Design & Development of Scalp Cooling Cap

By:

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Project Dates: Phase 1: May 2012 – 2013 on-going

Current Product:

Current product is wound length of silicone tubes
Individually hand made, slow & expensive to manufacture, 5 different sizes,

Project Aims and Objectives:

Stage 1:

- **Preliminary Research into European/Far-East human head size/shape** data and availability.
- **3D Scanning of the volunteer's** head creation of 3D CAD model.
- **Produce suitable method of cap design & tool design to suit supplier's production method.**
- In collaboration with Paxman and their supplier the **following objectives** were agreed:
  - **Improve Conductivity**
  - **Improve Cap Fit**
  - **Improve Patient Comfort and Ergonomics**
  - **Improve the Ability to Mass-Produce**
  - **Minimise the number of size options**
  - **Reduce Manufacturing Cost**
  - **Identify optimal flow pattern within the Cap Design**
- **Digital 3D CAD model** of the agreed cap design.
- