot} \cdot vAx^2; Ekin13 := 0.5 \cdot \text{massfoot} \cdot \text{LinVel}^2;$$

$$Ekin11 := 317.6287278$$

$$Ekin12 := 608.9906315$$

$$Ekin13 := 1102.716050$$

(2.2.6)

$$\begin{aligned}
 &> U := F_s \cdot \cos\left(\frac{0}{180}\right) \cdot \left(\frac{\text{displactoi}}{100}\right) + F_s \cdot \cos\left(\frac{\Theta l}{180}\right) \cdot \left(\frac{\text{lactivetoinjury}}{100}\right); \\
 &\quad E_{kin2} := 0 : \\
 &\quad \quad U := 0.03040095221 F_s \quad (2.2.7)
 \end{aligned}$$

$$\begin{aligned}
 &> \text{Energy1} := E_{kin11} - U = E_{kin2}; \text{Energy2} := E_{kin12} - U = E_{kin2}; \text{Energy3} := E_{kin13} \\
 &\quad - U = E_{kin2}; \\
 &\quad \quad \text{Energy1} := 317.6287278 - 0.03040095221 F_s = 0 \\
 &\quad \quad \text{Energy2} := 608.9906315 - 0.03040095221 F_s = 0 \\
 &\quad \quad \text{Energy3} := 1102.716050 - 0.03040095221 F_s = 0 \quad (2.2.8)
 \end{aligned}$$

$$\begin{aligned}
 &> F_{s1} := \text{solve}(\text{Energy1}, F_s); F_{s2} := \text{solve}(\text{Energy2}, F_s); F_{s3} := \text{solve}(\text{Energy3}, F_s); \\
 &\quad \quad F_{s1} := 10447.98616 \\
 &\quad \quad F_{s2} := 20031.95911 \\
 &\quad \quad F_{s3} := 36272.41813 \quad (2.2.9)
 \end{aligned}$$

$$\begin{aligned}
 &> F_x := F_{sx} - F_{Ax}; \\
 &\quad \quad F_x := 0.3733293882 F_s - F_{Ax} \quad (2.2.10)
 \end{aligned}$$

$$\begin{aligned}
 &> \text{Sum}(F_x) = 0 : \\
 &> F_y := F_i - F_{sy} - F_{Ay} - F_w; \\
 &\quad \quad F_y := 22574.61014 - 0.9276988563 F_s - F_{Ay} \quad (2.2.11)
 \end{aligned}$$

$$\begin{aligned}
 &> \text{Sum}(F_y) = 0 : \\
 &> M := F_i \cdot \left(\frac{r_i}{100}\right) - F_s \cdot \left(\frac{r_s}{100}\right) + M_a - F_w \cdot 0.5 \cdot \left(\frac{l_0}{100}\right); \\
 &\quad \quad M := 2030.585413 - 0.03801716977 F_s \quad (2.2.12)
 \end{aligned}$$

$$\begin{aligned}
 &> \text{Sum}(M) = 0 : \\
 &> F_s := \text{fsolve}(M, F_s); \\
 &\quad \quad F_s := 53412.32462 \quad (2.2.13)
 \end{aligned}$$

$$\begin{aligned}
 &> F_{Ay} := \text{fsolve}(F_y, F_{Ay}); \\
 &\quad \quad F_{Ay} := -26975.94232 \quad (2.2.14)
 \end{aligned}$$

$$\begin{aligned}
 &> F_{Ax} := \text{fsolve}(F_x, F_{Ax}); \\
 &\quad \quad F_{Ax} := 19940.39047 \quad (2.2.15)
 \end{aligned}$$

Material Properties

$$\begin{aligned}
 &> \text{Width1} := \frac{2}{100} : \text{Thickness1} := \frac{0.3}{100} : A := \text{Width1} \cdot \text{Thickness1}; \delta := \\
 &\quad \text{lactivetoinjury} : \\
 &\quad \quad A := 0.00006000000000 \quad (2.2.2.1)
 \end{aligned}$$

$$> E_{min1} := \frac{F_{s1} \cdot \left(\frac{l_{3active}}{100}\right)}{\left(\frac{\delta}{100}\right) \cdot 10^9 \cdot A}; E_{min2} := \frac{F_{s2} \cdot \left(\frac{l_{3active}}{100}\right)}{\left(\frac{\delta}{100}\right) \cdot 10^9 \cdot A}; E_{min3} :=$$

$$\frac{Fs3 \cdot \left(\frac{l3active}{100} \right)}{\left(\frac{\delta}{100} \right) \cdot 10^9 \cdot A};$$

$$Emin1 := 1.832518853$$

$$Emin2 := 3.513494582$$

$$Emin3 := 6.361981063 \quad (2.2.2.2)$$

$$> \sigma_{min1} := \frac{Fs1}{A \cdot 10^6}; \sigma_{min2} := \frac{Fs2}{A \cdot 10^6}; \sigma_{min3} := \frac{Fs3}{A \cdot 10^6};$$

$$\sigma_{min1} := 174.1331027$$

$$\sigma_{min2} := 333.8659852$$

$$\sigma_{min3} := 604.5403022 \quad (2.2.2.3)$$

$$> Elongationmax := \frac{\delta}{l3active} \cdot 100;$$

$$Elongationmax := 9.502390783 \quad (2.2.2.4)$$

▼ *Bepalen kracht voor trektest*

$$> Ft1 := \frac{\left(Emin \cdot \delta \cdot 10^9 \cdot \left(\frac{2.5}{100} \cdot \frac{0.04}{100} \right) \right)}{l3active};$$

$$Ft1 := 950.2390783 \text{ Emin} \quad (2.2.2.1.1)$$

$$> A2 := \frac{(10000 \cdot l3active)}{\delta \cdot 10^9 \cdot Emin};$$

$$A2 := \frac{0.0001052366739}{Emin} \quad (2.2.2.1.2)$$

$$> Ft := \sigma_{min} \cdot \left(\frac{0.5}{100} \cdot \frac{0.04}{100} \right) \cdot 10^6;$$

$$Ft := 2.000000000 \sigma_{min} \quad (2.2.2.1.3)$$

$$> A1 := \frac{10000}{\sigma_{min} \cdot 10^6};$$

$$A1 := \frac{1}{100 \sigma_{min}} \quad (2.2.2.1.4)$$

▼ *Kevlar - Minimal Surface Area*

$$> ElongationKevTh := 2.8 : EKevTheory := 100 : \sigma_{KevTheory} := 2880 :$$

$$EKevTest := 4.5333 : \sigma_{Kev} := 160 :$$

$$> \delta_{Kev} := \frac{ElongationKevTh}{100} \cdot l3active;$$

$$\delta_{Kev} := 0.2652183022 \quad (2.2.2.3.1)$$

$$> \text{Amin1} := \frac{Fs \cdot l3_{active}}{\delta Kev \cdot 10^9 \cdot EKevTest};$$

$$\text{Amin1} := 0.0004207934666 \quad (2.2.2.3.2)$$

$$> \text{Amin2} := \frac{Fs}{\sigma Kev \cdot 10^6};$$

$$\text{Amin2} := 0.0003338270289 \quad (2.2.2.3.3)$$

$$> \text{WidthMax} := \frac{2}{100};$$

$$> \text{ThicknessMin} := \frac{\text{Amin1}}{\text{WidthMax}} \cdot 100;$$

$$\text{ThicknessMin} := 2.103967333 \quad (2.2.2.3.4)$$

APPENDIX 16. DESIGN CHOICE SUPPORTING TESTS

16.1. First Measurements

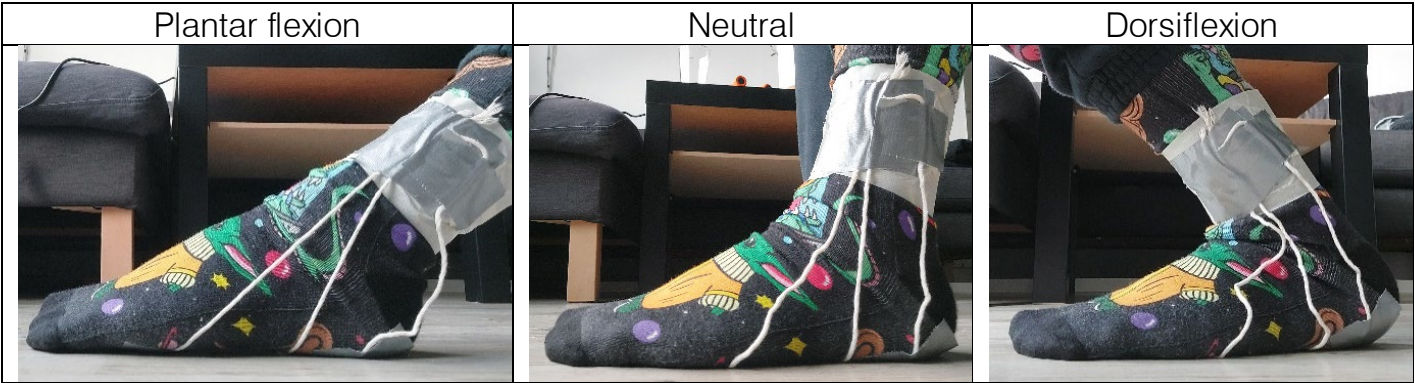
Calculating the amount stretch required for purely inversion and eversion is doable, as also data was available for these calculations. Combining the movement of inversion and eversion with plantar and dorsiflexion makes this very complex. To avoid getting lost in the theory, simple measurements were done of the amount needed to be provided to allow for the maximum active joint angles. At first the special contraption below was made to see how the different motions overlap, as to not limit other movements by limiting one. After that measurements were taken of other test subjects to get an understanding of the variance per person. The results were the foundation for the needed stretch per strap indicated in Appendix 18 about the knitting patterns.



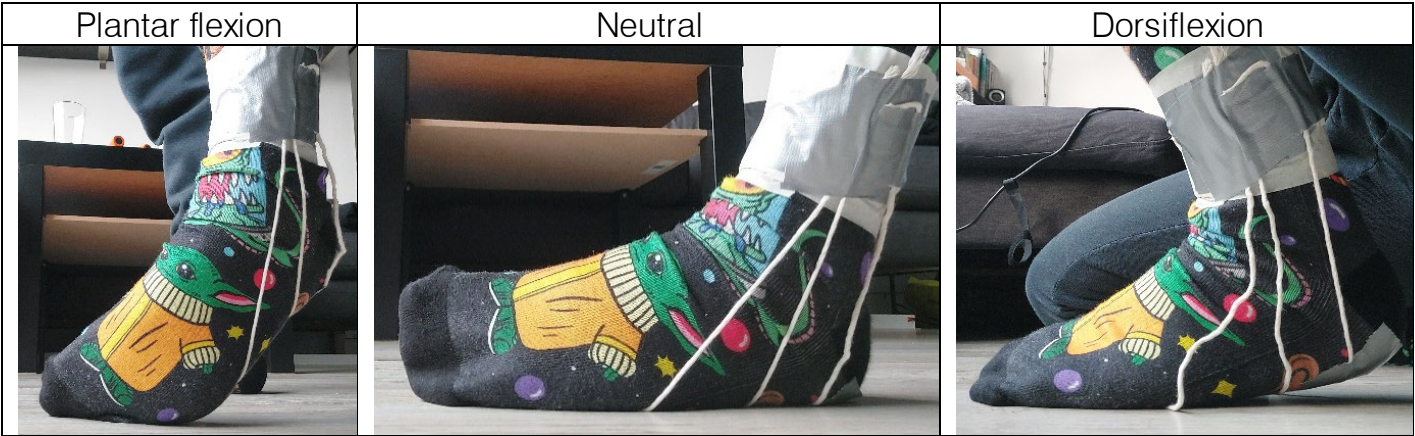
16.2. Topology Straps

The ligamentous structure on the lateral side is made up out of three connections. The ATF, CF and PTF ligaments of the collateral lateral ligament, connect the anterior (front) side of the talus and fibula, calcaneus and fibula and the posterior (back) side of the talus and fibula, respectively. The way they are laid out makes it so that they prohibit motion up onto a certain angle in different scenarios involving inversion. These scenarios are inversion combined with plantar flexion (ATFL), inversion combined with dorsiflexion (PTFL) and purely inversion (CFL). Compared to the deltoid ligament or collateral medial ligament (combined ligamentous structure on the medial side of the ankle), these are just small straps connecting the bones making them the most prone to damage. Therefore, preventing hyper rotation in all directions of inversion has the priority, but the other ligamentous structures are also considered. Supporting or even entirely relieving the ligaments is the main purpose of the ankle brace as these structures are not made for the enormous amount of force that would be applied to them during a crash. For this reason, the choice was made to create a system out of strong and stiff straps that mimic the ligamentous structures and to potentially add structures to limit adduction and abduction. Important is that the movement of plantar flexion and dorsiflexion should be as free as possible, as this does not result in injury and is indicated as an important design choice by the riders (Alpinestars, n.d.; Appendix 5). In theory this should be the case with the use of straps, but to be sure a rapid prototype was created with the use of strings and tape. Not only was this test about experiencing whether it would be possible to limit a certain set of movements and allow for another set, but the goal was also to figure out the right topology of the straps in the case of inversion and eversion in all scenarios. Moreover, a strap solution for limiting adduction and adduction was explored.

Neutral



Inversion



Eversion



The tests showed that three straps would be necessary to limit inversion and eversion in maximal plantar flexion and dorsiflexion and in a neutral position as the straps would tension at different angles. Interestingly in any foot position, the strings would not limit plantar flexion not dorsiflexion, which was the goal to be able to provide the wanted freedom of movement. In terms of the location of the straps it turned out to be important to avoid the malleoli as these are sensitive to pressure. Furthermore, the strap for plantarflexion and xversion should be placed as far to the forefoot as possible.

Though a good approximation, the initial test was done with strings instead of straps. To make sure the small pressure area was not the foundation of the conclusions, the same tests were done with knitted straps. This resulted in the same conclusions.



The findings were confirmed by another test person: no straps on the malleoli and no crossing the straps over the foot:



Takeaways

- The straps should be guided alongside the lateral and medial malleolus.
- The straps should not cross over the foot.
- Per side at least three straps are required for xversion while in plantar flexed, dorsiflexed or neutral position.
- The strap construction does not limit plantar flexion nor dorsiflexion which is exactly the way the riders wanted their freedom of movement to be.

16.3. Comparing Active Bracing, Passive Bracing & Taping

The figure below shows a prototype of the active brace of Betterguards, a passive brace of Orthobroker and a taping structure. I considered it important to feel the difference between the different available options, potentially taking something away from the experience for the design of the ankle brace.

The BetterGuard is a softshell brace that offers more and less support depending on the velocity of the extension of the micro-damper (Betterguards, n.d.). The brace limits the movement of inversion combined with plantarflexion. Talking to a former employee of the company made clear that it was truly making a difference in the sports world and that they are the first to try this type of brace. As velocity influences the likelihood of an injury, the idea arose to create a system that responds to this rapid movement. Though proven to work both in theory and in practice, issues with tensioning the straps were indicated. Users would not know how to do this properly and explaining it is fairly difficult. Wearing the brace for a while it very interesting to feel the difference in support depending on the speed of the movement. Yet, the brace was very uncomfortable to wear. This was also indicated in tests (OTWorld, 2022).



Takeaways

- The passive stiff brace barely prevents movement.
- Active bracing is relatively new but could be a great solution that stretches the displacement and decelerates slower, which is less uncomfortable.
- The tensioning of the active brace is apparently a big struggle and wearing it so tight that you could sense the support was a rather uncomfortable experience.
- As the bottom of the active brace was soft, the brace only worked when standing on it and then twisting the ankle. Otherwise, the sock-like structure would move along.
- The active brace was quite tight and therefore difficult to put on.
- With stiff tape a good foundation can be made that actually limits movement.

16.4. Strap Connection Prototypes

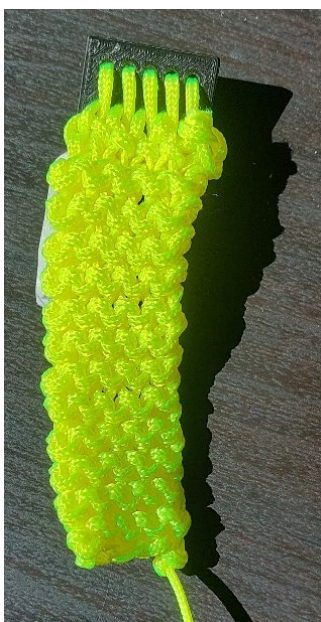
Based on the ideation the step was taken to compare different types of connections to see how they would function in practice. The first prototype was born by poking holes in cardboard, but the versions that followed were 3D printed and connected to the straps already created for the knitting pattern research.



The version with the smaller holes was the winner as this allowed the fibers to remain in places even when moved sideways. The connections were really stiff and

A static computer test and a real-life test will be done to confirm if the stiffness and strength of the connection is sufficient.

Based on these findings an iterated version was created:



16.5. Hard Part Prototypes

Based on the ideation sessions and with the help of a scan, multiple concepts were created and compared to the concept of REV'IT!. The initial test was to see whether the hard parts would fit well. 3D prints were made and these prints were strapped to the foot. Over the inner boot, in the inner boots and without an inner boot.



Takeaways

- The 3D prints were so comfortable on the foot, that I would forget that I was wearing them.
- The edges of the lower part should be less curved inwards.
- Wearing the brace inside the inner boot, would be an interesting area to explore.
- The shapes should be slightly larger for the situation of the brace being worn over the inner boot.
- The situation with no inner boot and the hard parts over the inner boot were most comfortable.
- Compared to the version of REV'IT! less pressure points were felt and the extra freedom of movement was very nice.

APPENDIX 17. QUESTIONNAIRE RIDER INPUT ANKLE PROTECTION

Intro

Hi! Thank you so much for participating in this survey regarding ankle injuries in top-level riders. During the Rider Event at REV'IT! last year, it became clear that ankle protection is an area of improvement for racing boots. That's why we would like to dive deeper into this topic, to strive for a system that helps you perform best and keeps you as protected as possible. It should take up to 10 minutes to complete.

The results of this survey will be used to draw conclusions for my graduation project, and they will only be shared with REV'IT! (at the end of the study, you can indicate whether you would like your results to be stored and stored anonymously). In any case, the medical data will be stored and shared anonymously and deleted at the end of my project.

There's no guarantee that REV'IT! will be able to implement the findings of this research, but they will serve as a base for future developments regarding the racing boots of REV'IT!. If you've got any questions or remarks or if at some point you would like me to remove your data, please feel free to contact me via

Best regards,
Sanne Guis
R&I Intern REV'IT!

Info

Name

Age

Nationality

At about what age did you start road racing?



Racing Competition & Level previous season

☐ MotoGP

☐ Moto2

☐ Moto3

☐ Other

Which boots do you wear now while racing?

Remarks/Elaboration:

The Boot

In general, on a scale from 1 to 10:

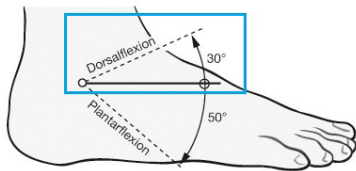
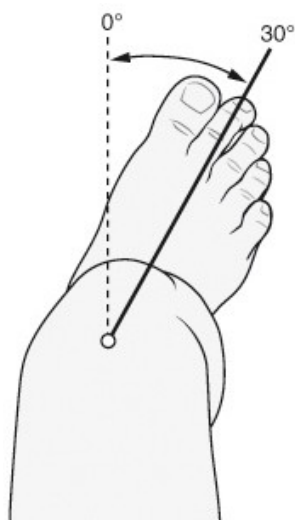
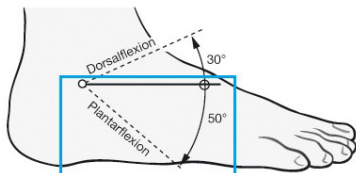
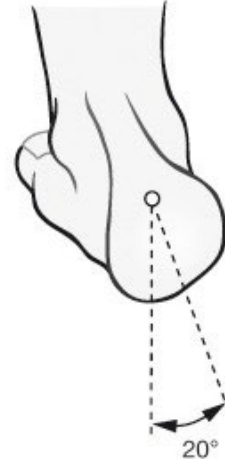
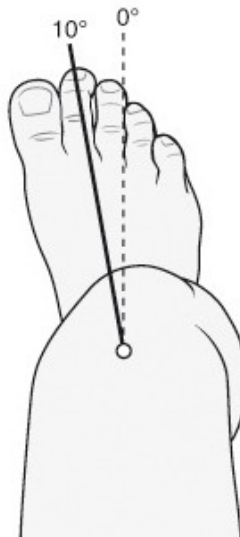
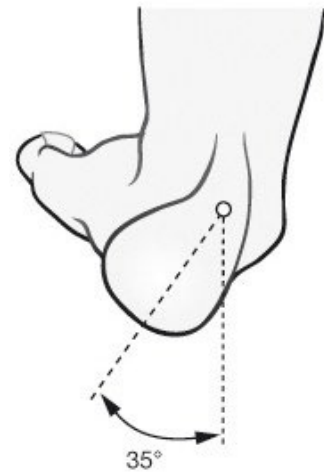
	1	2	3	4	5	6	7	8	9	10
How important is the ankle protection system in your boots to you? 1 = I would leave it out if I could 10 = I wouldn't wear a boot that doesn't have one	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How would you rate the ankle protection provided by your current boots? 1 = They don't protect my ankles at all 10 = They protect my ankles in any type of crash	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Elaboration/Remarks:



In which direction(s) would you like your boot to restrict overstretching?

Which direction(s) is/are the most important in your opinion?


☐
☐

☐

☐
☐

☐

☐

None of the directions

☐

Other

Remarks:



Please indicate what you consider to be more important when it comes to your boots:

So, if you had to choose between these factors, would you find the ankle protection more important or the other factor (weight, bulk, etc.).

For example...

- When I find the weight of the boot way more important than how well my boot protects my ankle, I would indicate this below with a 5, 6 or a 7 in Protection VS Weight.
- If I find the protection way more important than the weight was the other way around, I will indicate this below with a 1, 2 or a 3 in Protection VS Weight.
- If I would find both factors equally important, I indicate this with a 4.

	1	2	3	4	5	6	7
Best ankle protection (1) VS Best freedom of movement while riding (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Best ankle protection (1) VS Feeling safe (7) <i>If you had to choose between an ankle protection system in your boot that you don't feel at all, but that does offer proven protection (1) and a system that feels sturdy and safe but that isn't proven to offer any protection (7), which one would you choose?</i>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Best ankle protection (1) VS Less bulkiness (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Best ankle protection (1) VS Less weight (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Best ankle protection (1) VS Best tactile feel (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Best ankle protection (1) VS Best freedom of movement while walking (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Remarks:

Is there anything you do to prevent ankle injury?

E.g., training, applying tape, wearing special socks.

Which of the boots you've tried before provides the best ankle protection and why?

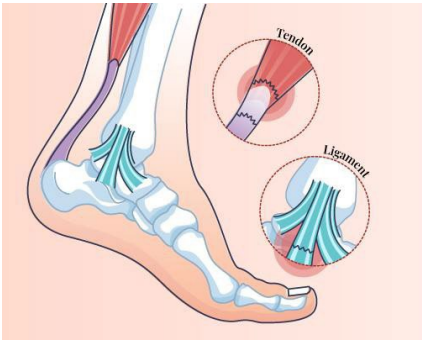
E.g., they prevented injury, feel sturdy and safe, don't limit my movement.

What makes a boot feel safe? What properties contribute to that feeling?

Maybe that it feels tight, comfortable, stiff and/or heavy? Or that it looks technical, like what you know, qualitative, and/or expensive? Or that the CE-levels of the boot are high? Anything goes!



Type of Injury



Tendons are connective tissues connecting muscles to bones.
Ligaments are connective tissues connecting one bone to another bone.

While road racing, did you ever...

Including tests, trainings, qualifications, races, etc. on circuits going as far back in time as you remember.

	Yes	No
... <u>overstretch</u> any ligaments in the area between your knee and toes?	<input type="radio"/>	<input type="radio"/>
... <u>tear</u> any ligaments in the area between your knee and toes?	<input type="radio"/>	<input type="radio"/>
... <u>break</u> any bones in the area between your knee and toes?	<input type="radio"/>	<input type="radio"/>
... <u>overstretch</u> any tendons in the area between your knee and toes?	<input type="radio"/>	<input type="radio"/>
... <u>tear</u> any tendons in the area between your knee and toes?	<input type="radio"/>	<input type="radio"/>
... <u>overstretch</u> any muscles in the area between your knee and toes?	<input type="radio"/>	<input type="radio"/>
... <u>tear</u> any muscles in the area between your knee and toes?	<input type="radio"/>	<input type="radio"/>
... <u>injure</u> yourself in the area between your knee and toes but it wasn't clear what exactly got damaged (from the abovementioned options)?	<input type="radio"/>	<input type="radio"/>

Please elaborate on your injuries:

- Do you recall which injury you specifically endured?
- How did this happen (highsider, lowsider, slip of the foot peg, etc.)?
- How long were you unable to ride?
- Which boots were you wearing during the incident (if you remember)?
- What helped you in your recovery?



After the injury

Is there anyone you go to once you've got an injury? If so, who?

E.g., the circuit medics, your doctor, a physical therapist

Is there anything you do differently once you've got an ankle injury?

E.g., less riding, different trainings, extra physical exercises, wearing a brace, applying tape, wearing different boots.

Processing

How would you like me to process your data?

- ☐ Onymously
☐ Anonymously

Would you be okay with doing a follow up interview regarding your answers?

- ☐ Yes
☐ No

Please fill in the contact info you would like me to use:

Any suggestions, general remarks or questions?



APPENDIX 18. RESULTS QUESTIONNAIRE RIDER INPUT

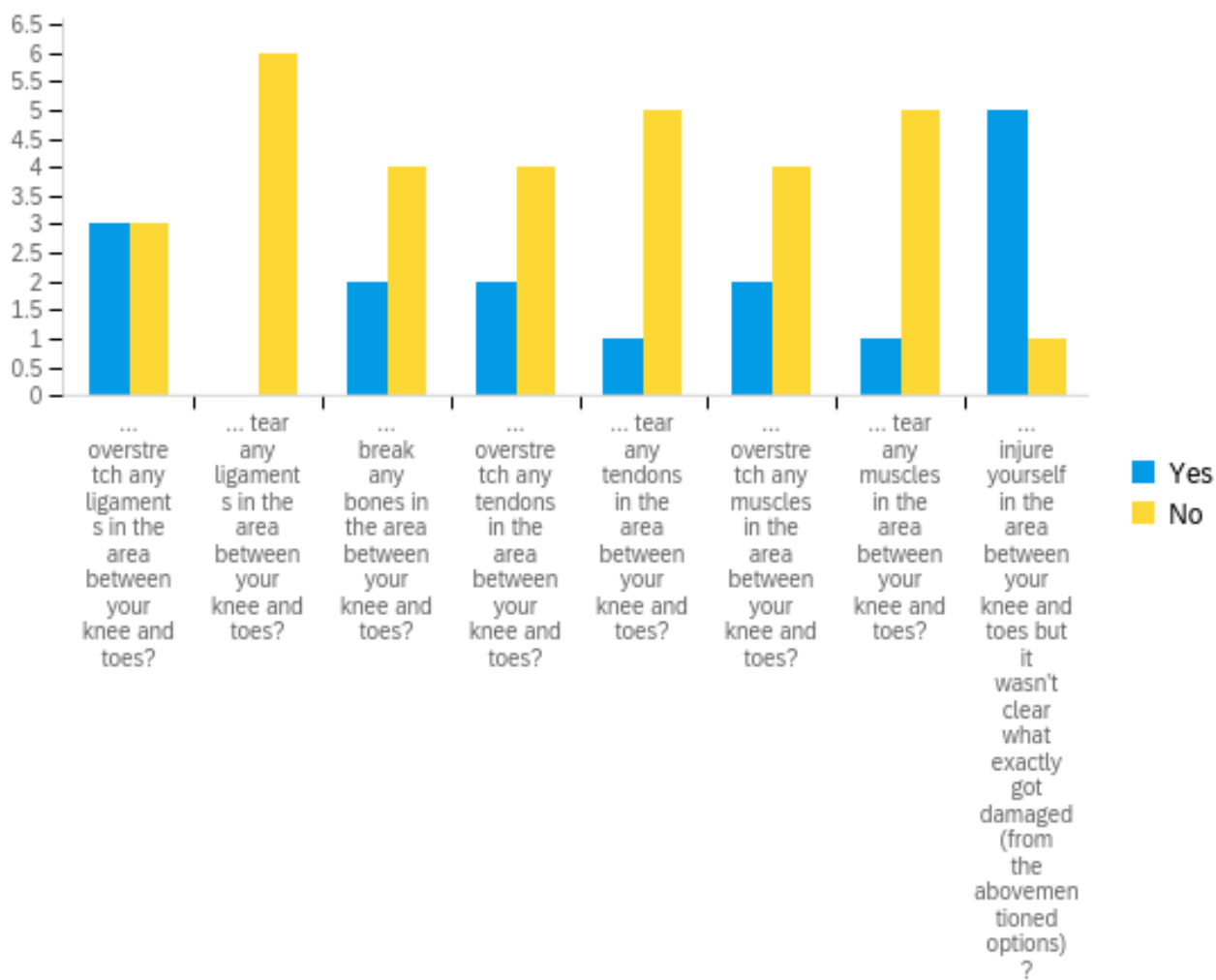
These are the results of the questionnaire of Appendix 17. This Qualtrics questionnaire was sent out to all eleven riders of REV'IT! to fill in on their mobile devices and even a paper version was distributed. Unfortunately, despite a lot of time and effort, not that many riders had the opportunity to fill it in. Therefore, the research was expended with acquainted riders from other competitions. The sample group is six people of which three are REV'IT! riders. Obviously, this means no conclusions of significance can be drawn. However, it can serve as a first step in understanding the rider's preferences, opinions, and experiences.

Results

Summary Results

Participant	1	2	3	4	5	6	
Age	17	18	22	25	30	40	
Riding Level	Moto2	Moto3	Moto3	British Superbike	Dutch ONK OW Cup	National	
Boot	Alpinestars Supertech R V2	XPD	Forma Boots	Dainese Axial D1	Difi mugello	Sidi	Av g
Importance of Ankle Protection	8	6	9	10	8	6	7,8
Current Ankle Protection	8	10	10	10	3	7	8,0
Wanted Movement Limitations	Inv	Dorsi	Abd	Inv, Ev	Add, Abd, Inv, Ev	Add, Abd, Inv, Ev	
AP (1) vs FoM while Riding (7)	4	5	4	5	5	3	4,3
AP (1) vs Feeling Safe (7)	4	5	4	4	1	5	3,8
AP (1) vs Bulk (7)	4	3	4	1	5	6	3,8
AP (1) vs Weight (7)	4	5	5	5	5	5	4,8
AP (1) vs FoM Walking (7)	4	4	3	7	2	3	3,8
AP (1) vs Tactile Feel (7)	4	4	4	4	5	5	4,3

While road racing, did you ever... Including tests, trainings, qualifications, races, etc. on circuits going as far back in time as you remember.



#	Question	Yes		No		Total
1	... overstretch any ligaments in the area between your knee and toes?	50.00%	3	50.00%	3	6
2	... tear any ligaments in the area between your knee and toes?	0.00%	0	100.00%	6	6
3	... break any bones in the area between your knee and toes?	33.33%	2	66.67%	4	6
4	... overstretch any tendons in the area between your knee and toes?	33.33%	2	66.67%	4	6
5	... tear any tendons in the area between your knee and toes?	16.67%	1	83.33%	5	6
6	... overstretch any muscles in the area between your knee and toes?	33.33%	2	66.67%	4	6
7	... tear any muscles in the area between your knee and toes?	16.67%	1	83.33%	5	6
8	... injure yourself in the area between your knee and toes but it wasn't clear what exactly got damaged (from the abovementioned options)?	83.33%	5	16.67%	1	6



Please elaborate on your injuries: - Do you recall which injury you specifically endured? - How did this happen (highsider, lowsider, slip of the foot peg, etc.)? - How long were you unable to ride? - Which boots were you wearing during the incident (if you remember)? - What helped you in your recovery?

The muscles on my ankle and my Achilles

High sided and on another occasion stuck between motorcycle and the asphalt. Grinded down on ankle side. Both were Berik.

Bruised ankle/top of foot, low sider where my foot got under the motor, was not very severe, could still ride training was a bit difficult and took some rest for 2 weeks, I wore Difi Mugello at the crash, in the recovery helped cooling and rest

With Alpinestars, I had injured ankle and toe. One toe broke little when I hit.

- I overstretched something before / twisted my foot, basically whilst coming out of a corner on a karting track, I lost control, the bike wheelied and my foot slipped off, it twisted (leg straight, but foot touching the tarmac with the outside or inside, I can't remember which way). I am not sure where exactly, but I know it was my left foot that 'twisted'

- I broke one toe when slamming into a tire barrier after a crash, broke a small bone in my foot highsiding in Misano (T5) and twisted my foot on the 'Junior Track' in Assen

- 1 other small bone in my foot (separate crash) I was wearing Alpinestars Supertech R

Is there anyone you go to once you've got an injury? If so, who? E.g. the circuit medics, your doctor, a physical therapist

Medics and fysio

Circuit medic, and if the problem is lasting longer then an x period, or something I can't work around during x period, my doctor

Physical therapist

No

My doctor

I have a therapist in the Netherlands that I visit when I have broken bones.

Is there anything you do differently once you've got an ankle injury? E.g. less riding, different trainings, extra physical exercises, wearing a brace, applying tape, wearing different boots

Fysio and tape

Adjust and adapt riding

Less riding and different trainings to reduce load on the ankle, after enough rest slowly build up the training again.

Nothing

I haven't had one so I can't confirm, but I guess try to stress it less. So let's say if you run often, do it less or not at all.

In general, on a scale from 1 to 10:

#		Field	Mean				
2	How would you rate the ankle protection provided by your current boots? 1 = They don't protect my ankles at all 10 = They protect my ankles in any type of crash		8.00				
1	How important is the ankle protection system in your boots to you? 1 = I would leave it out if I could 10 = I wouldn't wear a boot that doesn't have one		7.83				
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	How important is the ankle protection system in your boots to you? 1 = I would leave it out if I could 10 = I wouldn't wear a boot that doesn't have one	6.0	10.0	7.8	1.5	2.1	6
2	How would you rate the ankle protection provided by your current boots? 1 = They don't protect my ankles at all 10 = They protect my ankles in any type of crash	3.0	10.0	8.0	2.5	6.3	6

Elaboration/Remarks:

De dainese laarzen waar ik mee rijd hebben mijn al een paar keer gered tegen een blessure. De laarzen zitten ook goed en comfortabel

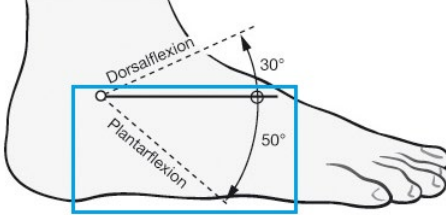
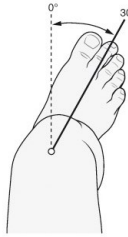
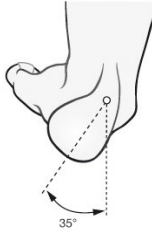
Hardened and stiff leather with carbon plate reinforcement. I'd like to think top 70% regarding to feet and ankle safety. Could be better, could be worse. Price vs wear and tear plays a big part.

Only side protection, no stifferers in the boots that prevent over stretching or limit ankle movement

I have personally never had a ankle injury, hence why I am not sure how much it'd influence. Although, I reckon (depending on the injury) it could greatly affect it, since you won't be able to put pressure on the footpeg.



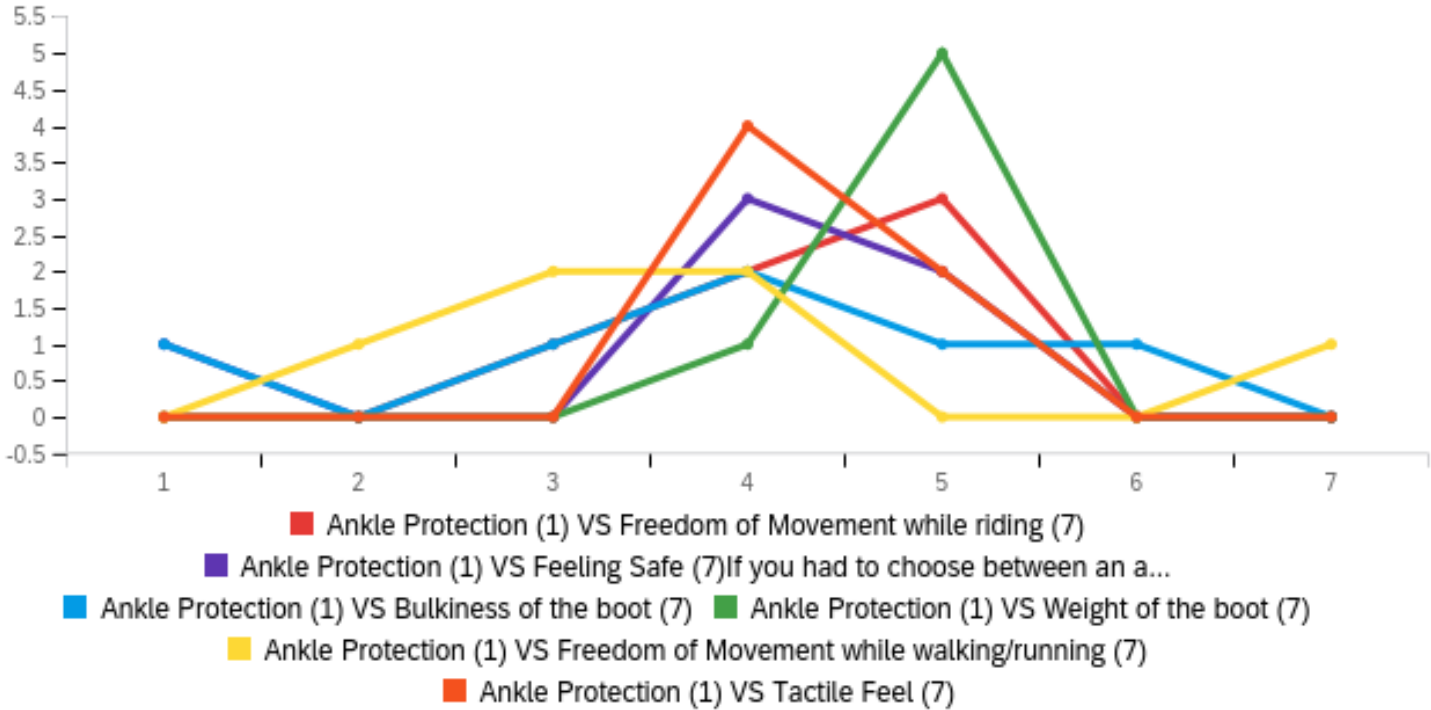
In which direction(s) would you like your boot to restrict overstretching? Which direction(s) is/are the most important in your opinion?

#	Answer		%	Count
1	Dorsiflexion		7.69%	1
2	Plantarflexion		0.00%	0
3	Adduction		15.38%	2
4	Abduction		23.08%	3
5	Eversion		23.08%	3
6	Inversion		30.77%	4
7	None of the directions		0.00%	0
8	Other		0.00%	0
	Total		100%	13

Remarks:

High side and "landing" protection

Please indicate what you consider to be more important when it comes to your boots: So, if you had to choose between these factors, would you find the ankle protection more important or the other factor (weight, bulk, etc.). For example, if I find the weight of the boot way more important than how well my boot protects my ankle, I would indicate this below with a five, six or a seven (depending on how important I think find the weight), but if it was the other way around, I would fill in a one, two or three. If I would find both factors equally important, I indicate this with a four.



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Ankle Protection (1) VS Freedom of Movement while riding (7)	3.00	5.00	4.33	0.75	0.56	6
2	Ankle Protection (1) VS Feeling Safe (7) If you had to choose between an ankle protection system in your boot that you don't feel at all, but that does offer proven protection (1) and a system that feels sturdy and safe but that isn't proven to offer any protection (7), which one would you choose?	1.00	5.00	3.83	1.34	1.81	6
3	Ankle Protection (1) VS Bulkiness of the boot (7)	1.00	6.00	3.83	1.57	2.47	6
4	Ankle Protection (1) VS Weight of the boot (7)	4.00	5.00	4.83	0.37	0.14	6



5	Ankle Protection (1) VS Freedom of Movement while walking/running (7)	2.00	7.00	3.83	1.57	2.47	6
6	Ankle Protection (1) VS Tactile Feel (7)	4.00	5.00	4.33	0.47	0.22	6

#	Question	1	2	3	4	5	6	7	Tot
1	Ankle Protection (1) VS Freedom of Movement while riding (7)	0.0% 0	0.0% 0	16.7% 1	33.3% 2	50.0% 3	0.0% 0	0.0% 0	6
2	Ankle Protection (1) VS Feeling Safe (7) If you had to choose between an ankle protection system in your boot that you don't feel at all, but that does offer proven protection (1) and a system that feels sturdy and safe but that isn't proven to offer any protection (7), which one would you choose?	16.7% 1	0.0% 0	0.0% 0	50.0% 3	33.3% 2	0.0% 0	0.0% 0	6
3	Ankle Protection (1) VS Bulkiness of the boot (7)	16.7% 1	0.0% 0	16.7% 1	33.3% 2	16.7% 1	16.7% 1	0.0% 0	6
4	Ankle Protection (1) VS Weight of the boot (7)	0.0% 0	0.0% 0	0.0% 0	16.7% 1	83.3% 5	0.0% 0	0.0% 0	6
5	Ankle Protection (1) VS Freedom of	0.0% 0	16.7% 1	33.3% 2	33.3% 2	0.0% 0	0.0% 0	16.7% 1	6

	Movement while walking/running (7)																
6	Ankle Protection (1) VS Tactile Feel (7)	0.0%	0	0.0%	0	0.0%	0	66.7 %	4	33.3 %	2	0.0%	0	0.0%	0	0	6

Is there anything you do to prevent ankle injury? E.g. training, applying tape, wearing special socks.

Wearing the right boots

Not really

No

I never had ankle injuries but I have a lot less pain in my ankle and feet with forma boots than Alpinestars. It was little painful to crash with Alpinestars

Nothing

-

Which of the boots you've tried before provides the best ankle protection and why? E.g. they prevented injury, feel sturdy and safe, don't limit my movement.

Dainese, i got the best feeling with them on They have good movement and.

The sidi's I got now has "tighting straps" the strap them firm and feels like an exoskeleton. And still gives me the feeling I can "dance" on my steps.

Have only had one set of boots

Forma had the best protection in my experience. But it is little more uncomfortable till you get use to it.

I have only really ran with Alpinestar boots (when I just started with racing, I started of with Sidi's, but this was only on NSF100, some years ago). They have always made me feel safe, and as said, never had a ankle injury, although I have had 2 other injury's on my foot.

What makes a boot feel safe? What properties contribute to that feeling? Maybe that it feels tight, comfortable, stiff and/or heavy? Or that it looks technical, like what you know, qualitative, and/or expensive? Or that the CE-levels of the boot are high? Anything goes!

The quality off the boots

The seperate "shielding" parts prohibit the feel to make unnatural movement. So stiff and regit with the visual shielding and tighting straps make me feel saver

That it fits well with your foot, that the material feels sturdy, hard protection plates at key areas, fits tight around your foot, so not too loose

I don't think boots need to be so long, but ankle protection is important.

Interior boots

What exactly makes it feel safe, I am not sure. I have only seriously ridden with 1 boot supplier so I can't say the difference / what makes it feel safe, since I don't have a comparison.

Any suggestions, general remarks or questions?

We consider falling off, or highsiding a rare occasion, even though it occurs way more often than we would think. Our goal is going fast, not feeling safe. Even the most expensive Dainese boots can result in a broken ankle or permanent physical disability. We try not to think of that too often.

Likely, I have had more injuries than pointed out in here, like I know I hurt my knee sometime whilst doing Supermoto training, just have no clue what was wrong, and it didn't last long (a day or 2). All the injury's spoken about are all the main ones that have affected me stronger / I can properly remember.

Conclusions

All the riders that participated wear different boots. There is no consensus about which boot is safest. The only person who reviewed the ankle protection in their current boots poorly wears lower-level racing boots. The rest, however, rated their ankle protection very high, despite the theoretically low level of protection. All riders indicated the importance of ankle protection to be significant. On average, they rated it with a 7,8 on a scale from one to ten. The rating of trade-offs concerning the design drivers for the ankle brace made it clear that the level of protection was almost as important as the other design drivers.

Interestingly, the riders indicated that when choosing between an ankle protection system they do not feel at all yet offers proven protection and a system that feels sturdy and safe but is not proven to offer any protection, they choose the option somewhat in-between. This means they want to feel the protection is there even when it is made of less well-proven technology. Naturally, they most likely would like everything at an ideal level. However, it is interesting to see where they draw the line. What feels safe is up for debate as they indicate different characteristics. Some interesting ones were creating a snug fit, sturdy and stiff materials, the perceived quality of the boots, the visible presence of hard parts, an inner boot and ankle protection.

The weight, freedom of movement while riding and tactile feel were considered slightly more important than other design drivers. In contrast, freedom of movement while walking and bulk were rated slightly less important. Limiting inversion was indicated four times, eversion and abduction three times, adduction two times and dorsiflexion once. Dorsiflexion and plantarflexion were shown not to be linked to injury patterns in the MotoGP, so this will be left out of the design.

None of the riders has remained unharmed. What they damaged exactly was, most of the time, unknown. Twisting and hurting the ankle and breaking forefoot bones were mentioned multiple times, however. Generally, the riders do not undertake something to prevent ankle injury other than wearing

injuries, there is not one method they apply. One does physical therapy and uses tape, one adapts their riding style, and one would try to put less stress on it.

Finally, an interesting remark of one of the riders is that they “consider falling off, or high-siding a rare occasion, even though it occurs way more often than we would think. Our goal is going fast, not feeling safe. Even the most expensive boots can result in a broken ankle or permanent physical disability. We try not to think of that too often.” Feeling safe was indeed indicated as a means for performing better and going faster in the REV'IT! rider session. The fact that they do not consider crashing to be of high risk because of the low likelihood, could be the reason why they feel well protected by their boots, even though they all endured injury. This means the riders require less from their boots in terms of protection than they theoretically should and rate them well in terms of protection even without proof. This makes it easier for designers but raises an ethical question; should we focus on making the riders feel safe to perform better and save money and resources on the development of protection the riders do not know they miss, or should we invest and protect the riders much better even when they would not necessarily notice the difference.

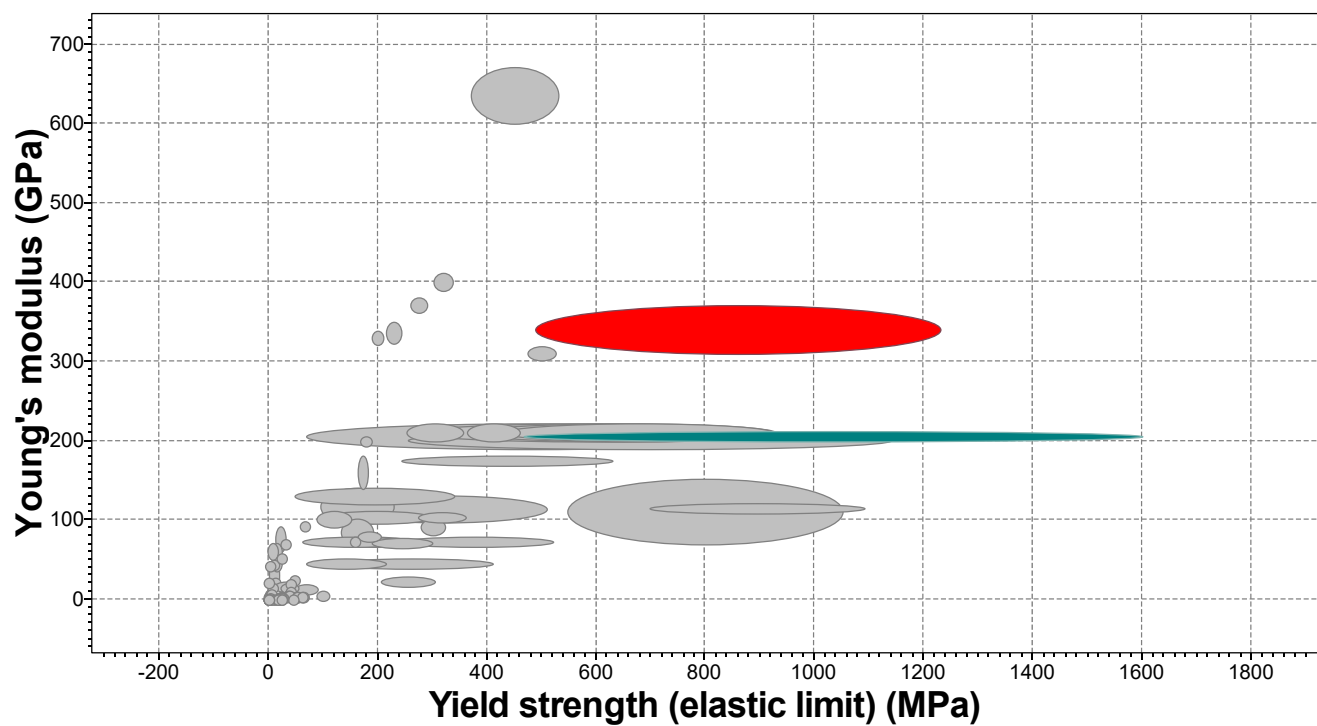
More research into the topics of when does a boot feel safe, the influence of the rider's risk perception on the overall appreciation of a boot and the influence of feeling safe on the actual risk of riders is recommended to create a better understanding of the effect of choosing to focus on one or the other.



APPENDIX 19. MATERIAL STUDY RESULTS

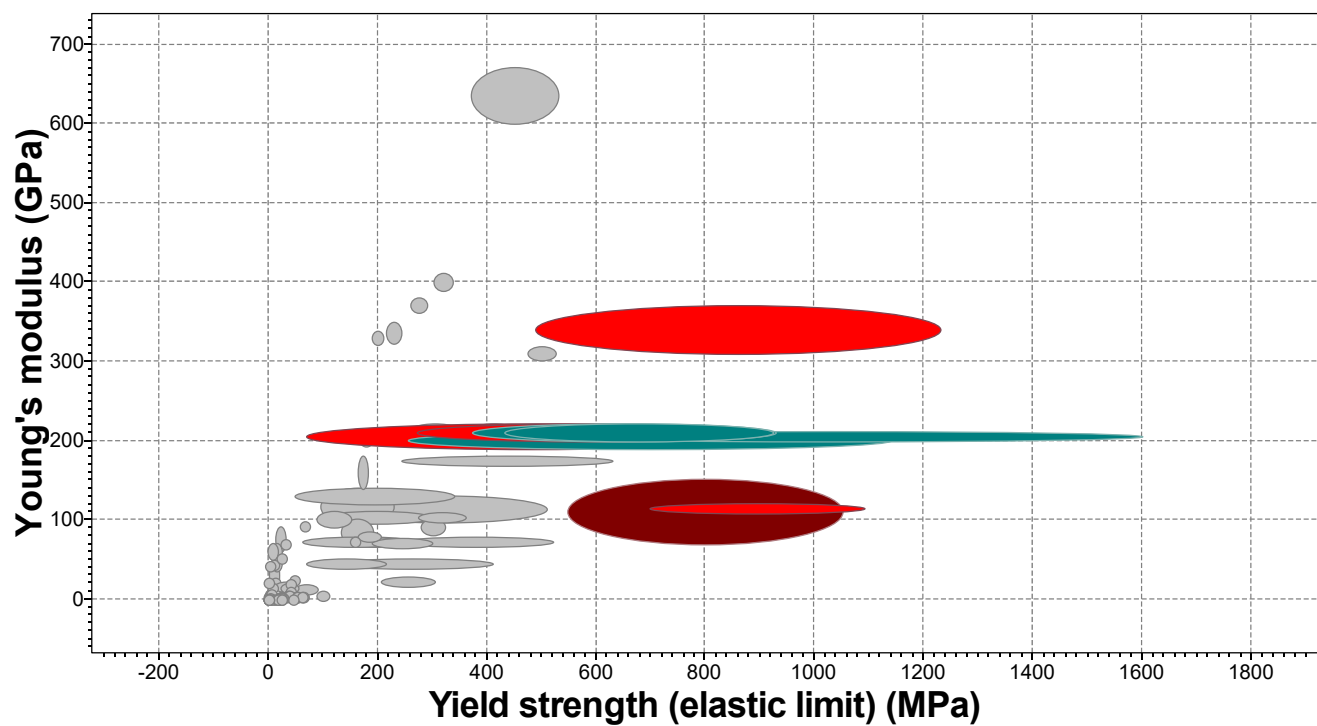
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General properties			
Mechanical properties			
	Minimum	Maximum	
Young's modulus	6,7		GPa
Shear modulus			GPa
Bulk modulus			GPa
Poisson's ratio			
Yield strength (elastic limit)	633		MPa
Tensile strength			MPa
Compressive strength			MPa
Elongation			% strain
Hardness - Vickers			HV
Fatigue strength at 10 ⁷ cycles			MPa
Fracture toughness			MPa.m ^{0.5}
Mechanical loss coefficient (tan delta)			
Thermal properties			
Electrical properties			
Optical properties			
Critical Materials Risk			
Processability			
Durability: water and aqueous solutions			
Durability: acids			
Durability: alkalis			
Durability: fuels, oils and solvents			
Durability: alcohols, aldehydes, ketones			
Durability: halogens and gases			
Durability: built environments			
Durability: flammability			
Durability: thermal environments			
Geo-economic data for principal component			
Primary material production: energy, CO2 and water			
Material processing: energy			
Material processing: CO2 footprint			
Material recycling: energy, CO2 and recycle fraction			



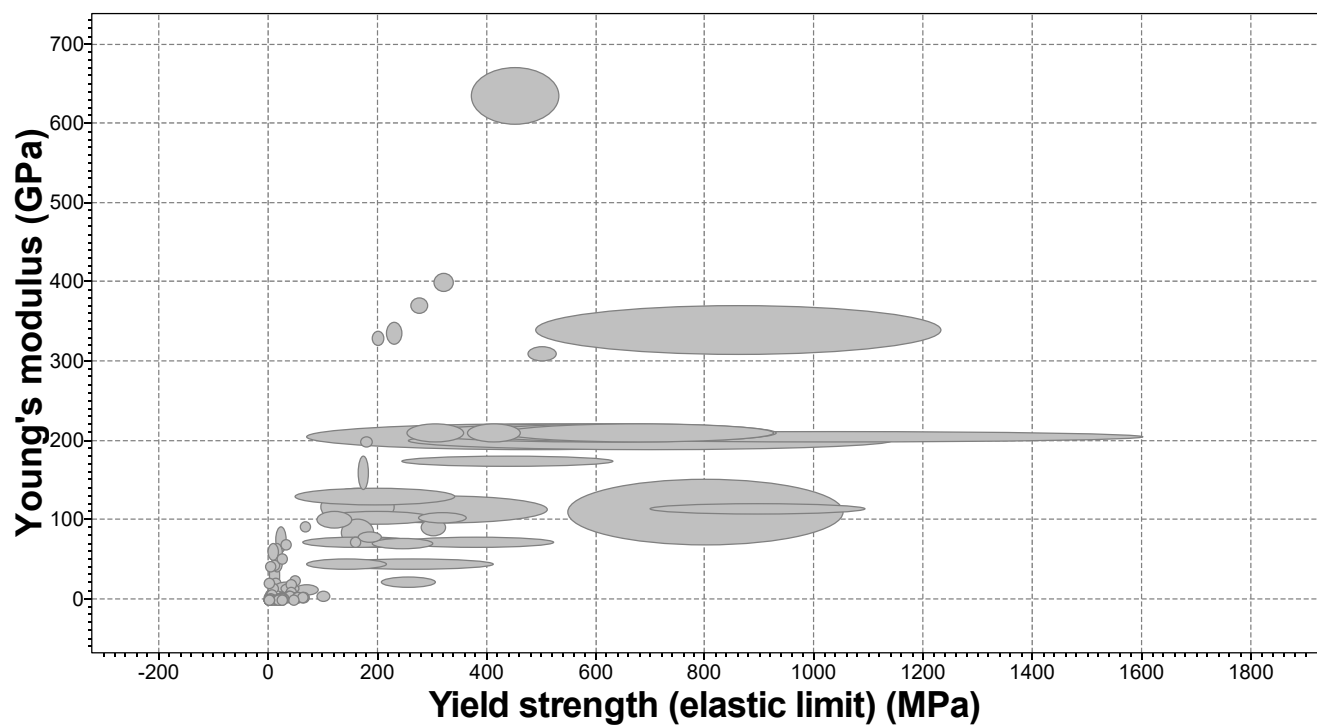
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General properties			
Mechanical properties			
	Minimum	Maximum	
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Shear modulus	<input type="text"/>	<input type="text"/>	GPa
Bulk modulus	<input type="text"/>	<input type="text"/>	GPa
Poisson's ratio	<input type="text"/>	<input type="text"/>	
Yield strength (elastic limit)	<input type="text" value="1215"/>	<input type="text"/>	MPa
Tensile strength	<input type="text"/>	<input type="text"/>	MPa
Compressive strength	<input type="text"/>	<input type="text"/>	MPa
Elongation	<input type="text"/>	<input type="text"/>	% strain
Hardness - Vickers	<input type="text"/>	<input type="text"/>	HV
Fatigue strength at 10 ⁷ cycles	<input type="text"/>	<input type="text"/>	MPa
Fracture toughness	<input type="text"/>	<input type="text"/>	MPa.m ^{0.5}
Mechanical loss coefficient (tan delta)	<input type="text"/>	<input type="text"/>	
Thermal properties			
Electrical properties			
Optical properties			
Critical Materials Risk			
Processability			
Durability: water and aqueous solutions			
Durability: acids			
Durability: alkalis			
Durability: fuels, oils and solvents			
Durability: alcohols, aldehydes, ketones			
Durability: halogens and gases			
Durability: built environments			
Durability: flammability			
Durability: thermal environments			
Geo-economic data for principal component			
Primary material production: energy, CO2 and water			
Material processing: energy			
Material processing: CO2 footprint			
Material recycling: energy, CO2 and recycle fraction			



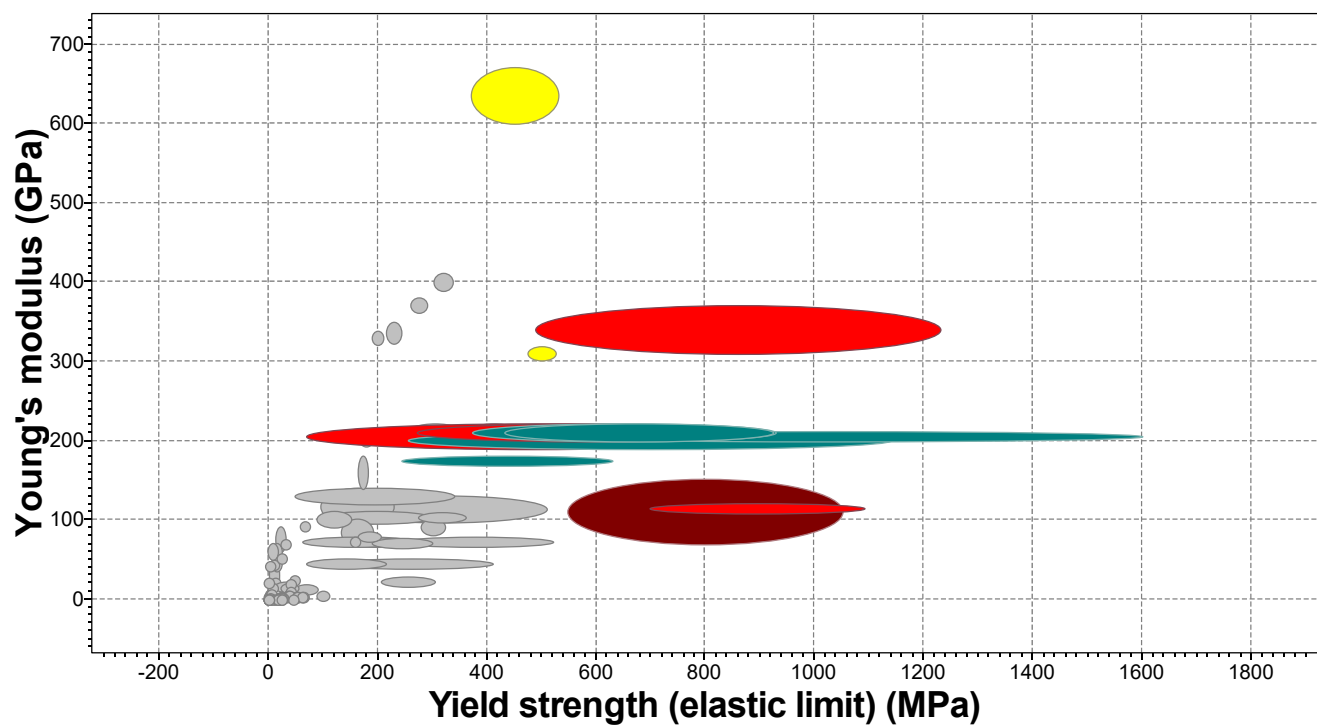
[Can't find the property you are looking for?](#)

General properties			
Mechanical properties			
	Minimum	Maximum	
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Shear modulus	<input type="text"/>	<input type="text"/>	GPa
Bulk modulus	<input type="text"/>	<input type="text"/>	GPa
Poisson's ratio	<input type="text"/>	<input type="text"/>	
Yield strength (elastic limit)	<input type="text" value="2201"/>	<input type="text"/>	MPa
Tensile strength	<input type="text"/>	<input type="text"/>	MPa
Compressive strength	<input type="text"/>	<input type="text"/>	MPa
Elongation	<input type="text"/>	<input type="text"/>	% strain
Hardness - Vickers	<input type="text"/>	<input type="text"/>	HV
Fatigue strength at 10 ⁷ cycles	<input type="text"/>	<input type="text"/>	MPa
Fracture toughness	<input type="text"/>	<input type="text"/>	MPa.m ^{0.5}
Mechanical loss coefficient (tan delta)	<input type="text"/>	<input type="text"/>	
Thermal properties			
Electrical properties			
Optical properties			
Critical Materials Risk			
Processability			
Durability: water and aqueous solutions			
Durability: acids			
Durability: alkalis			
Durability: fuels, oils and solvents			
Durability: alcohols, aldehydes, ketones			
Durability: halogens and gases			
Durability: built environments			
Durability: flammability			
Durability: thermal environments			
Geo-economic data for principal component			
Primary material production: energy, CO2 and water			
Material processing: energy			
Material processing: CO2 footprint			
Material recycling: energy, CO2 and recycle fraction			



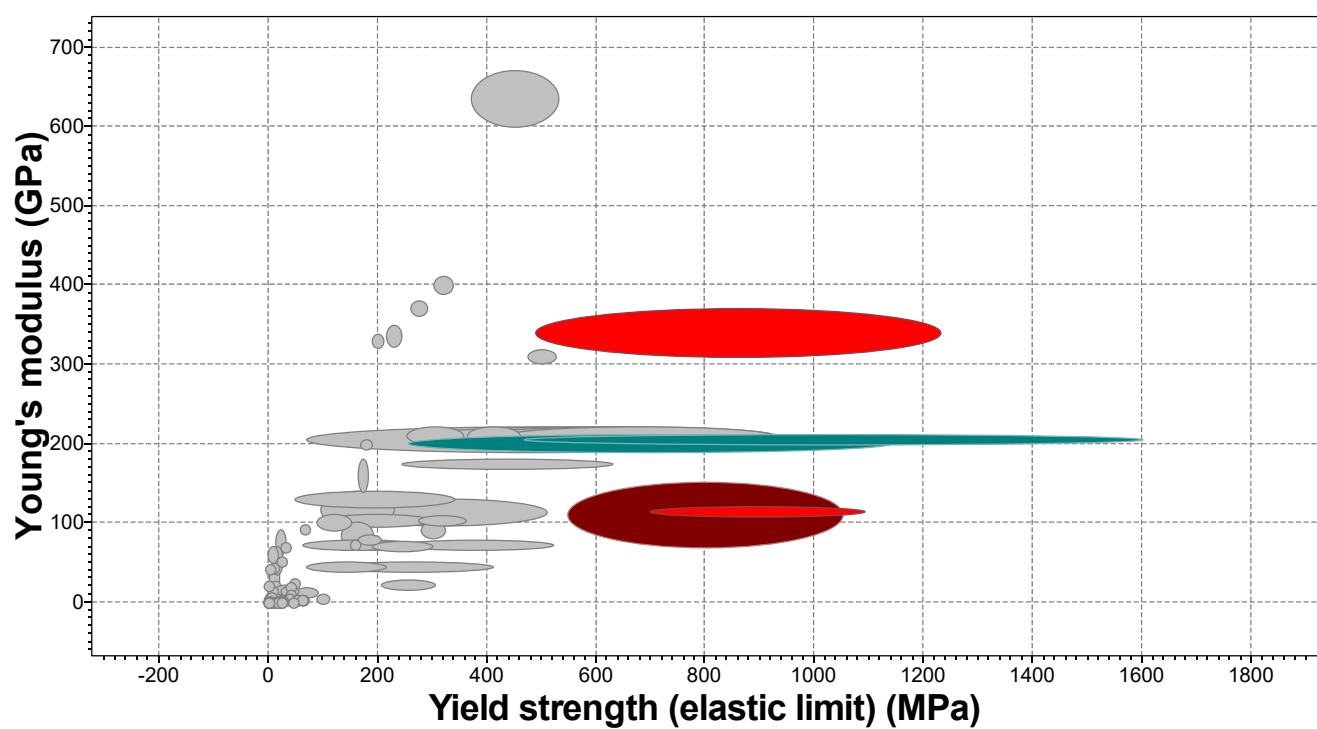
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General properties			
Mechanical properties			
	Minimum	Maximum	
Young's modulus	<input type="text" value="5"/>	<input type="text"/>	GPa
Shear modulus	<input type="text"/>	<input type="text"/>	GPa
Bulk modulus	<input type="text"/>	<input type="text"/>	GPa
Poisson's ratio	<input type="text"/>	<input type="text"/>	
Yield strength (elastic limit)	<input type="text" value="521"/>	<input type="text"/>	MPa
Tensile strength	<input type="text"/>	<input type="text"/>	MPa
Compressive strength	<input type="text"/>	<input type="text"/>	MPa
Elongation	<input type="text"/>	<input type="text"/>	% strain
Hardness - Vickers	<input type="text"/>	<input type="text"/>	HV
Fatigue strength at 10 ⁷ cycles	<input type="text"/>	<input type="text"/>	MPa
Fracture toughness	<input type="text"/>	<input type="text"/>	MPa.m ^{0.5}
Mechanical loss coefficient (tan delta)	<input type="text"/>	<input type="text"/>	
Thermal properties			
Electrical properties			
Optical properties			
Critical Materials Risk			
Processability			
Durability: water and aqueous solutions			
Durability: acids			
Durability: alkalis			
Durability: fuels, oils and solvents			
Durability: alcohols, aldehydes, ketones			
Durability: halogens and gases			
Durability: built environments			
Durability: flammability			
Durability: thermal environments			
Geo-economic data for principal component			
Primary material production: energy, CO2 and water			
Material processing: energy			
Material processing: CO2 footprint			
Material recycling: energy, CO2 and recycle fraction			



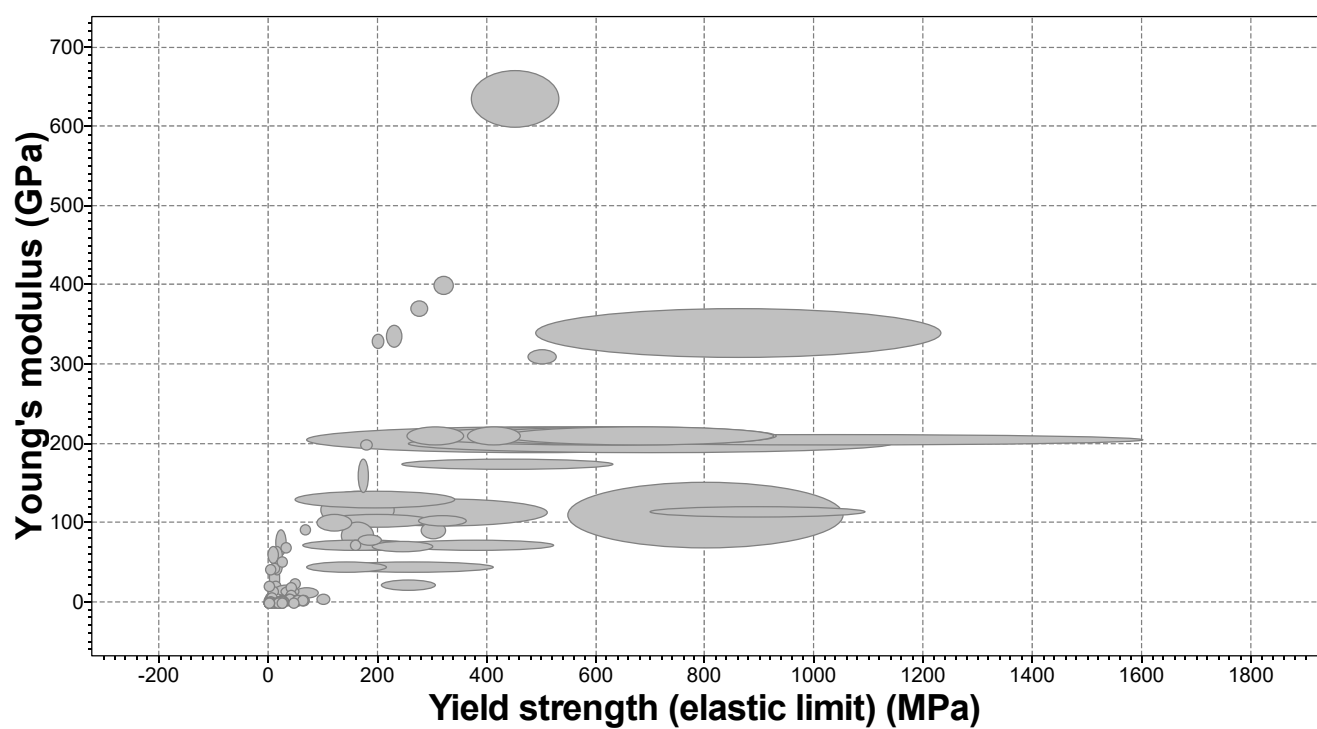
[Can't find the property you are looking for?](#)

General properties			
Mechanical properties			
	Minimum	Maximum	
Young's modulus	<input type="text" value="9,6"/>	<input type="text"/>	GPa
Shear modulus	<input type="text"/>	<input type="text"/>	GPa
Bulk modulus	<input type="text"/>	<input type="text"/>	GPa
Poisson's ratio	<input type="text"/>	<input type="text"/>	
Yield strength (elastic limit)	<input type="text" value="999"/>	<input type="text"/>	MPa
Tensile strength	<input type="text"/>	<input type="text"/>	MPa
Compressive strength	<input type="text"/>	<input type="text"/>	MPa
Elongation	<input type="text"/>	<input type="text"/>	% strain
Hardness - Vickers	<input type="text"/>	<input type="text"/>	HV
Fatigue strength at 10 ⁷ cycles	<input type="text"/>	<input type="text"/>	MPa
Fracture toughness	<input type="text"/>	<input type="text"/>	MPa.m ^{0.5}
Mechanical loss coefficient (tan delta)	<input type="text"/>	<input type="text"/>	
Thermal properties			
Electrical properties			
Optical properties			
Critical Materials Risk			
Processability			
Durability: water and aqueous solutions			
Durability: acids			
Durability: alkalis			
Durability: fuels, oils and solvents			
Durability: alcohols, aldehydes, ketones			
Durability: halogens and gases			
Durability: built environments			
Durability: flammability			
Durability: thermal environments			
Geo-economic data for principal component			
Primary material production: energy, CO2 and water			
Material processing: energy			
Material processing: CO2 footprint			
Material recycling: energy, CO2 and recycle fraction			



[Can't find the property you are looking for?](#)

General properties			
Mechanical properties			
	Minimum	Maximum	
Young's modulus	<input type="text" value="17,3"/>	<input type="text"/>	GPa
Shear modulus	<input type="text"/>	<input type="text"/>	GPa
Bulk modulus	<input type="text"/>	<input type="text"/>	GPa
Poisson's ratio	<input type="text"/>	<input type="text"/>	
Yield strength (elastic limit)	<input type="text" value="1810"/>	<input type="text"/>	MPa
Tensile strength	<input type="text"/>	<input type="text"/>	MPa
Compressive strength	<input type="text"/>	<input type="text"/>	MPa
Elongation	<input type="text"/>	<input type="text"/>	% strain
Hardness - Vickers	<input type="text"/>	<input type="text"/>	HV
Fatigue strength at 10 ⁷ cycles	<input type="text"/>	<input type="text"/>	MPa
Fracture toughness	<input type="text"/>	<input type="text"/>	MPa.m ^{0.5}
Mechanical loss coefficient (tan delta)	<input type="text"/>	<input type="text"/>	
Thermal properties			
Electrical properties			
Optical properties			
Critical Materials Risk			
Processability			
Durability: water and aqueous solutions			
Durability: acids			
Durability: alkalis			
Durability: fuels, oils and solvents			
Durability: alcohols, aldehydes, ketones			
Durability: halogens and gases			
Durability: built environments			
Durability: flammability			
Durability: thermal environments			
Geo-economic data for principal component			
Primary material production: energy, CO2 and water			
Material processing: energy			
Material processing: CO2 footprint			
Material recycling: energy, CO2 and recycle fraction			



APPENDIX 20. INTERVIEW MOTO2 RIDER



A few of the REV'IT! Riders filled in the questionnaire of Appendix 17. In that survey one of the questions was whether the rider would be okay with doing a follow up interview to go deeper into the topics influencing the ankle brace. said yes and so a Zoom meeting was scheduled. The asked questions and link to the recording can be found below.

Questions (in Dutch)

- Je gaf de huidige enkelprotectie een 8.
 - o Waar baseer je dat op? Kijk je ooit naar CE-labels of is het meer een gutfeeling?
 - Wat bepaalt dat?
 - o Vind je veiligheid op zich überhaupt iets belangrijks of is het belangrijk omdat het ten kosten kan gaan van je prestatie? Is dat zo voor alle coureurs?
 - o Heb je het gevoel dat je laarzen je beschermd hebben of heb je het gevoel dat je geluk hebt gehad?
 - o Zou het je iets boeien als de braces nog veiliger zouden worden gemaakt? Denk je dat dat nodig is? Zou je daarvoor van laars switchen?
 - o Is de veiligheid van jullie materialen iets waar over wordt gepraat?
 - o Wat vind je van het idee om een brace te hebben waarbij je de bewegingsvrijheid zou kunnen aanpassen naar jouw voorkeuren? Per coureur of zelfs per race?
- Je gaf aan dat het hebben van een enkelbrace belangrijk is. In welke situaties komt deze van pas? In welke situaties wil je je enkels beschermen?
 - o Wat mag in jouw ogen ten kosten gaan van die bescherming?
 - o Wat is voor jou “veilig”? Sidi's veiliger?
 - o Zie jij andere coureurs dingen doen om hun enkels te beschermen?
 - o Maakt het je iets uit hoe de brace er uit ziet? Qua looks
- Waarop selecteer jij jouw laarzen? Als je ze in de winkel zou moeten kopen?
- Heb jij bepaalde rituelen die je uitvoert om tot rust te komen of focus te krijgen? Hoe ervaar jij die stress?
 - o Speelt het aantrekken van je pak etc. daar een rol in? Moet dat zo snel mogelijk of zo comfortabel mogelijk?
- Wat is jouw ogen een misvatting die mensen die zelfs nog nooit hebben geraced hebben?
- Is er in jouw ogen iets waar ontwerpers van bijv. laarzen totaal niet bij stilstaan terwijl dat voor jullie iets super logisch is?
- Waar staat in jouw ogen REV'IT! voor?

Full version of Interview

See Confidential Appendix



APPENDIX 21. CAD-MODEL DESIGNS

See Confidential Appendix

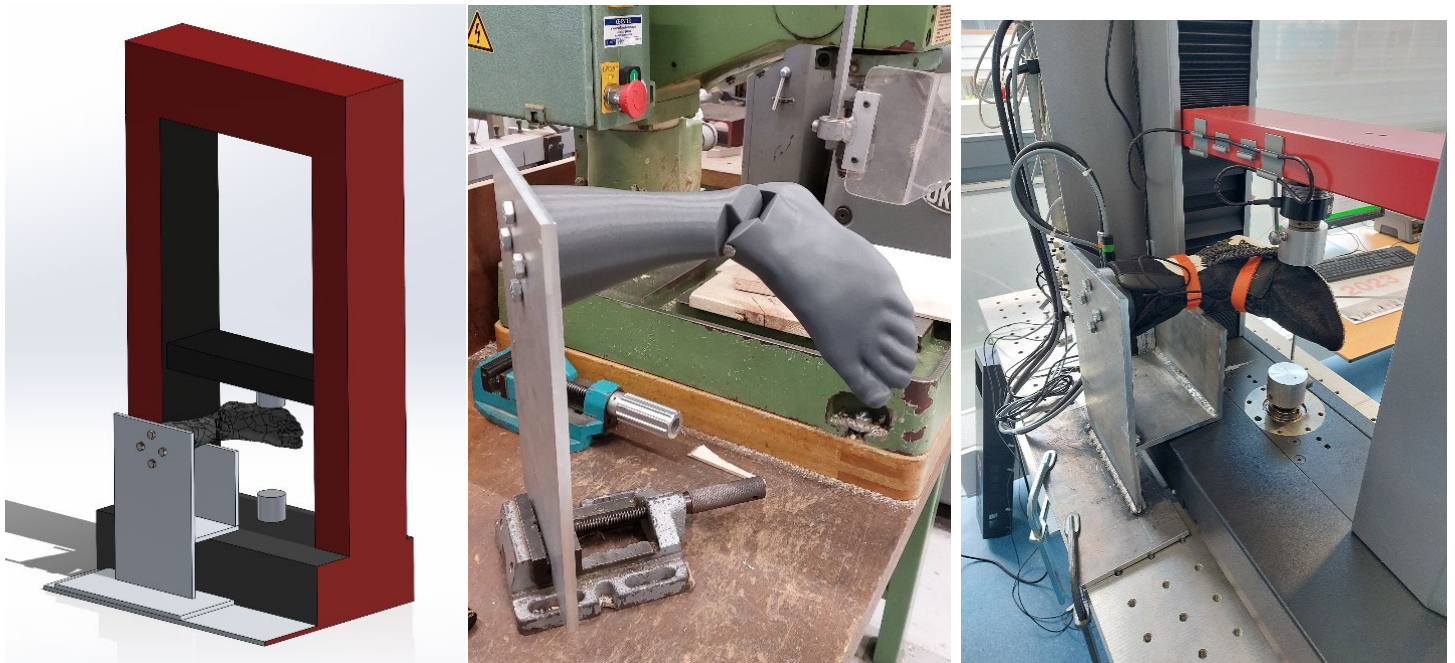
APPENDIX 22. COMPRESSION TESTS CONCEPTS



The EN13634 standard does not state a way to evaluate the efficacy of the ankle brace. Alpinestars is currently the only one trying to express this level of protection in numbers (Den Dekker, 2021). They put a pivoting lower leg model into a compression testing machine and saw how much force was required to rotate the foot, providing a sense of the stiffness. The machine measured this rotation as the distance the compressor was moved downwards. Inspired by the test setup they used, a setup was designed for the Faculty of Industrial Design Engineering testing facility: the 10 kN Zwick. The Zwick does not have a tool to perform this specific test, so it was designed and handmade in the workshop. The foot model inside the prototype was a 3D print of the lower leg scan that pivoted around two axes: one that mimics the movement of xflexion and one xversion. This way, the most injury-prone position could be simulated: plantarflexed inversion. This model had limitations based on the angles defined in Chapter 17. For xflexion, the limit was the aROM and for xversion, the injury angle, as the latter is the one of interest for finding the resultant force required to rotate it. This model was used to calibrate the machine and define the travel distance to reach the injury angle in all positions unrestrictively. Going beyond this point would give a skewed perspective, as the force would be generated by the foot model and not by the brace. The machine was forced to stop at that point.

Test Setup

For the test setup a 3D printed model was created of a lower limb, that would fit a regular racing boot. A 3D scan was made as a basis for the model. An axis of motion was simulated by creating hinge points along an axes that were found in literature, as seen below.



Talocrural joint

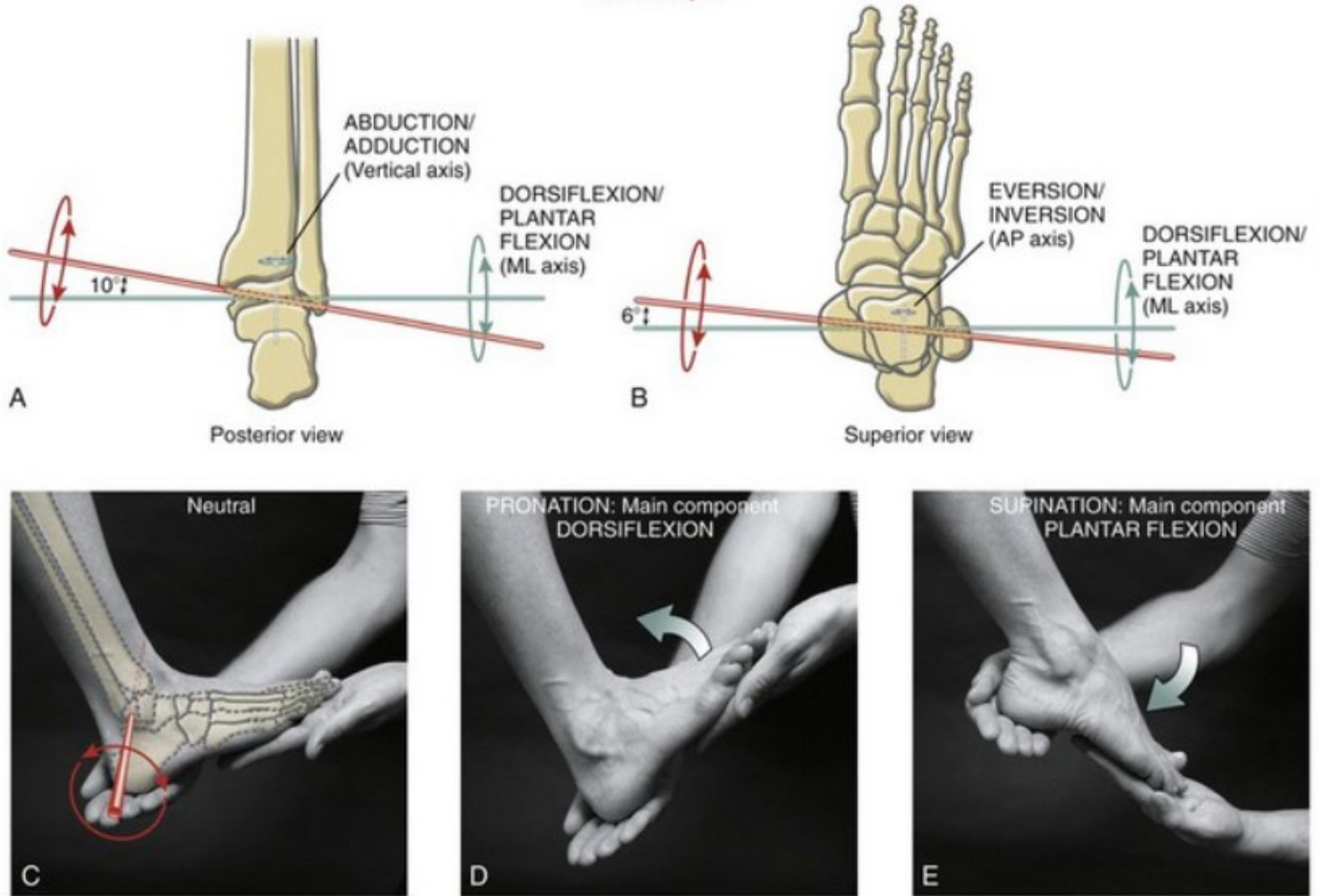
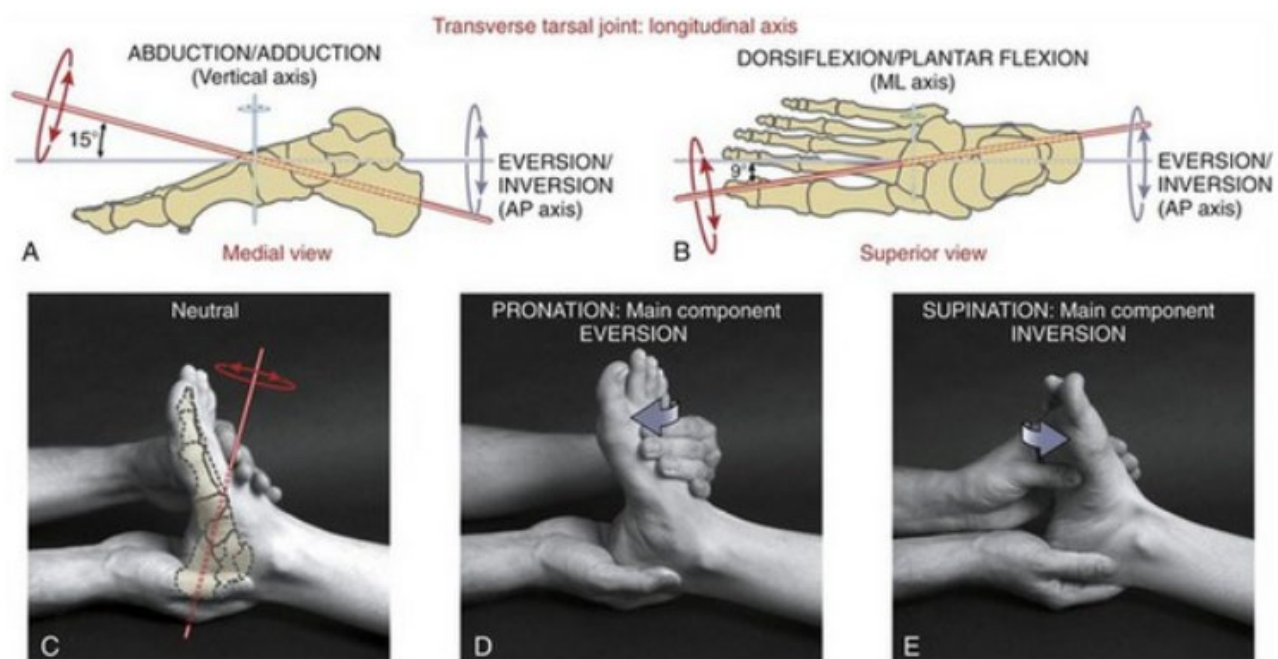


FIGURE 14-17. The axis of rotation and osteokinematics at the talocrural joint. The slightly oblique axis of rotation (red) is shown from behind (A) and from above (B); this axis is shown again in C. The component axes and associated osteokinematics are also depicted in A and B. Note that, although subtle, dorsiflexion (D) is combined with slight abduction and eversion, which are components of pronation; plantar flexion (E) is combined with slight adduction and inversion, which are components of supination.



<https://clinicalgate.com/ankle-and-foot/>

Method

All concept models with significant structural adaptations were put to the test. As Alpinestars is considered the best, their inner boot was also tested to compare results. The tests were done in different positions: neutral with the compressor on the middle of the foot and the forefoot (Abduction) and strapped into a plantar and dorsiflexed position. Most tests were done in an inverted position. The goal was to see how the concepts compared to each other. In principle, eversion occurs similarly. The difference, however, is that the aROM and injury angle are slightly smaller, meaning on that side, the stiffness should be even greater and the strings tighter on that side.



Results

The results can be seen below. Some data was left out due to it being unusable.

Test Subject	Alter-nations	Xversion	Xflexion	Force Location Foot	Deform. Rate	Test #	Code per Case	Code	Fmax	Average Fmax	Deform. at Fmax	FBreak	Deform. at break
					mm/s				N	N	mm		mm
Inner Boot (IB)		Inversion (I)	Neutral (N)	Forefoot (F)	8,3 (S)	1	IB-I-N-F-S-1	IB-I-N-F-S	5,1	4,9	70,0		
						2	IB-I-N-F-S-2		4,8		70,0		
						3	IB-I-N-F-S-3		4,9		70,0		
						4	IB-I-N-F-S-4		4,8		70,0		
		Inversion (I)	Neutral (N)	Middle (M)	8,3 (S)	1	IB-I-N-M-S-1	IB-I-N-M-S	11,7	11,3	29,5		
						2	IB-I-N-M-S-2		11,5		29,9		
						3	IB-I-N-M-S-3		11,2		30,0		
						4	IB-I-N-M-S-4		10,7		30,0		
	Velcro (V)	Inversion (I)	Neutral (N)	Forefoot (F)	16,6 (F)	1	IBV-I-N-F-F-1	IBV-I-N-F-F	9,2	9,6	69,9		
						2	IBV-I-N-F-F-2		9,5		70,0		
						3	IBV-I-N-F-F-3		9,4		70,0		
						4	IBV-I-N-F-F-4		10,4		70,0		
Concept 2 (C2)		Inversion (I)	Neutral (N)	Forefoot (F)	16,6 (F)	1	C2-I-N-F-F-1	C2-I-N-F-F	41,9	28,6	70,0		
						2	C2-I-N-F-F-2		22,9		70,0		
						3	C2-I-N-F-F-3		23,9		70,0		
						4	C2-I-N-F-F-4		25,9		70,0		
	One Support Strap (S)	Inversion (I)	Neutral (N)	Forefoot (F)	16,6 (F)	1	C2S-I-N-F-F-1	C2S-I-N-F-F	27,7	28,0	68,8		
						2	C2S-I-N-F-F-2		27,7		69,8		
						3	C2S-I-N-F-F-3		28,5		70,0		
						4	C2S-I-N-F-F-4		28,0		70,0		
	Double strap (DS)	Inversion (I)	Neutral (N)	Forefoot (F)	16,6 (F)	1	C2DS-I-N-F-F-1	C2DS-I-N-F-F	30,5	30,5	69,2		
	Triple strap (TS)	Inversion (I)	Neutral (N)	Forefoot (F)	16,6 (F)	1	C2TS-I-N-F-F-1	C2TS-I-N-F-F	31,2	31,2	69,9		
		Inversion (I)	Neutral (N)	Middle (M)	16,6 (F)	1	C2-I-N-M-F-1	C2-I-N-M-F	84,1	75,0	29,7		
						2	C2-I-N-M-F-2		68,1		29,6		
						3	C2-I-N-M-F-3		69,9		29,9		
						4	C2-I-N-M-F-4		77,9		29,8		
		Inversion (I)	Neutral (N)	Middle (M)	8,3 (S)	1	C2-I-N-M-S-1	C2-I-N-M-S	74,8	74,2	29,9		
						2	C2-I-N-M-S-2		73,5		30,0		
						3	C2-I-N-M-S-3		75,4		29,9		
						4	C2-I-N-M-S-4		73,1		29,9		
	Double strap (DS)	Inversion (I)	Neutral (N)	Middle (M)	16,6 (F)	1	C2DS-I-N-M-F-1	C2DS-I-N-M-F	122,7	122,7	29,9		
	Triple strap (TS)	Inversion (I)	Neutral (N)	Middle (M)	16,6 (F)	1	C2TS-I-N-M-F-1	C2TS-I-N-M-F	143,0	132,7	29,8		
						2	C2TS-I-N-M-F-2		132,3		29,9		
						3	C2TS-I-N-M-F-3		128,4		29,9		
						4	C2TS-I-N-M-F-4		127,1		29,9		
3D Print REV'IT! (REV)		Inversion (I)	Neutral (N)	Forefoot (F)	8,3 (S)	1	REV-I-N-F-S-1	REV-I-N-F-S	34,5	38,7	68,5		
						2	REV-I-N-F-S-2		42,8		69,6		
						3	REV-I-N-F-S-3		39,5		69,9		
						4	REV-I-N-F-S-4		38,1		69,9		
		Inversion (I)	Neutral (N)	Forefoot (F)	16,6 (F)	1	REV-I-N-F-F-1	REV-I-N-F-F	36,6	37,0	69,5		
						2	REV-I-N-F-F-2		39,2		70,0		
						3	REV-I-N-F-F-3		35,1		69,9		

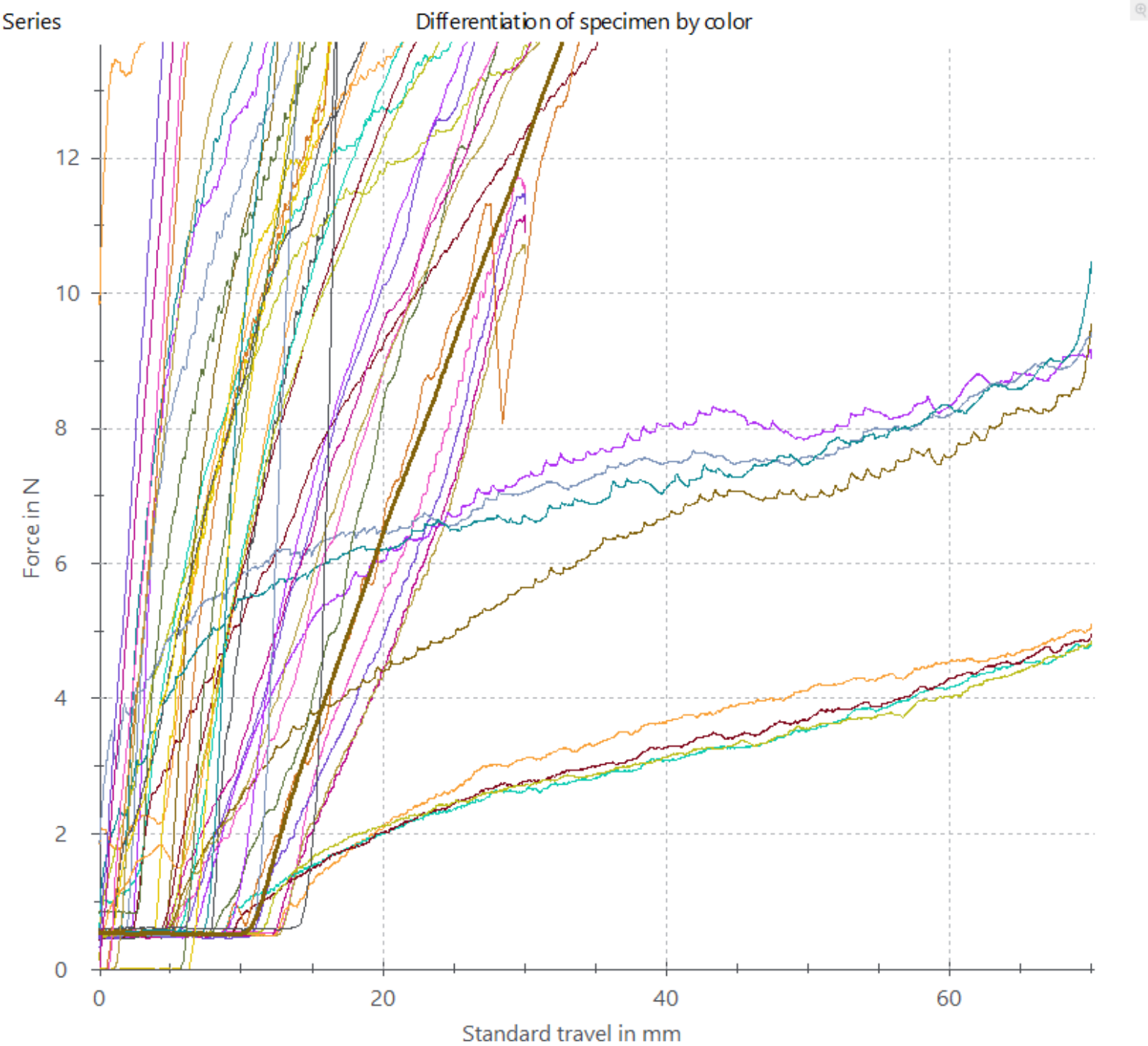


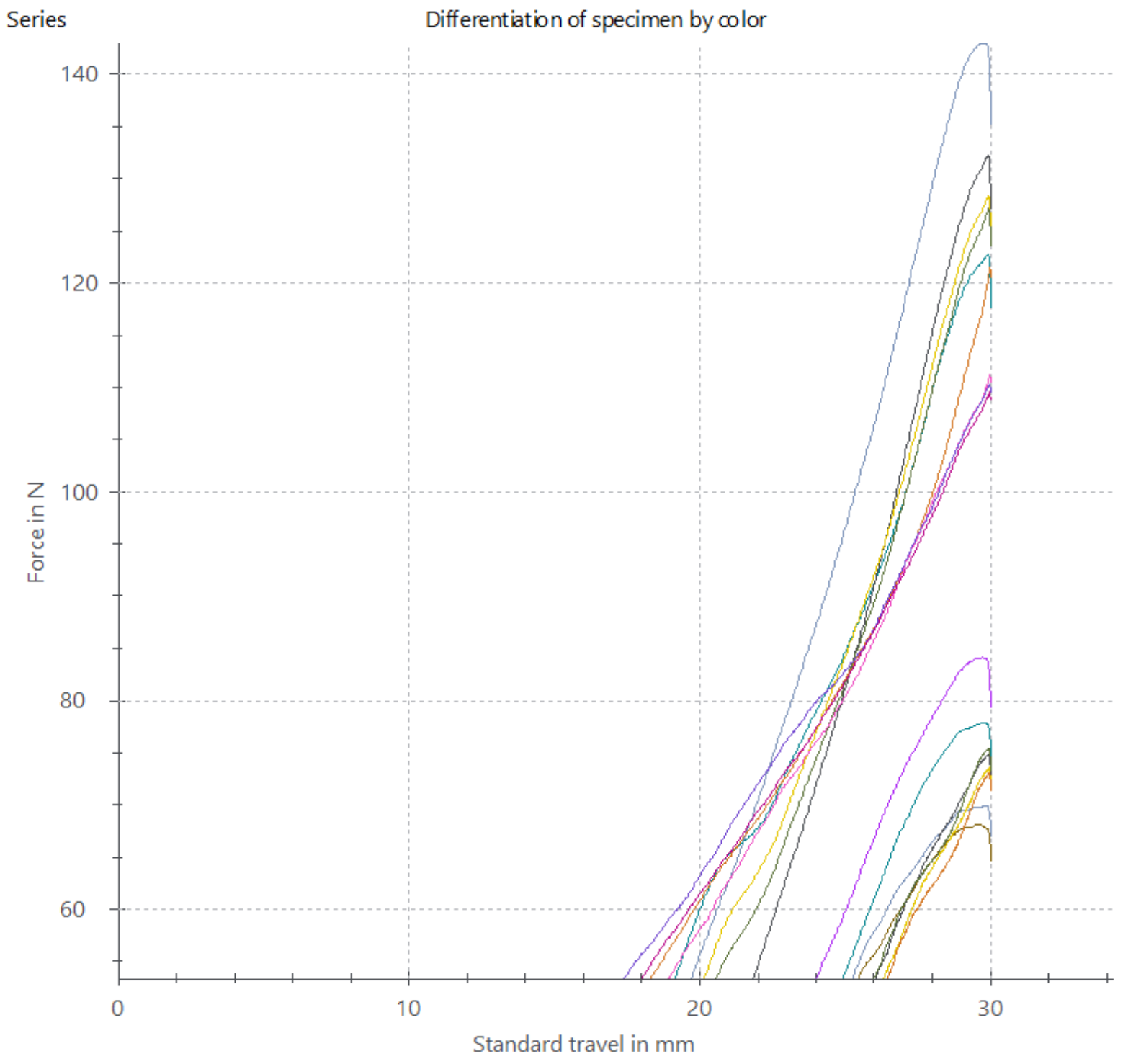
						4	REV-I-N-F-F-4		37,0	70,0	
		Inversion (I)	Neutral (N)	Middle (M)	16,6 (F)	1	REV-I-N-M-F-1	REV-I-N-M-F	121,5	30,0	
					2	REV-I-N-M-F-2	111,2		30,0		
					3	REV-I-N-M-F-3	110,3		30,0		
					4	REV-I-N-M-F-4	109,5		30,0		
Alpinestars Supertech R V1 Inner Boot (AS)		Inversion (I)	Neutral (N)	Forefoot (F)	16,6 (F)	1	AS-I-N-F-F-1	AS-I-N-F-F	126,6	29,7	
					2	AS-I-N-F-F-2	123,9		29,7		
					3	AS-I-N-F-F-3	127,0		29,7		
					4	AS-I-N-F-F-4	125,6		29,7		
		Inversion (I)	Neutral (N)	Middle (M)	16,6 (F)	1	AS-I-N-M-F-1	AS-I-N-M-F	80,1	16,2	
					2	AS-I-N-M-F-2	77,9		16,1		
					3	AS-I-N-M-F-3	74,9		16,1		
					4	AS-I-N-M-F-4	78,1		16,2		
		Inversion (I)	Plantar flexed (P)	Forefoot (F)	16,6 (F)	1	AS-I-P-F-F-1	AS-I-P-F-F	114,5	27,3	
					2	AS-I-P-F-F-2	107,7		27,9		
					3	AS-I-P-F-F-3	100,9		28,2		
					4	AS-I-P-F-F-4	102,4		28,3		
		Inversion (I)	Dorsi-flexed (D)	Heel (H)	16,6 (F)	1	AS-I-D-H-F-1	AS-I-D-H-F	60,1	8,0	
					2	AS-I-D-H-F-2	58,1		8,0		
					3	AS-I-D-H-F-3	57,0		8,0		
					4	AS-I-D-H-F-4	59,3		8,1		
		Eversion (E)	Neutral (N)	Forefoot (F)	16,6 (F)	1	AS-E-N-F-F-1	AS-E-N-F-F	37,9	16,6	
					2	AS-E-N-F-F-2	34,7		16,6		
					3	AS-E-N-F-F-3	34,5		16,6		
					4	AS-E-N-F-F-4	33,4		16,6		
	Eversion (E)	Neutral (N)	Middle (M)	16,6 (F)	1	AS-E-N-M-F-1	AS-E-N-M-F	172,7	8,9		
				2	AS-E-N-M-F-2	120,4		7,5			
				3	AS-E-N-M-F-3	144,6		7,5			
				4	AS-E-N-M-F-4	148,5		7,5			
				5	AS-E-N-M-F-5	135,6		7,5			
	Eversion (E)	Plantar flexed (P)	Forefoot (F)	16,6 (F)	2	AS-E-P-F-F-1	AS-E-P-F-F	69,8	33,7		
				3	AS-E-P-F-F-2	46,8		33,7			
				4	AS-E-P-F-F-3	66,1		33,7			
				5	AS-E-P-F-F-4	44,7		33,7			
	Eversion (E)	Dorsi-flexed (D)	Heel (H)	16,6 (F)	1	AS-E-D-H-F-1	AS-E-D-H-F	80,3	10,7		
				2	AS-E-D-H-F-2	82,0		10,7			
				3	AS-E-D-H-F-3	84,5		10,7			
				4	AS-E-D-H-F-4	84,0		10,7			
Concept 4 (C4)		Inversion (I)	Neutral (N)	Middle (M)	16,6 (F)	1	C4-I-N-M-F-1	C4-I-N-M-F	252,5	25,0	
					2	C4-I-N-M-F-2	329,4		29,9		

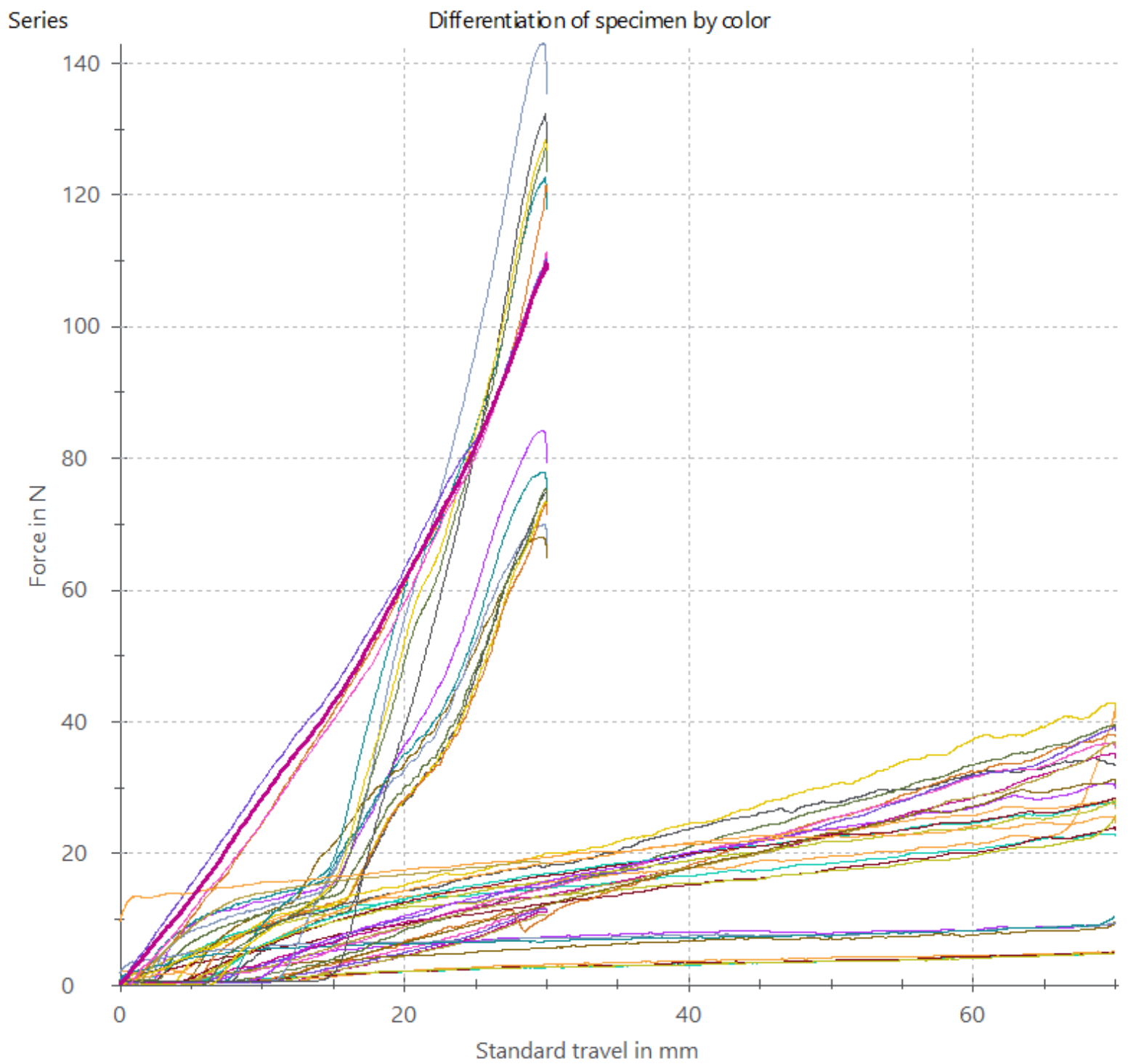
					3 (Break)	C4-I-N-M-F-3		431,8		35,7	297,4	36,5
	Broken (B)	Inversion (I)	Neutral (N)	Middle (M)	16,6 (F)	1 2	C4B-I-N-M-F-1 C4B-I-N-M-F-2	C4B-I-N-M-F	139,3 116,3	127,8	37,0 36,3	
	Looser strings (L)	Inversion (I)	Neutral (N)	Middle (M)	16,6 (F)	1 2 3	C4L-I-N-M-F-1 C4L-I-N-M-F-2 C4L-I-N-M-F-3	C4L-I-N-M-F	36,6 71,4 85,4	78,4	17,7 35,0 37,0	
	Less Loose strings (LL)					1 2 3	C4LL-I-N-M-F-1 C4LL-I-N-M-F-2 C4LL-I-N-M-F-3	C4LL-I-N-M-F	186,9 175,6 174,3	178,9	49,9 50,0 50,0	
		Inversion (I)	Plantar flexed (P)	Forefoot (F)	16,6 (F)	1 2 3 4	C4-I-P-F-F-1 C4-I-P-F-F-2 C4-I-P-F-F-3 C4-I-P-F-F-4	C4-I-P-F-F	127,1 95,0 91,7 105,8	104,9	55,2 47,0 47,4 50,1	
		Inversion (I)	Dorsi-flexed (D)	Heel (H)	16,6 (F)	1 2 3 4	C4-I-D-H-F-1 C4-I-D-H-F-2 C4-I-D-H-F-3 C4-I-D-H-F-4	C4-I-D-H-F	40,9 72,2 129,3 144,1	115,2	24,9 34,9 39,6 44,7	
	Concept 5 (C5)	Eversion (E)	Neutral (N)	Middle (M)	16,6 (F)	1 2 3 4	C5-E-N-M-F-1 C5-E-N-M-F-2 C5-E-N-M-F-3 C5-E-N-M-F-4	C5-E-N-M-F	291,6 403,1 393,2 389,7	395,3	29,8 34,9 34,9 34,9	
		Eversion (E)	Plantar flexed (P)	Forefoot (F)	16,6 (F)	1 2 3 (Break)	C5-E-P-F-F-1 C5-E-P-F-F-2 C5-E-P-F-F-3	C5-E-P-F-F	266,2 249,8 314,1	276,7	29,8 29,9 33,1	250,3 34,1
		Eversion (E)	Dorsi-flexed (D)	Heel (H)	16,6 (F)	1 2 3 4	C5-E-D-H-F-1 C5-E-D-H-F-2 C5-E-D-H-F-3 C5-E-D-H-F-4	C5-E-D-H-F	207,7 456,8 438,4 425,2	440,2	20,0 29,9 29,9 29,9	
Concept 7 (C7)		Inversion (I)	Neutral (N)	Forefoot (F)	16,6 (F)	1 2 3 4 5	C7-I-N-F-F-1 C7-I-N-F-F-2 C7-I-N-F-F-3 C7-I-N-F-F-4 C7-I-N-F-F-5	C7-I-N-F-F	172,1 218,7 196,1 198,9 191,9	201,4	27,5 29,7 29,7 29,7 29,7	
		Inversion (I)	Neutral (N)	Middle (M)	16,6 (F)	1 2 3	C7-I-N-M-F-1 C7-I-N-M-F-2 C7-I-N-M-F-3	C7-I-N-M-F	488,5 470,5 451,4	470,2	16,1 16,2 16,2	
	Tightened (T)	Inversion (I)	Neutral (N)	Middle (M)	16,6 (F)	1 2 3 4	C7T-I-N-M-F-1 C7T-I-N-M-F-2 C7T-I-N-M-F-3 C7T-I-N-M-F-4	C7T-I-N-M-F	722,3 699,8 680,2 668,2	692,6	16,1 16,2 16,2 16,2	

		Inversion (I)	Plantar flexed (P)	Forefoot (F)	16,6 (F)	1	C7-I-P-F-F-1		239,3		28,4	
						2	C7-I-P-F-F-2		241,3	236,5	28,4	
						3	C7-I-P-F-F-3	C7-I-P-F-F	234,0		28,4	
						4	C7-I-P-F-F-4		231,5		28,4	
Concept 9 (C9)		Inversion (I)	Neutral (N)	Forefoot (F)	16,6 (F)	1	C9-I-N-F-F-1		301,4		29,7	
						2	C9-I-N-F-F-2		279,9		29,7	
						3	C9-I-N-F-F-3	C9-I-N-F-F	262,8	272,7	29,7	
						4	C9-I-N-F-F-4		261,1		29,7	
						5	C9-I-N-F-F-5		258,2		29,7	
		Inversion (I)	Neutral (N)	Middle (M)	16,6 (F)	1	C9-I-N-M-F-1		560,3		16,1	
						2	C9-I-N-M-F-2		535,3	541,4	16,2	
						3	C9-I-N-M-F-3	C9-I-N-M-F	537,2		16,2	
						4	C9-I-N-M-F-4		532,9		16,2	
		Inversion (I)	Plantar flexed (P)	Forefoot (F)	16,6 (F)	1	C9-I-P-F-F-1		233,1		28,3	
						2	C9-I-P-F-F-2		223,2	221,9	28,4	
						3	C9-I-P-F-F-3	C9-I-P-F-F	218,3		28,4	
						4	C9-I-P-F-F-4		213,0		28,4	
		Inversion (I)	Dorsi-flexed (D)	Heel (H)	16,6 (F)	1	C9-I-D-H-F-1		227,8		8,0	
						2	C9-I-D-H-F-2		220,9	219,3	8,0	
						3	C9-I-D-H-F-3	C9-I-D-H-F	215,8		8,0	
						4	C9-I-D-H-F-4		212,5		8,0	

...graph...







Series layout

Specimen graph

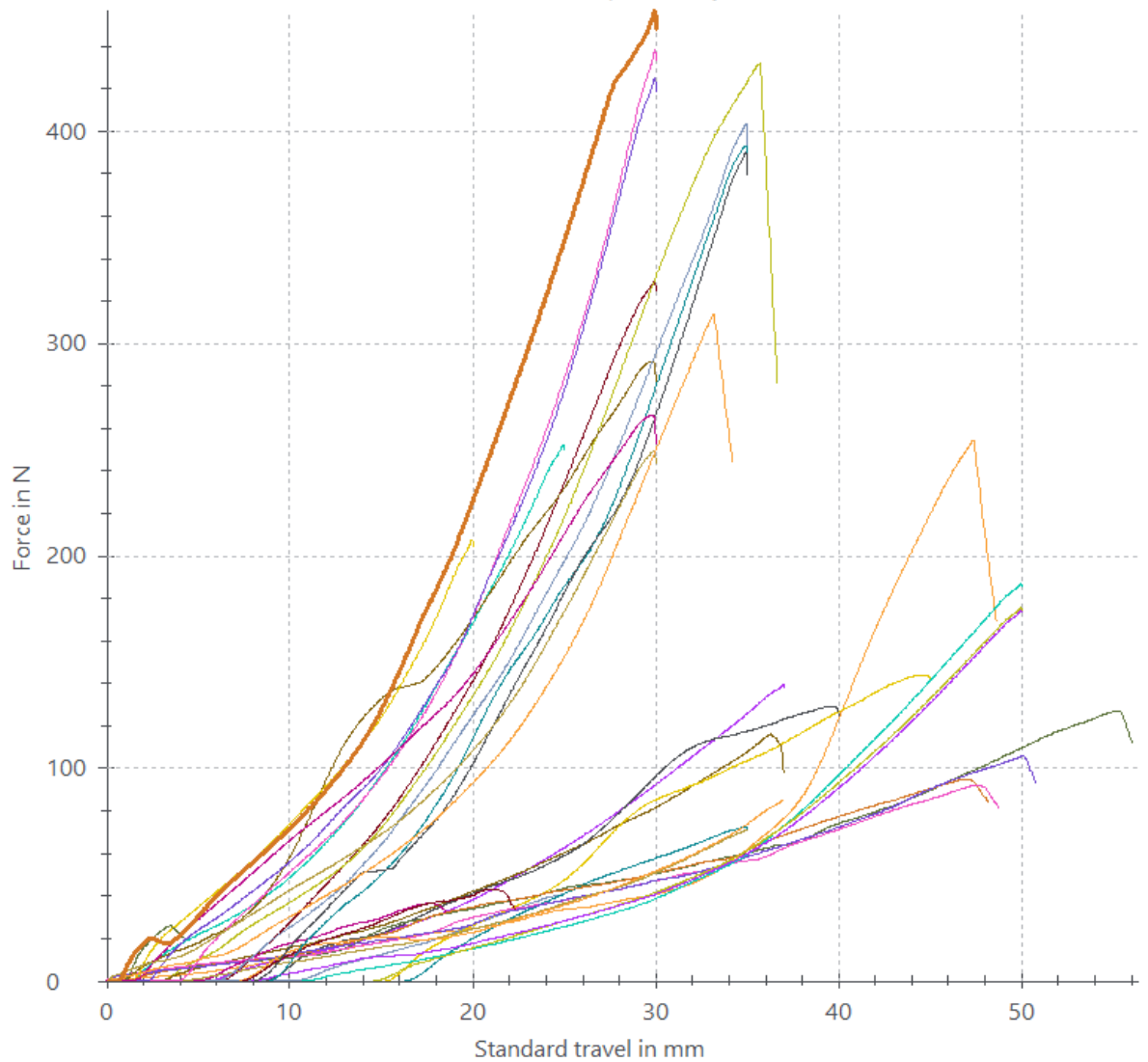
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- Dors - PTFL 2
- Dors - PTFL 2
- Dors - PTFL 2
- Plant - ATFL1
- Plant - ATFL2
- Plant - ATFL3
- Plant - ATFL4
- Neu - Los - C1
- Neu - Los - C2
- Neu - Los - C3
- Neu - Los - C4
- Neu - Los - C5
- Neu - Los - C6
- Neu - Los - C7
- Ev - Neu - C1
- Ev - Neu - C2
- Ev - Neu - C3
- Ev - Neu - C4
- Dors - Ev - P1
- Dors - Ev - P2
- Dors - Ev - P3
- Dors - Ev - P4
- Dors - Ev - P5
- Plan - Ev - A1
- Plan - Ev - A2
- Plan - Ev - A3 (Br)
- Specimen 34

Series

Differentiation of specimen by color



SET UP TESTING SYSTEM

CONFIGURE TEST

RUN TEST

EXPORT TEST DATA

Series layout

Specimen graph

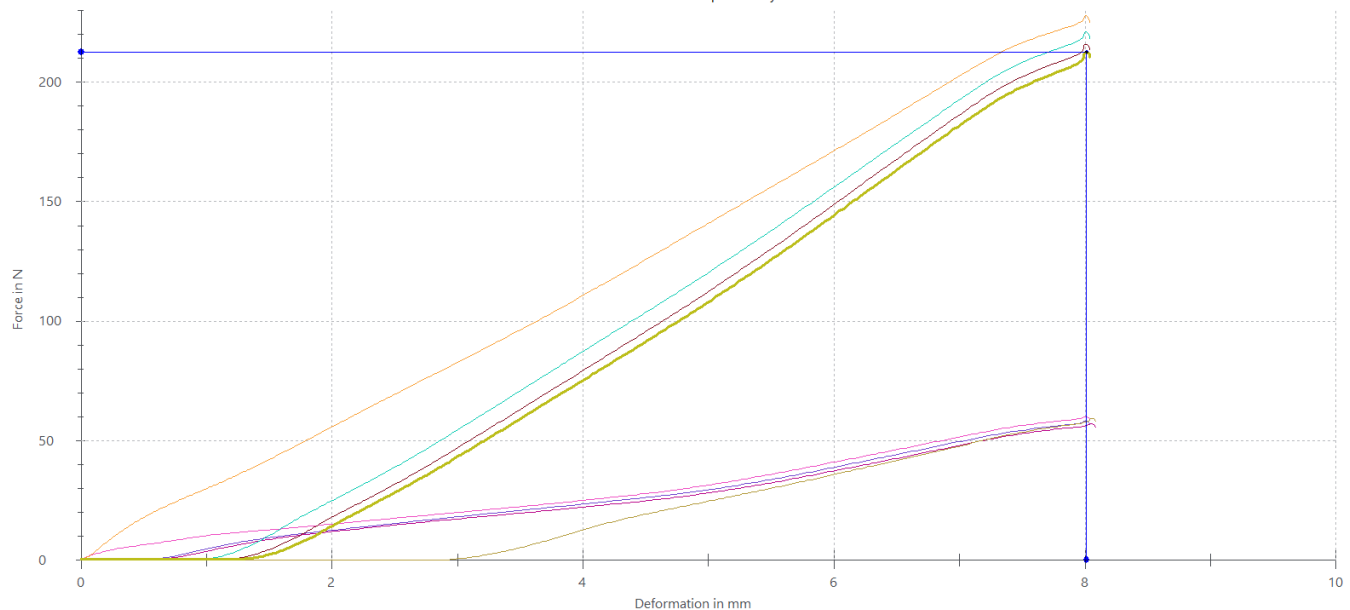
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- AS - Neu - Inv
- Specimen 2
- Specimen 3
- Specimen 4
- AS - Neu - Inv - vv
- Specimen 6
- Specimen 7
- Specimen 8
- AS - Pla - Inv
- Specimen 10
- Specimen 11
- Specimen 12
- AS - Dor - Inv
- Specimen 17
- Specimen 18
- Specimen 19
- C2 - Neu - Inv
- Specimen 21
- Specimen 22
- C2 - Neu - Inv - t
- Specimen 24
- Specimen 25
- Specimen 26
- C2 - Neu - vv
- Specimen 28
- Specimen 29
- Specimen 30

Specimen 40 ...

Differentiation of specimen by color



Series layout Specimen graph ...

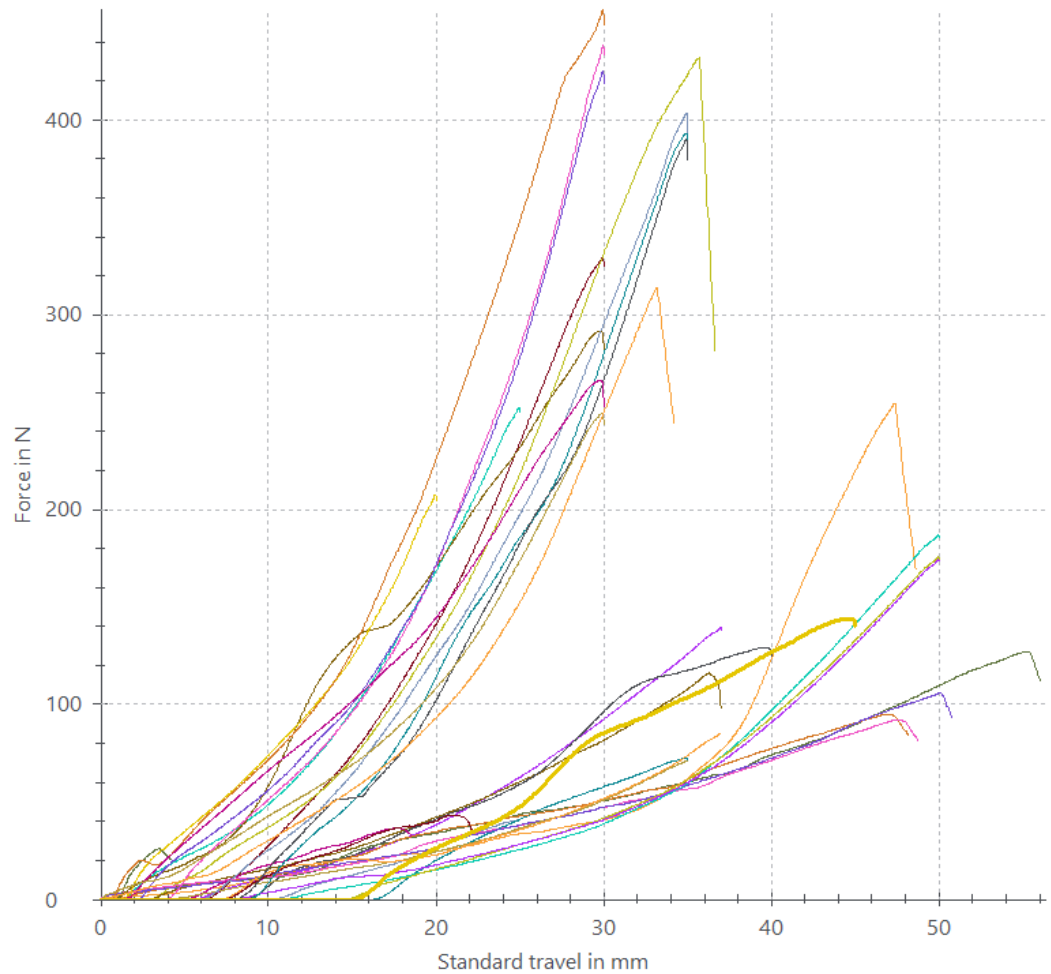


Series

- Voorvoet - Neutraal 1
- Neu - CFL1
- Neu - CFL2
- Neu - CFL3 (Br)
- Neu - CLF Br1
- Neu - CFL Br2
- Dors - PTFL 1
- Dors - PTFL 2
- Dors - PTFL 2
- Dors - PTFL 2
- Plant - ATFL1
- Plant - ATFL2
- Plant - ATFL3
- Plant - ATFL4
- Neu - Los - C1
- Neu - Los - C2
- Neu - Los - C3
- Neu - Los - C4
- Neu - Los - C5
- Neu - Los - C6
- Neu - Los - C7
- Ev - Neu - C1
- Ev - Neu - C2
- Ev - Neu - C3
- Ev - Neu - C4
- Dors - Ev - P1

Series

Differentiation of specimen by color



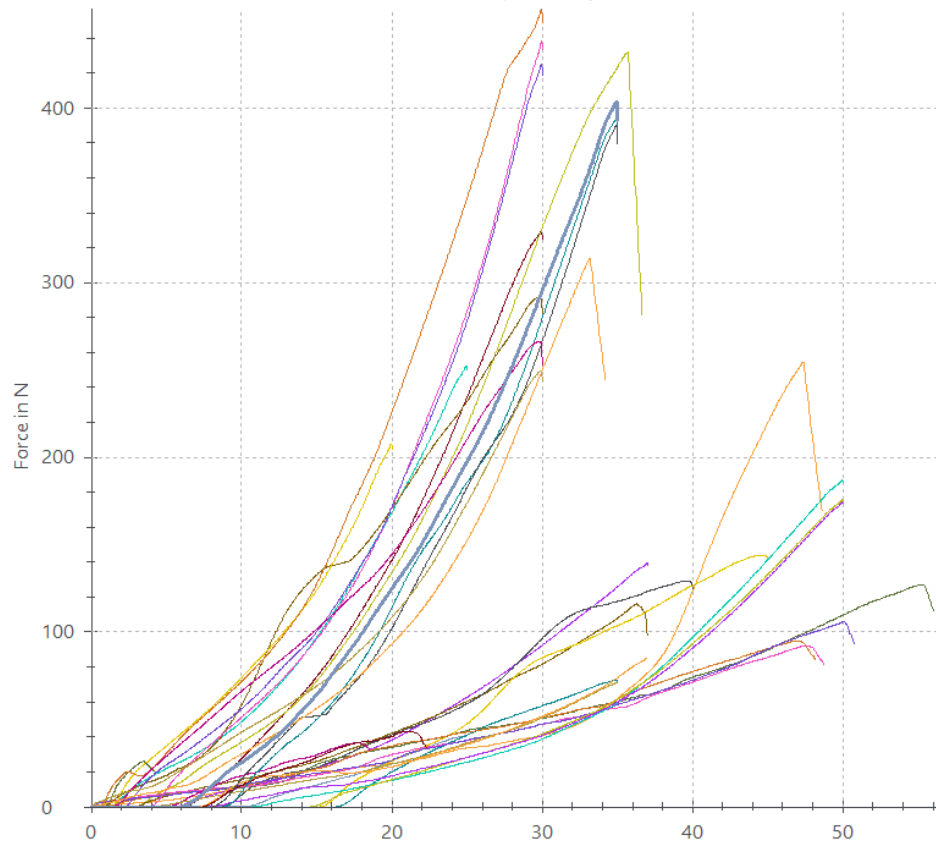
Series layout Specimen graph ...

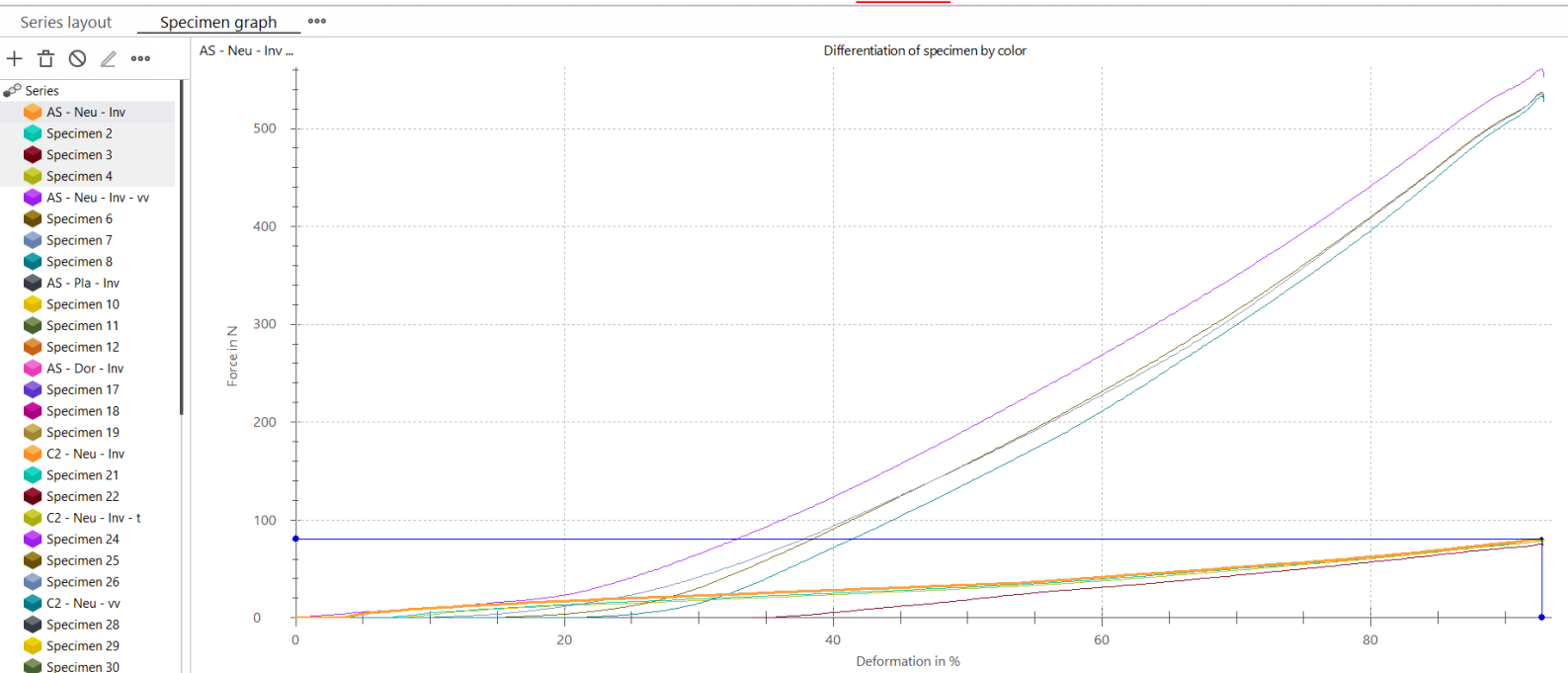
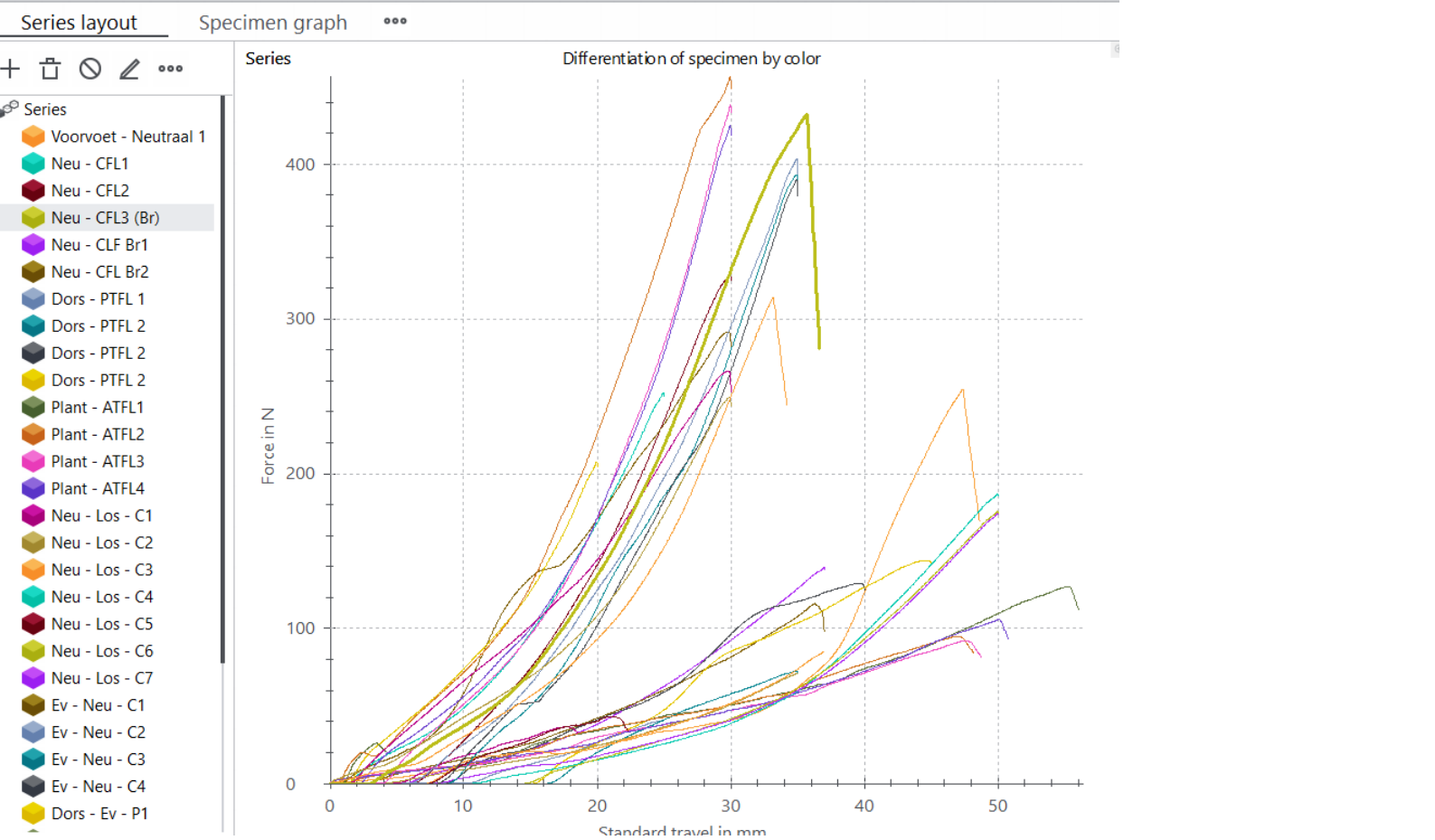


- Neu - CLF Br1
- Neu - CFL Br2
- Dors - PTFL 1
- Dors - PTFL 2
- Dors - PTFL 2
- Dors - PTFL 2
-
- Plant - ATFL2
- Plant - ATFL3
- Plant - ATFL4
- Neu - Los - C1
- Neu - Los - C2
- Neu - Los - C3
- Neu - Los - C4
- Neu - Los - C5
- Neu - Los - C6
- Neu - Los - C7
- Ev - Neu - C1
- Ev - Neu - C2
- Ev - Neu - C3
- Ev - Neu - C4
- Dors - Ev - P1
- Dors - Ev - P2
- Dors - Ev - P3
- Dors - Ev - P4
- Dors - Ev - P5
- Plan - Ev - A1

Series

Differentiation of specimen by color



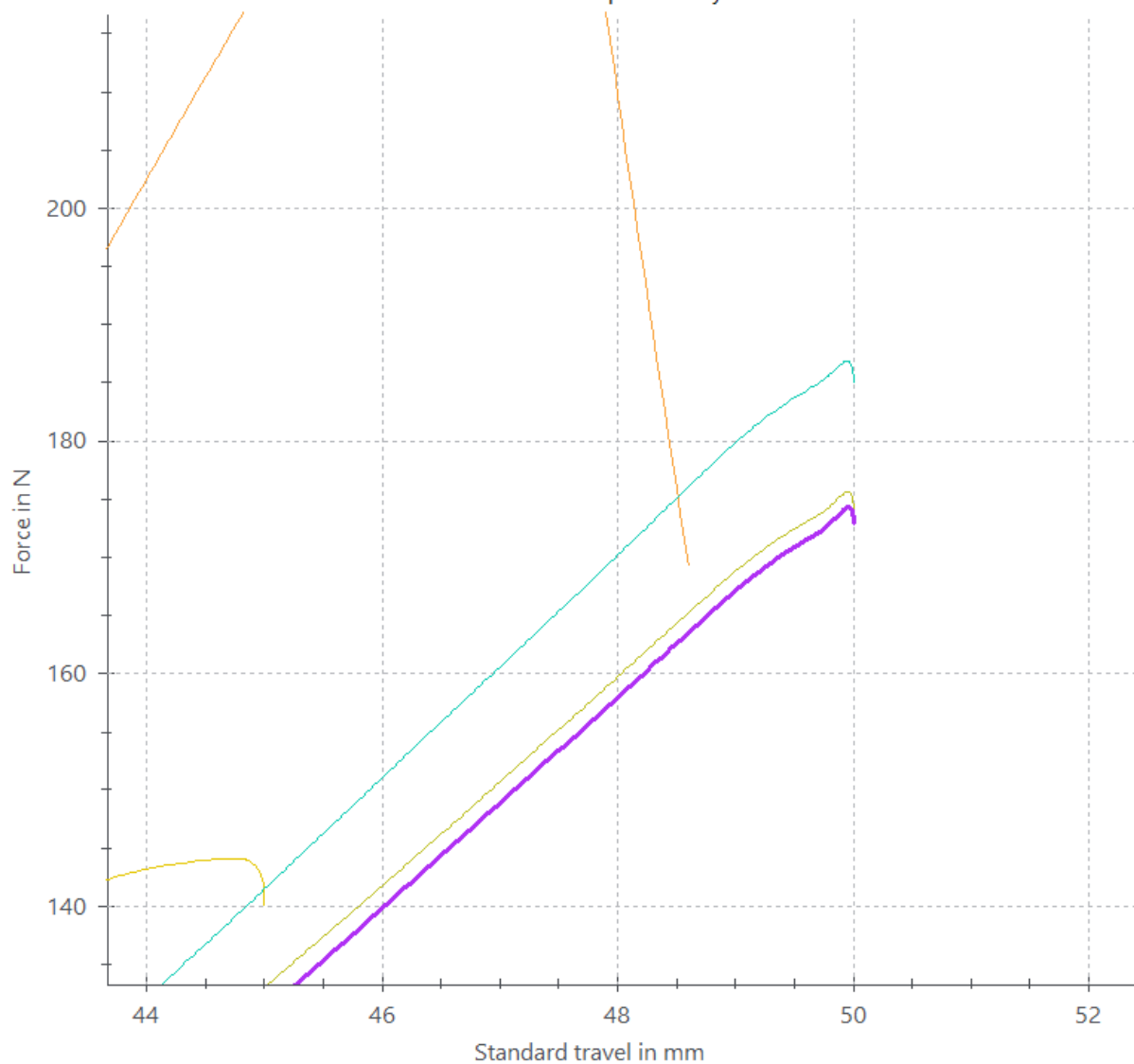




- Dors - PTFL 2
- Dors - PTFL 2
- Dors - PTFL 2
- Plant - ATFL1
- Plant - ATFL2
- Plant - ATFL3
- Plant - ATFL4
- Neu - Los - C1
- Neu - Los - C2
- Neu - Los - C3
- Neu - Los - C4
- Neu - Los - C5
- Neu - Los - C6
- Neu - Los - C7
- Ev - Neu - C1
- Ev - Neu - C2
- Ev - Neu - C3
- Ev - Neu - C4
- Dors - Ev - P1
- Dors - Ev - P2
- Dors - Ev - P3
- Dors - Ev - P4
- Dors - Ev - P5
- Plan - Ev - A1
- Plan - Ev - A2
- Plan - Ev - A3 (Br)
- Specimen 34

Series

Differentiation of specimen by color



SET UP TESTING SYSTEM CONFIGURE TEST RUN TEST EXPORT TEST DATA

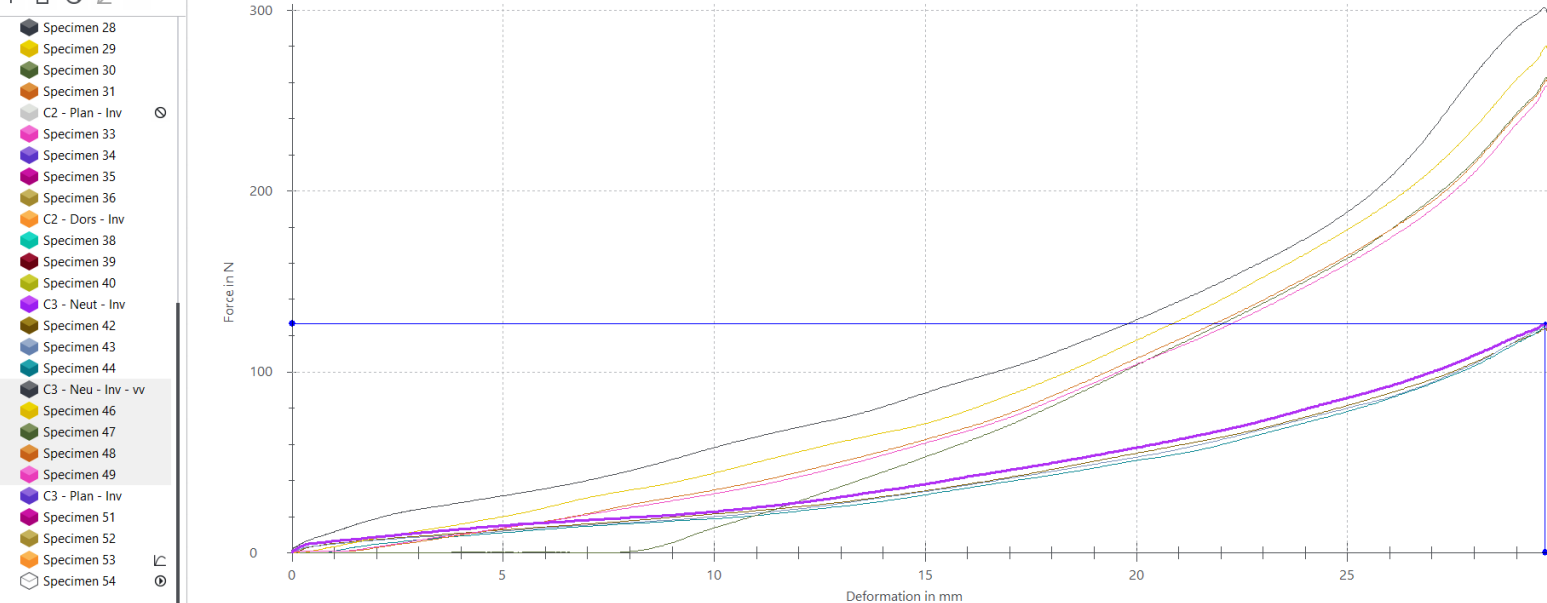
Series layout

Specimen graph



AS - Neu - Inv - vv ...

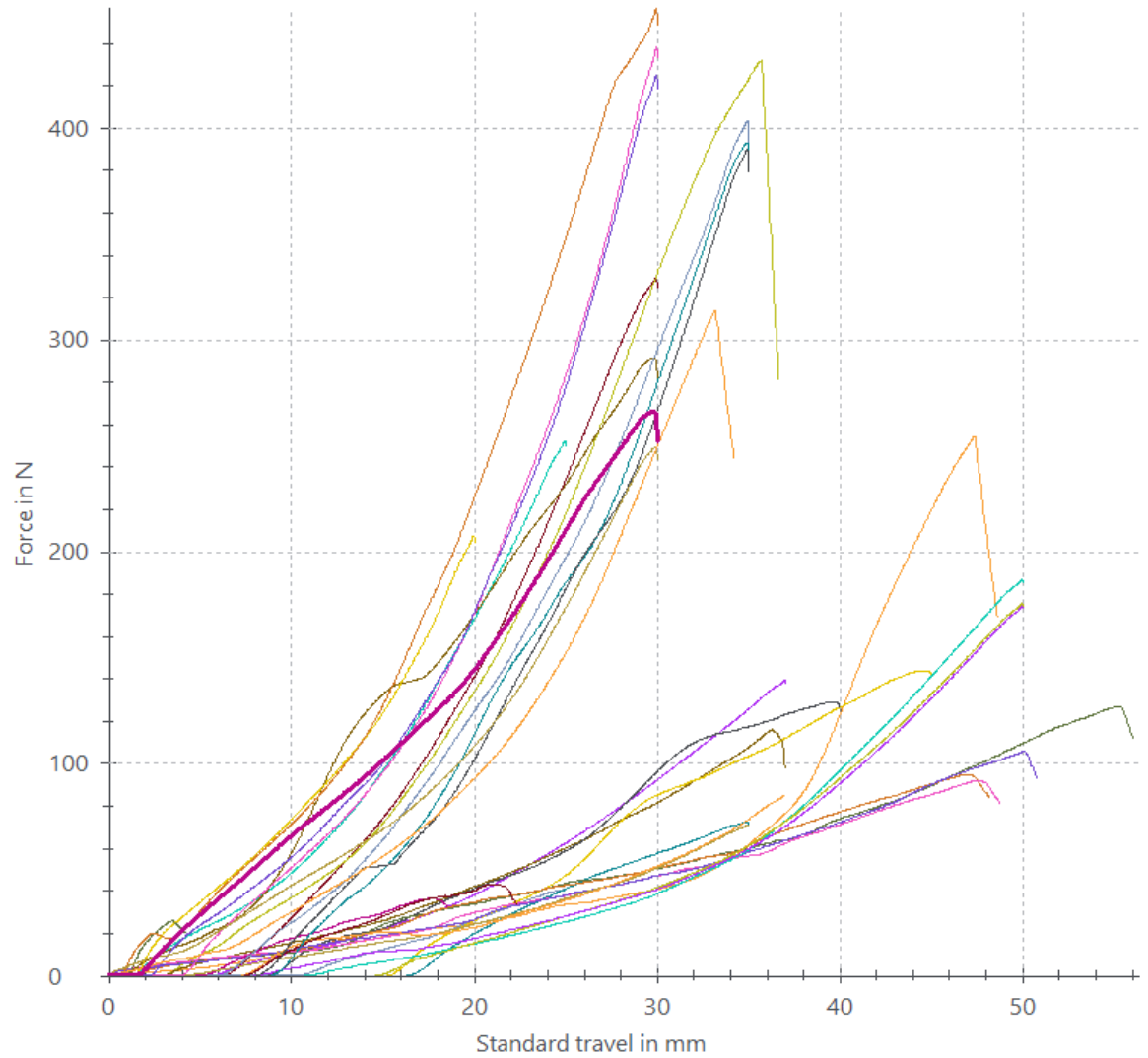
Differentiation of specimen by color





Series

Differentiation of specimen by color

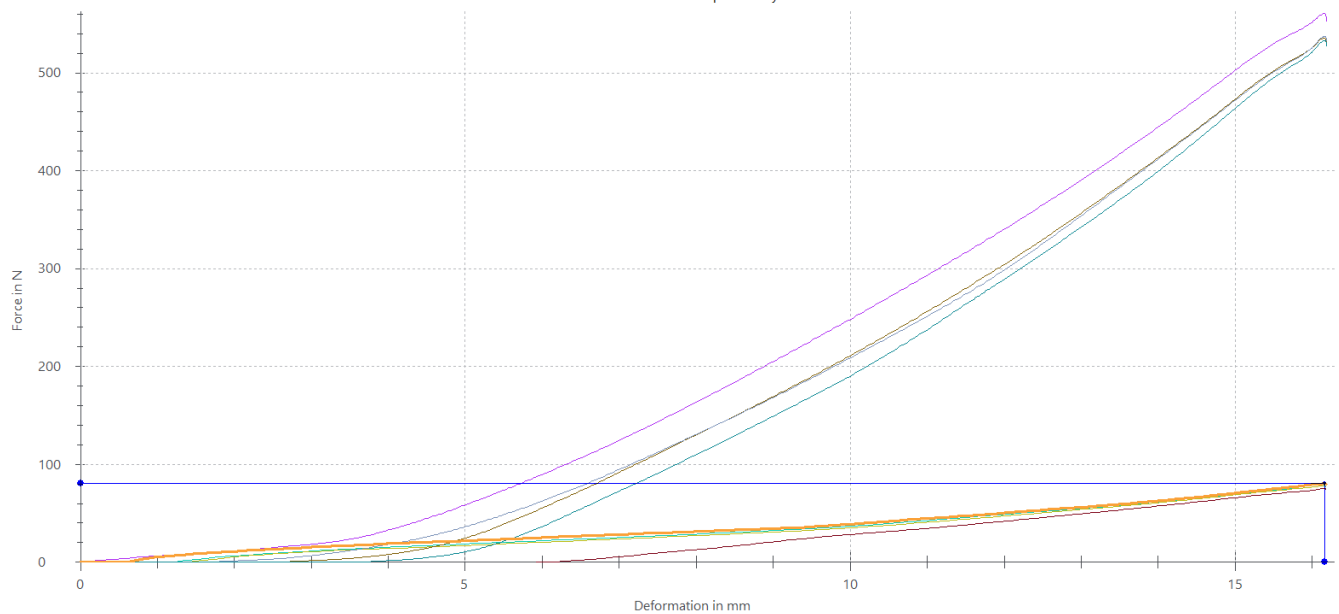
SET UP TESTING SYSTEM | CONFIGURE TEST | **RUN TEST** | EXPORT TEST DATA

Series layout | Specimen graph | ...



AS - Neu - Inv ...

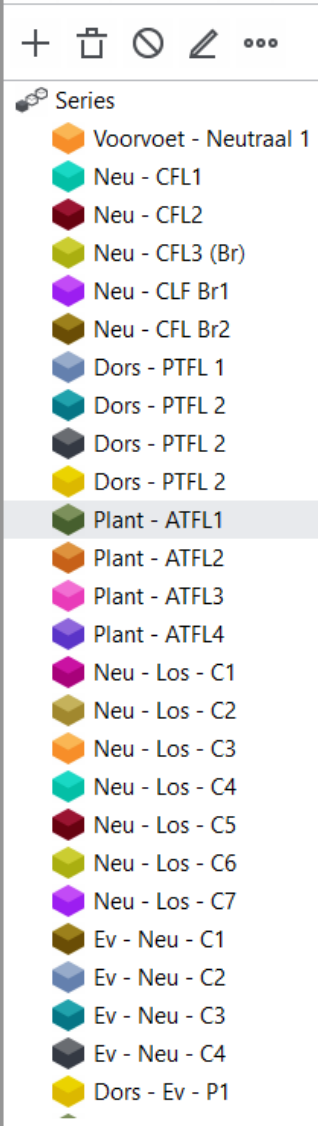
Differentiation of specimen by color



Series layout

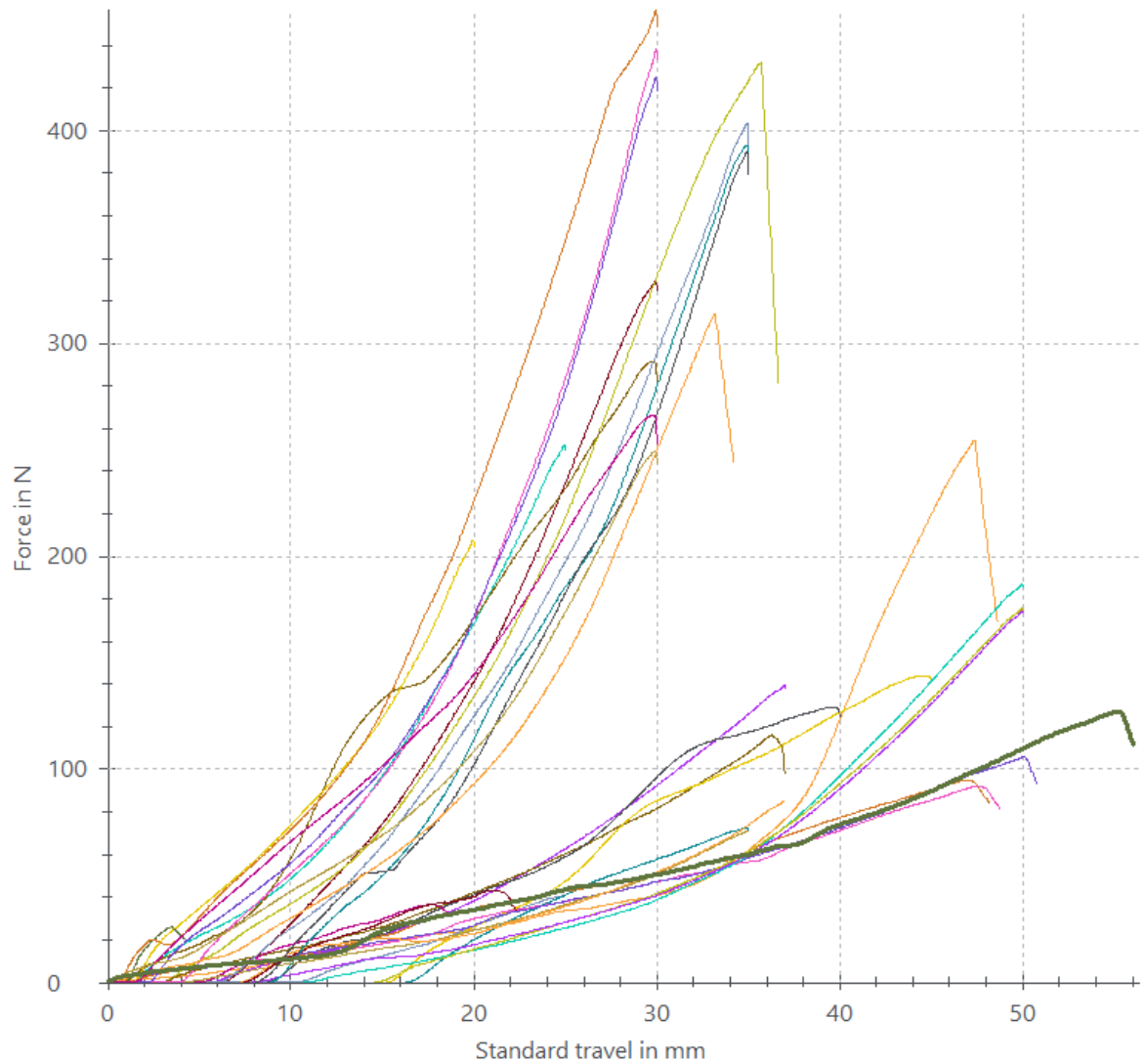
Specimen graph

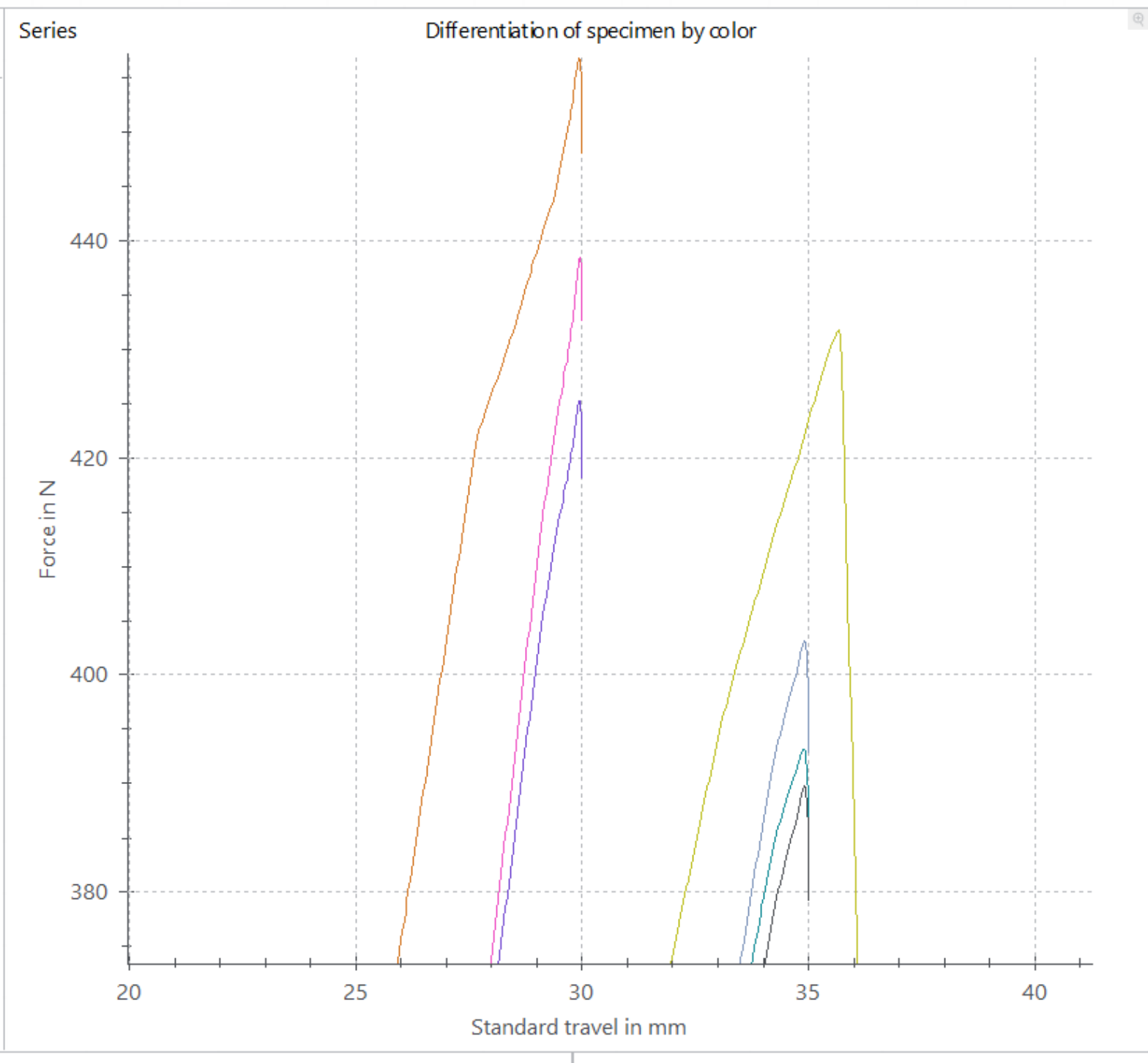
...



Series

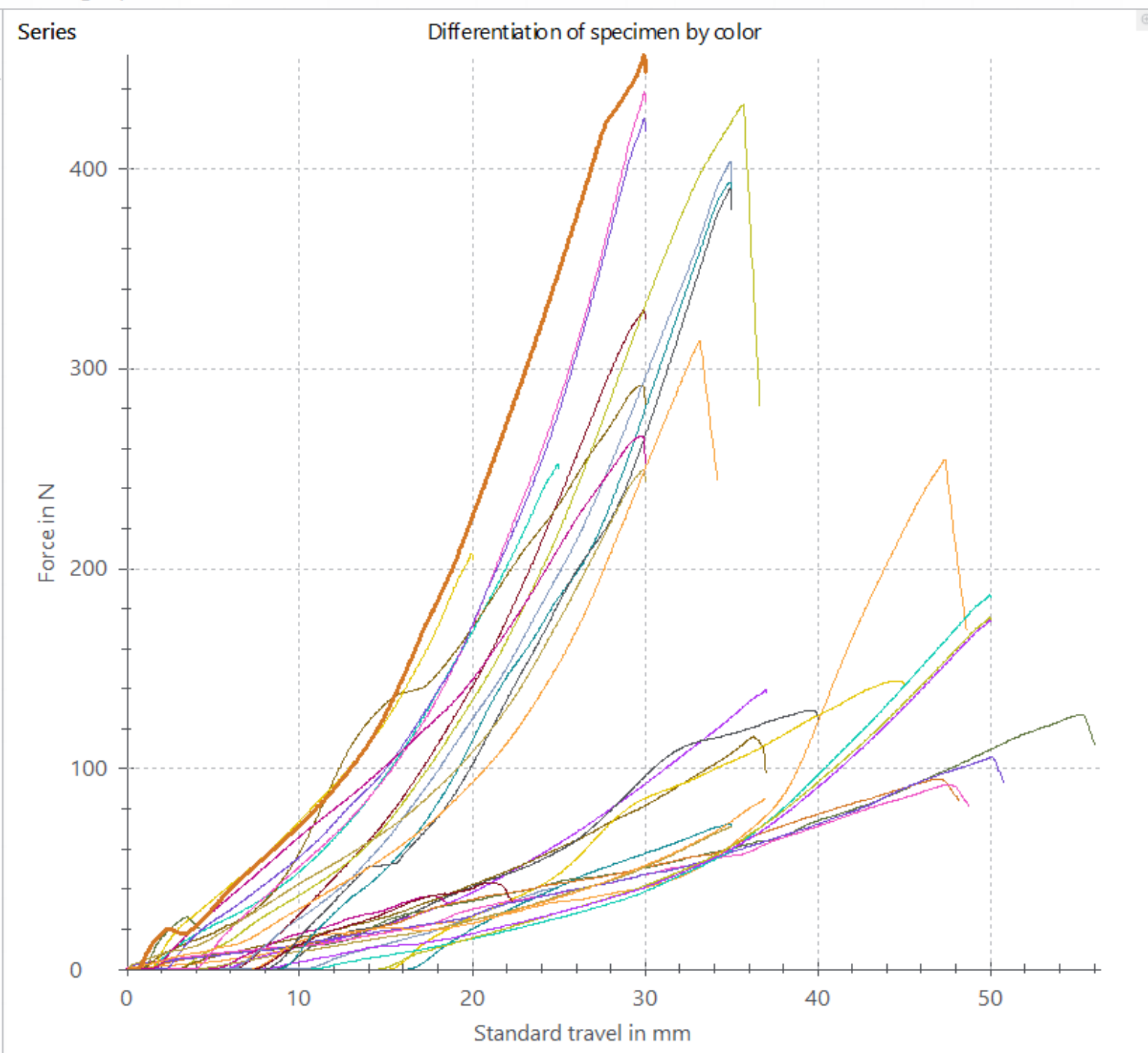
Differentiation of specimen by color

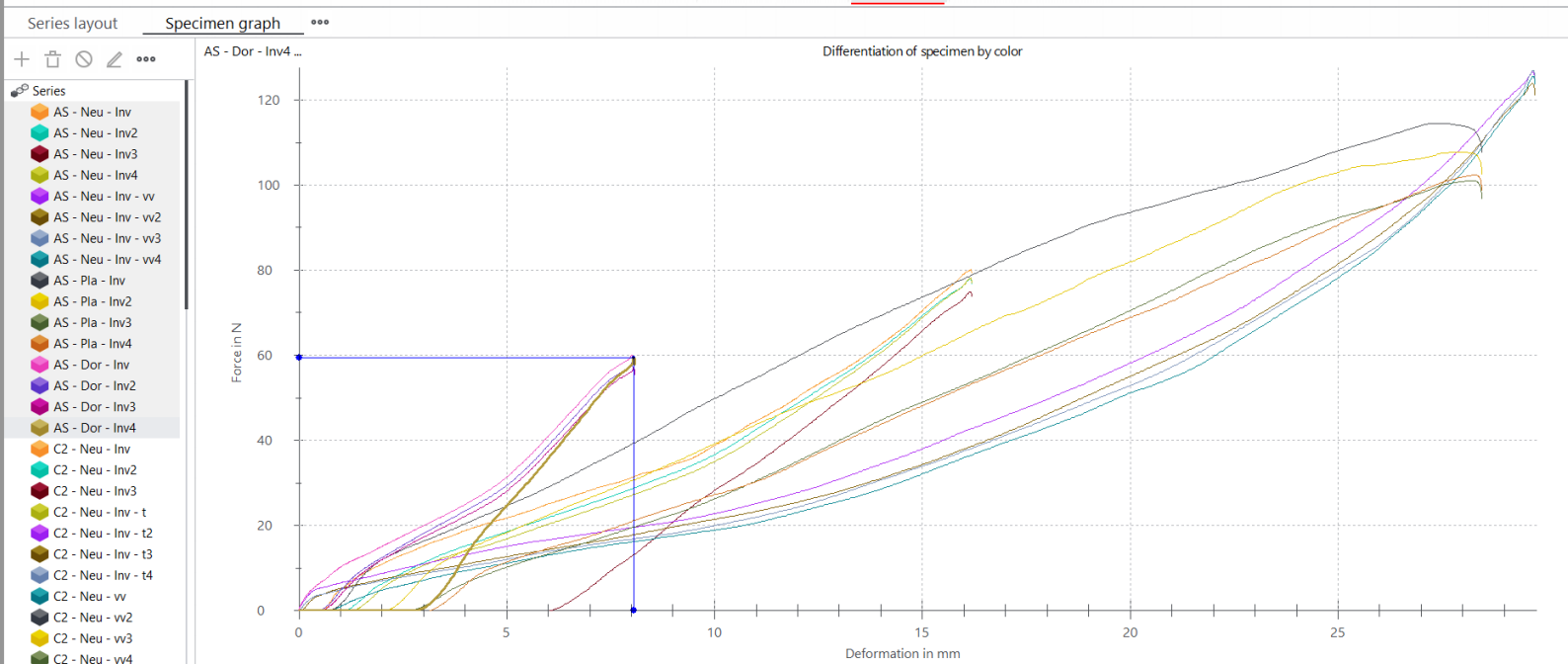
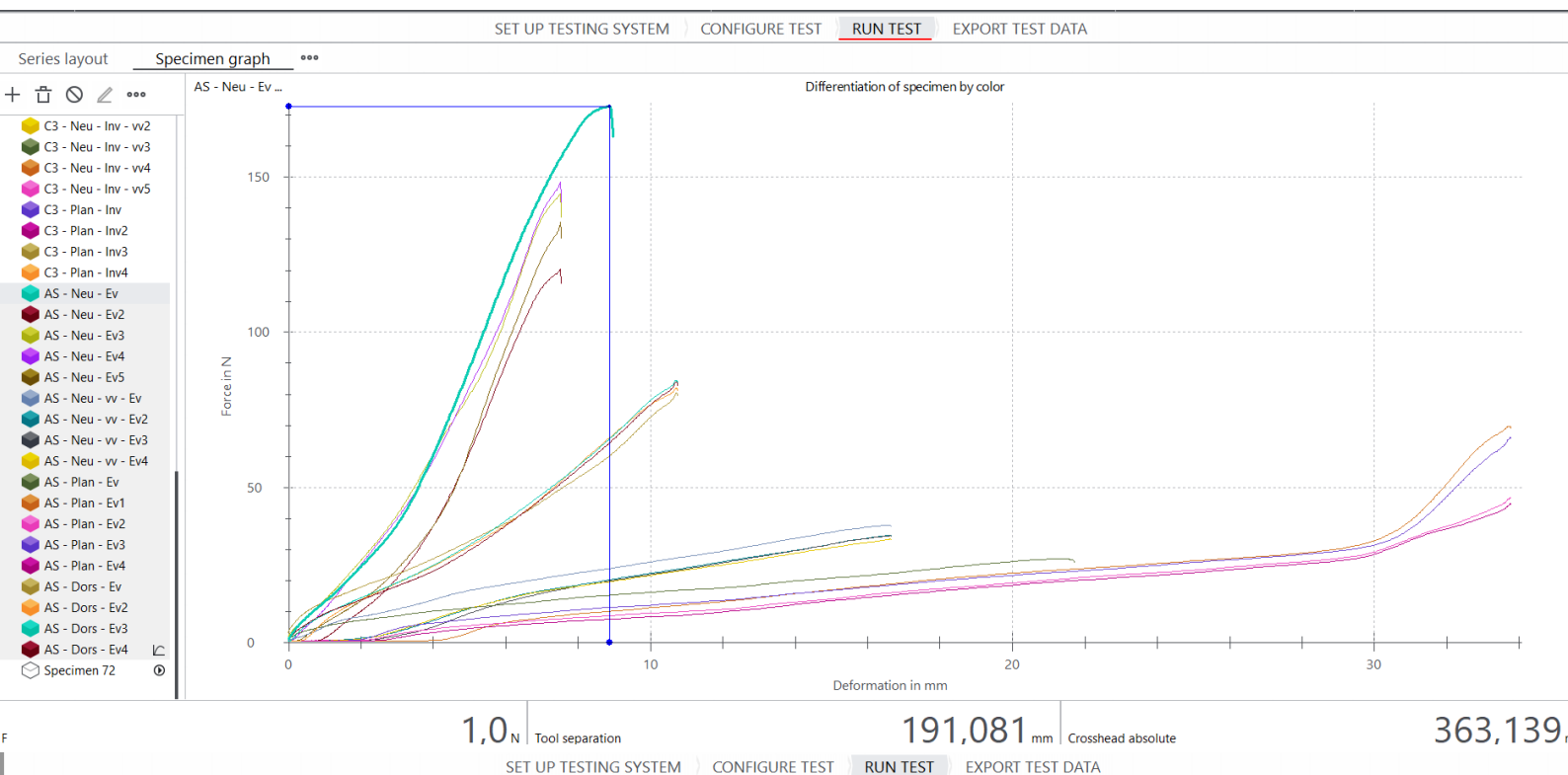




cimen graph

...





Series layout

Specimen graph

...

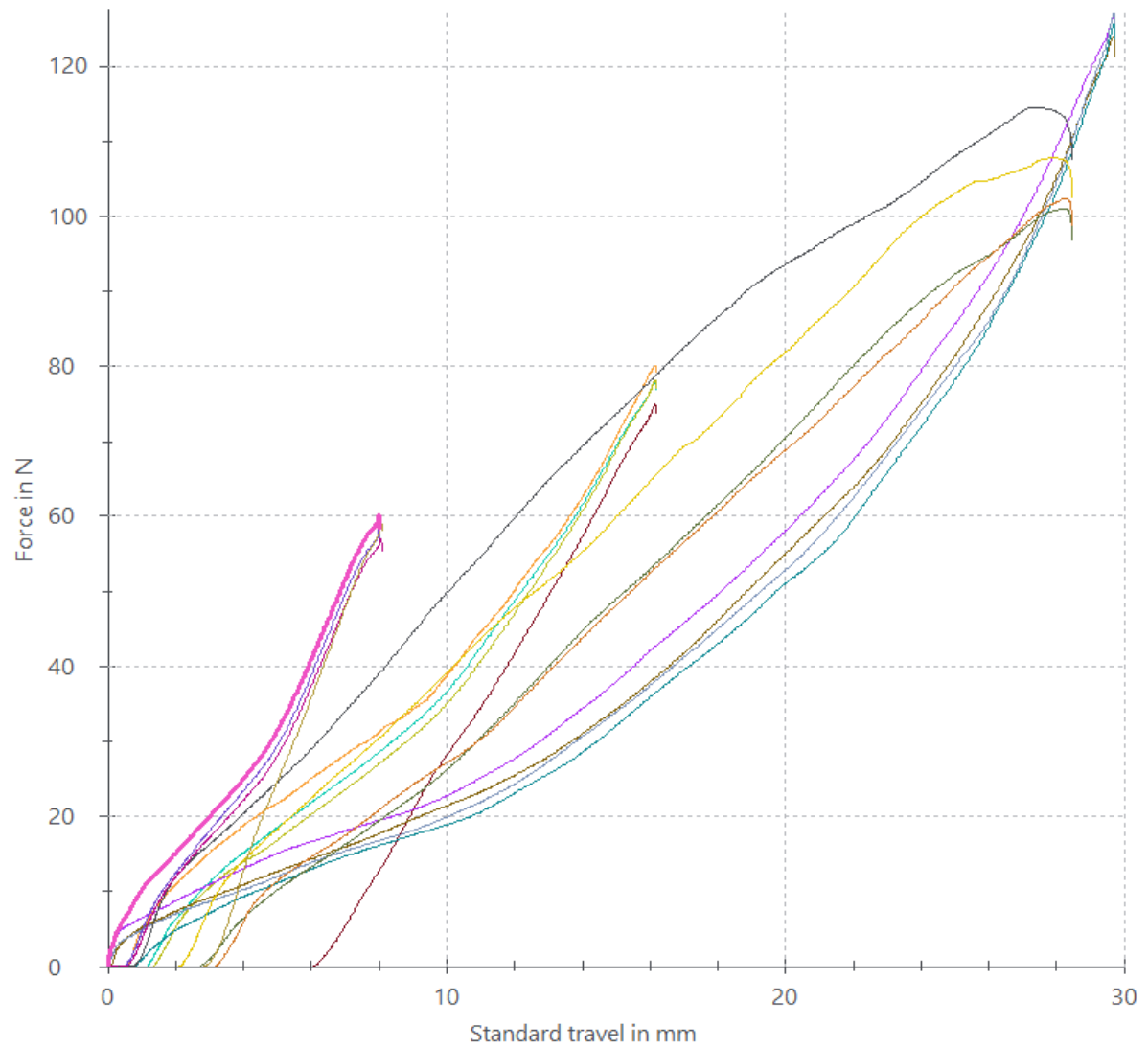
+ □ ○ ✎ ...

Series

- AS - Neu - Inv
- Specimen 2
- Specimen 3
- Specimen 4
- AS - Neu - Inv - vv
- Specimen 6
- Specimen 7
- Specimen 8
- AS - Pla - Inv
- Specimen 10
- Specimen 11
- Specimen 12
- AS - Dor - Inv
- Specimen 17
- Specimen 18
- Specimen 19
- Specimen 20

Series

Differentiation of specimen by color



Series layout

Specimen graph

...

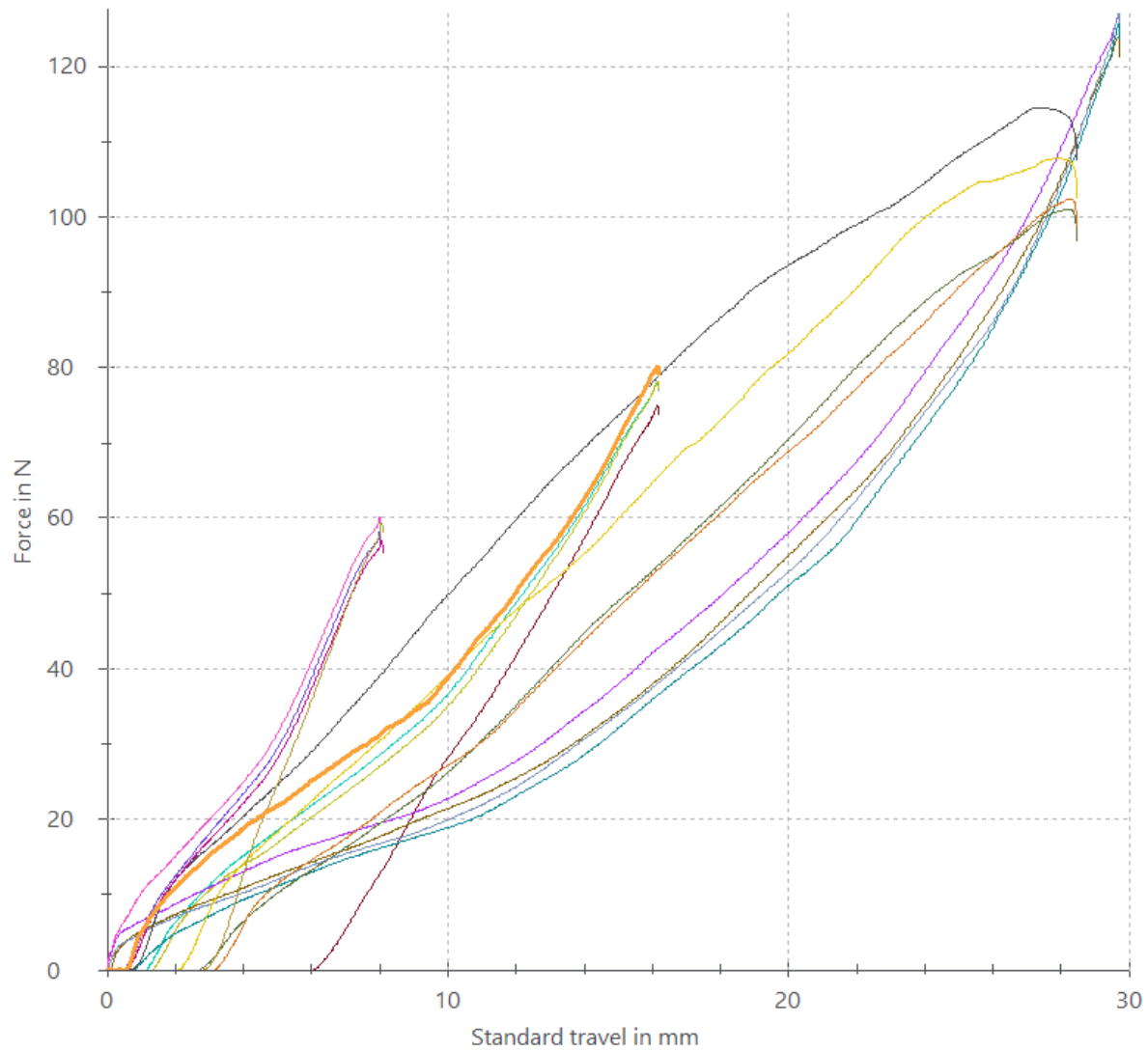
+ □ ○ ✎ ⋮

Series

- AS - Neu - Inv
- Specimen 2
- Specimen 3
- Specimen 4
- AS - Neu - Inv - vv
- Specimen 6
- Specimen 7
- Specimen 8
- AS - Pla - Inv
- Specimen 10
- Specimen 11
- Specimen 12
- AS - Dor - Inv
- Specimen 17
- Specimen 18
- Specimen 19
- Specimen 20

Series

Differentiation of specimen by color

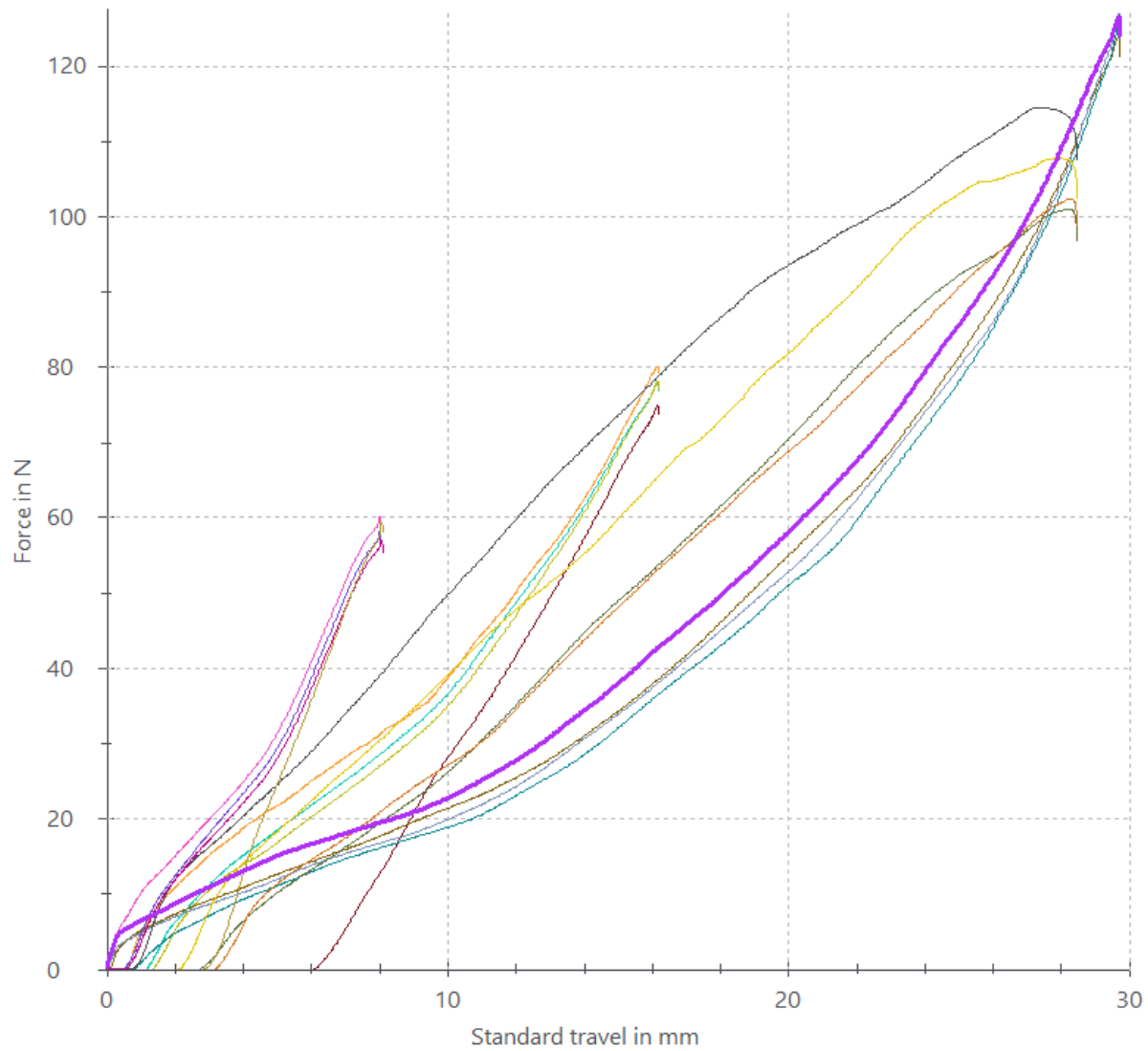




- Series
- AS - Neu - Inv
 - Specimen 2
 - Specimen 3
 - Specimen 4
 - AS - Neu - Inv - vv
 - Specimen 6
 - Specimen 7
 - Specimen 8
 - AS - Pla - Inv
 - Specimen 10
 - Specimen 11
 - Specimen 12
 - AS - Dor - Inv
 - Specimen 17
 - Specimen 18
 - Specimen 19
 - Specimen 20

Series

Differentiation of specimen by color

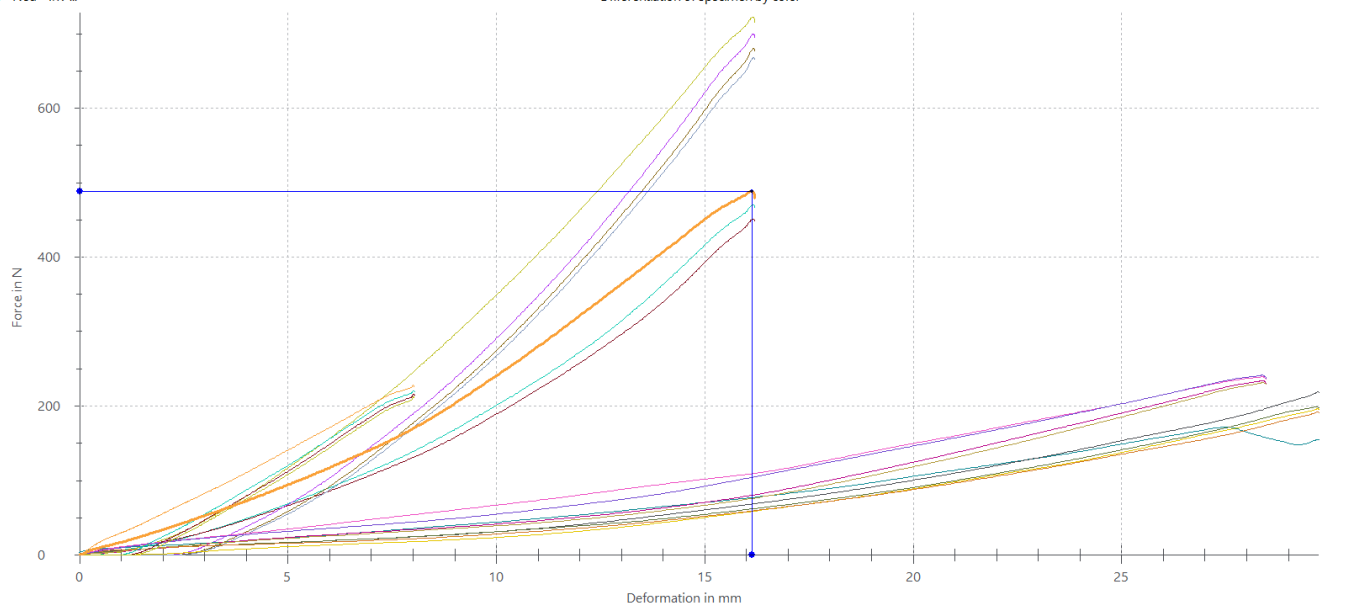
SET UP TESTING SYSTEM | CONFIGURE TEST | **RUN TEST** | EXPORT TEST DATA

Series layout | Specimen graph | ...



- C2 - Neu - Inv ...
- C2 - Neu - vv
 - C2 - Neu - vv2
 - C2 - Neu - vv3
 - C2 - Neu - vv4
 - C2 - Neu - vv5
 - C2 - Plan - Inv
 - C2 - Plan - Inv2
 - C2 - Plan - Inv3
 - C2 - Plan - Inv4
 - C2 - Dors - Inv
 - C2 - Dors - Inv2
 - C2 - Dors - Inv3
 - C2 - Dors - Inv4
 - C3 - Neu - Inv
 - C3 - Neu - Inv2
 - C3 - Neu - Inv3
 - C3 - Neu - Inv4
 - C3 - Neu - Inv - vv
 - C3 - Neu - Inv - vv2
 - C3 - Neu - Inv - vv3
 - C3 - Neu - Inv - vv4
 - C3 - Neu - Inv - vv5
 - C3 - Plan - Inv
 - C3 - Plan - Inv2
 - C3 - Plan - Inv3
 - C3 - Plan - Inv4
 - AS - Neu - Ev
 - AS - Neu - Ev2

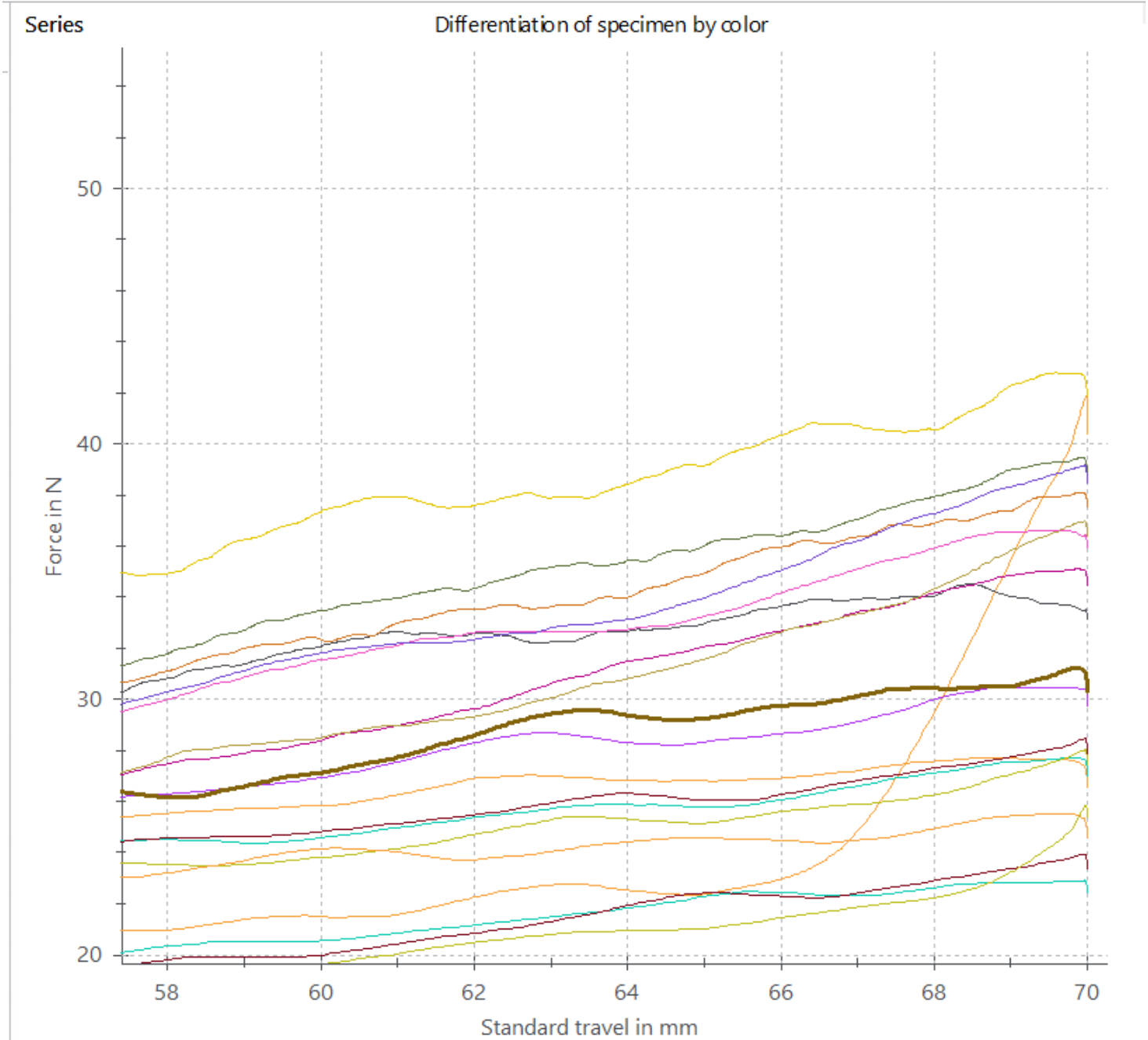
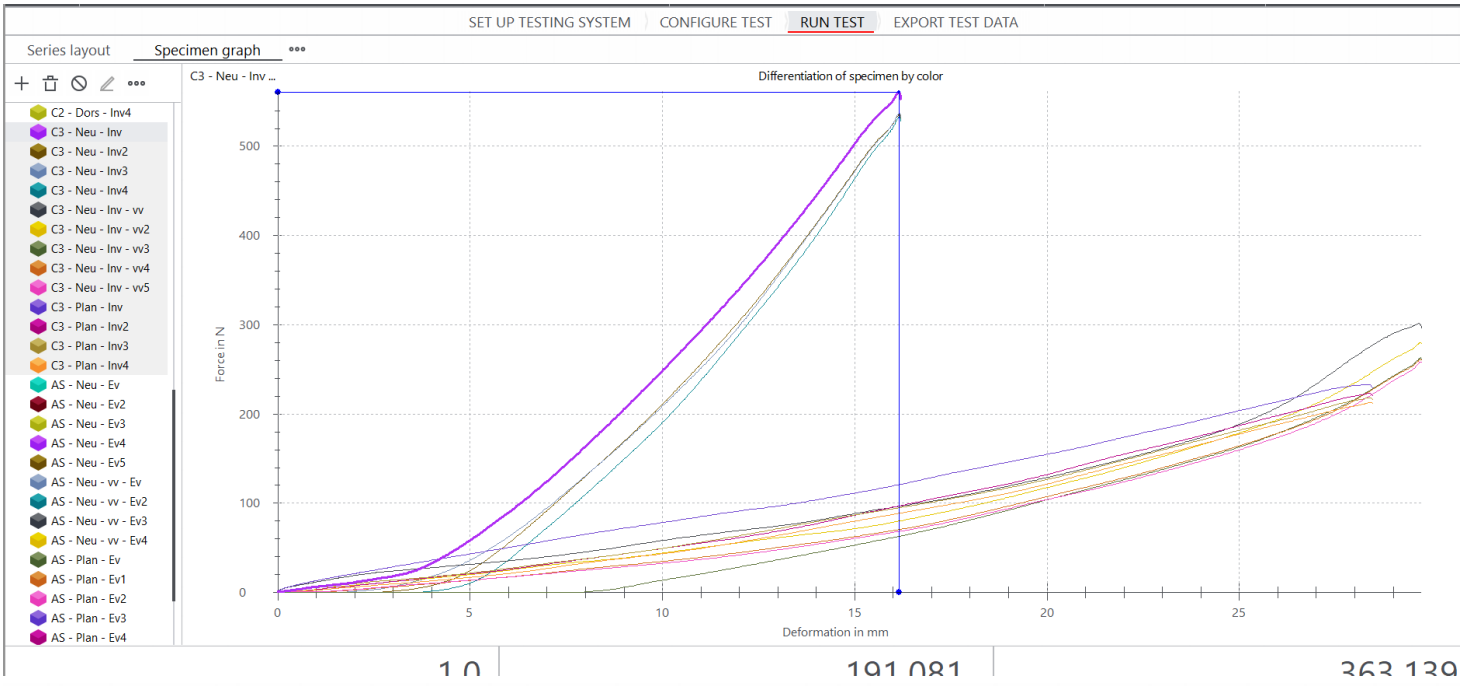
Differentiation of specimen by color

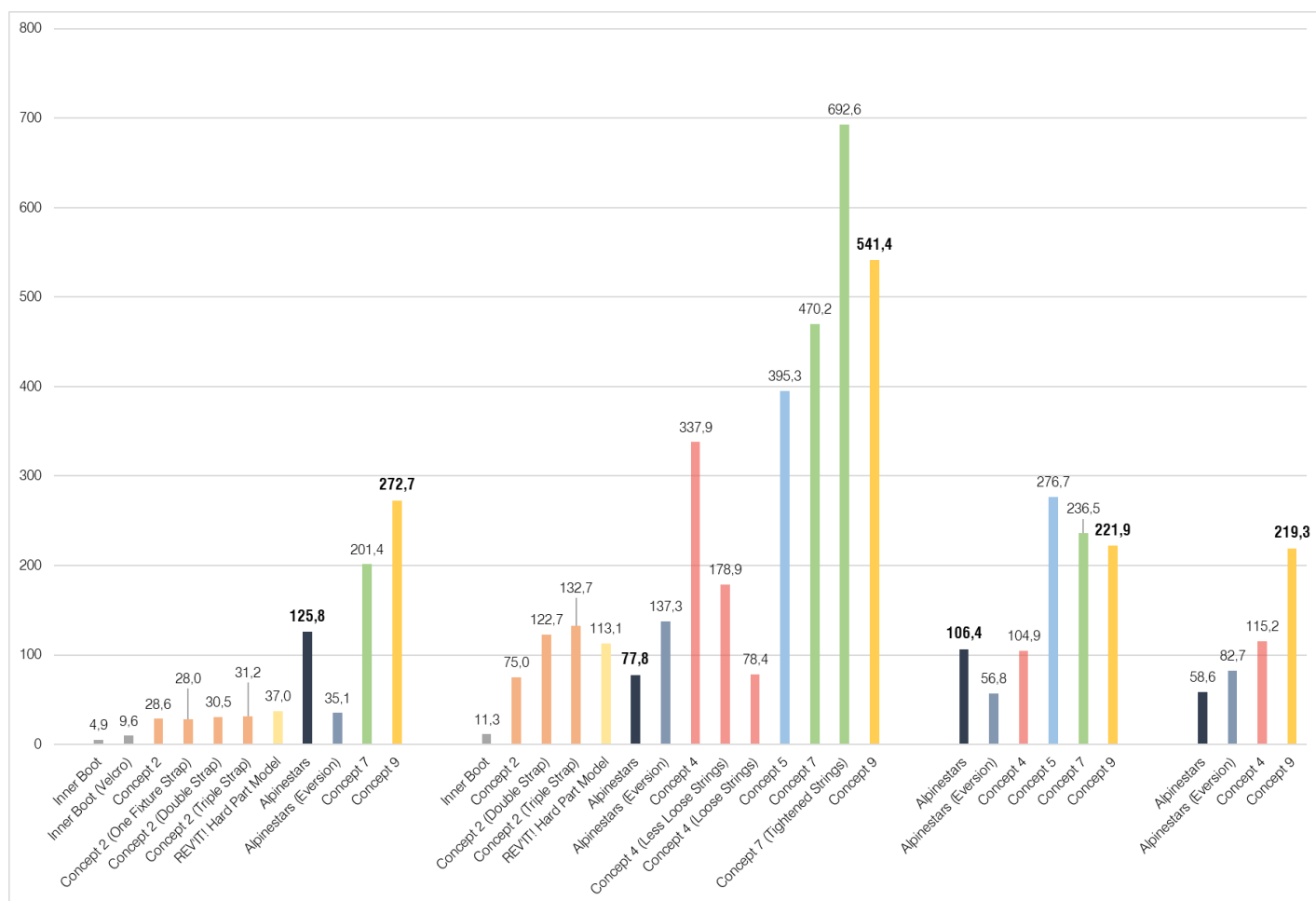
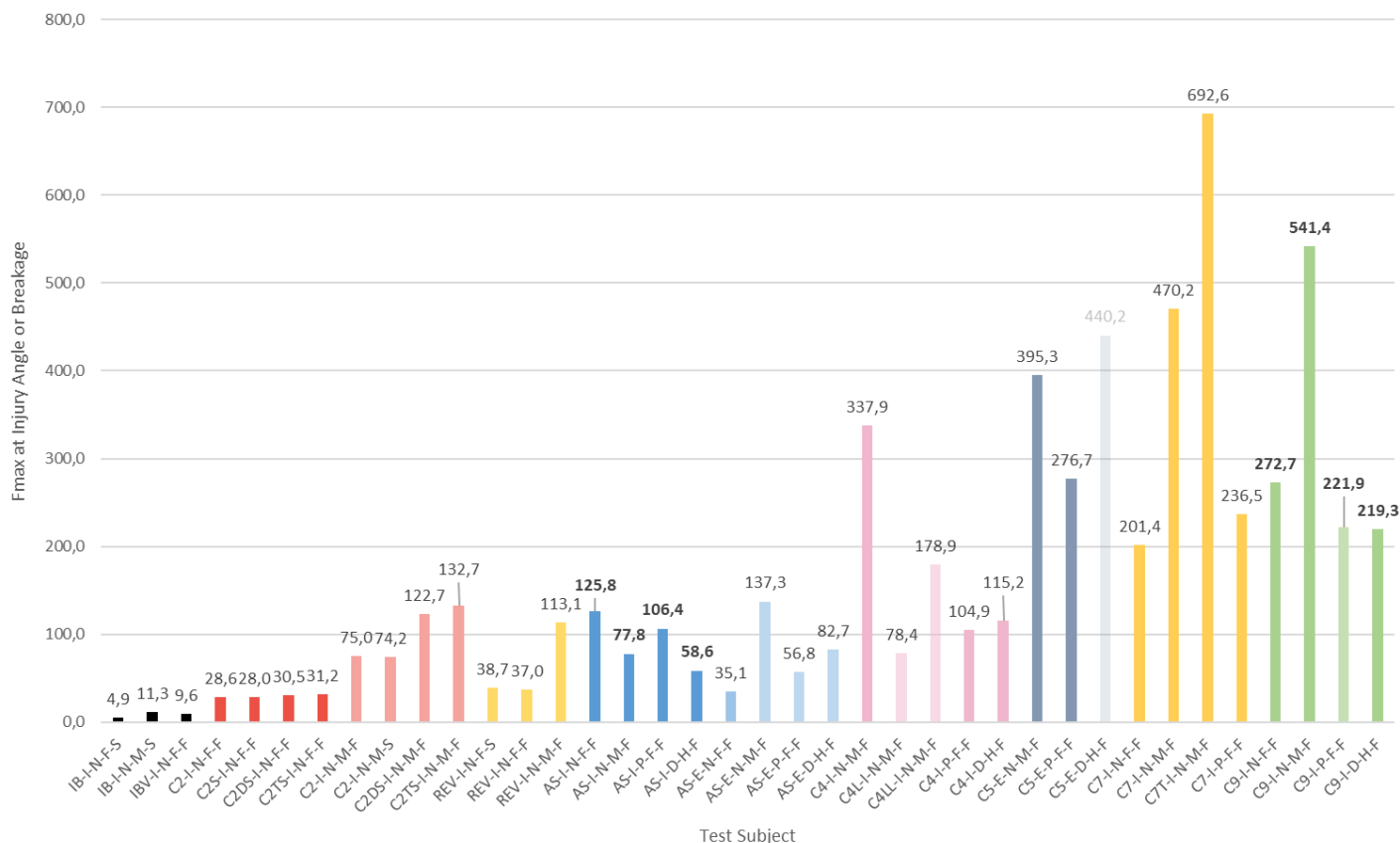


1 0 ...

191 081

363 139





Conclusion

It shows that with every iterative step, the concept became better. Only Concept 7 once exceeded the final version when the strings were tightened so that the joint in the hard part no longer allowed for xversion. In Concept 9, the strings were a little looser to provide more FOM. With the same looseness of the strings, Concept 9 performed slightly better, which is interesting as Concept 9 is 4 mm thick and Concept 7 is 2 mm. The curves show that the model allows for a certain range of motion with limited resistance and, after that point, becomes stiffer, which is the ideal behaviour. Finally and most importantly, it can be concluded that the new brace design requires 2.2, 7.0, 2.1, and 3.7 times more force to push the towards the inversion injury angle in a neutral (with the compressor on the forefoot and middle of the foot), plantar flexed and dorsiflexed position, respectively, compared to the brace of Alpinestars. Meaning the goal was achieved.

APPENDIX 23. ANKLE BRACE COLOUR STUDY



Colour does not only affect the aesthetic of a product, but it can also function as a means to communicate a certain message to the user. In the case of the inner boot and ankle brace, the message would be about the interaction, functionality, and branding. In this study, the goal was to explore what colour combination would give off the right message; the only interaction required is the tightening of the inner boot with the use of the lacing system and the straps are part of the support system of the brace that should come off as qualitative and so trustworthy to increase the sense of safety of the riders. Less mandatory are the objectives to clearly communicate that the ankle brace is of REV'IT! and to make it so that the ankle brace looks aesthetically pleasing. The ankle brace will be covered by an outer shell once it is incorporated into the racing boot. Most likely, only part of the brace will be visible during donning and doffing, which is for an insignificant amount of time.

Method

With the use of SolidWorks and with the requirements in mind 22 colour variants were created. A first selection of colours was made based on looks, the style of REV'IT! and the general association with colours. The colours that fit and looked best were red, blue, black and white. The colour symbolism chart of Colour Meanings (2023) was used to get an understanding of the different meanings of colour. This is of course no exact science, but it is an interesting base for creating a narrative that fits the design story and to make a choice based on something as there are endless amounts of colour. Red is generally associated with aggression, power and confidence, which fits the context of a racing boot. Blue is generally associated with security, trust and calmness, which is an association that fits the goal of providing a sense of security. Black stands for protection, power and sophistication and is a main colour of REV'IT!. And finally white communicates cleanliness, purity and perfection, while also being a main colour of REV'IT!. Also, different metals colours for the lacing hoops were tested beforehand, silver, black and gold and the best-looking combination was with gold rings. Gold is generally associated with success, optimism, and confidence, which is, even with its limited presence, a nice touch.

The colour variants were, all at once, presented to six participants and they were asked to make a top three of the designs that fit the above-described requirements best. They were asked: "Which colour combinations communicate best that the only thing you have to do is adjust the laces to your liking, seems the most trustworthy and looks most aesthetically pleasing in your opinion. Please select your three favourites."

The following pictures were shown to the participants:

1



2



3



4



5



6



7



8



9



10



11



12



13



14



15



16



17



18



19



20



21



22



Results

Per participant their three favourites were noted, see left table below. All votes were then counted and summed up per concept, see right table below.

Participant	Favourites		
1	19	7	18
2	18	14	1
3	18	14	21
4	1	14	13
5	14	18	6
6	17	18	6

Concept #	1	6	7	13	14	17	18	19	20
Score	2	2	1	1	4	1	5	1	1

Conclusion

According to the participants of this small study, concept 18 communicates best that the only interaction required is the tightening of the lacing system, while exuding trustworthiness and looking aesthetically pleasing. Therefore, this will be the colour combination that will be applied to the final concept.

Concept 18



APPENDIX 24. INVOICE FOR PA11 MJF 3D PRINTING

10 rue Auguste Perret
94800 VILLEJUIF
FRANCE
+33 (0)1 83 64 11 22
contact@sculpteo.com

Quote reference: EP7FS88X
Date: June 6, 2023

Shipping Address

Billing Information

Phone: 0000000000

Payment terms

30 day payment

YOUR QUOTE / PROFORMA INVOICE

Description	Item Preview	Quantity	Unit Price	Discount	Subtotal
3D print of Lower hard part Material: Multijet Fusion, PA11 Finish: Not Dyed Polished, Grey Size: 249.7 × 95.6 × 108.2 mm		1	€160.60		€160.60
Handling fee		1	€14.23		€14.23
3D print of Upper hard part Material: Multijet Fusion, PA11 Finish: Not Dyed Polished, Grey Size: 91.3 × 151.3 × 108.6 mm		1	€124.04		€124.04
Express shipping		1	€10.00		€10.00
Subtotal (excluding tax)					€308.87
Sales Tax					€64.86
Total					€373.73

Caution :

- The objects we are producing are not toys and must not be given to children. They must not come in contact with food and drink and should be kept away from any heat sources or electricity.

While the provided price is valid for a period of 8 days from the date indicated above, the delivery date is indicative and will be recalculated at time of order. This quote does not guarantee available production capacity at time of order. You may [review](#) or [accept and pay](#) your quote online.

Delay: 8 days after order payment, to be inserted in production planning.

Total amount is valid only for the provided quantities and this file.

Sculpteo - SIREN 514.971.654 - RCS Créteil - SAS with registered capital of 2,750,184 EUR

Sales Tax: FR 48 514 971 654 - EORI: FR 514 971 654 00041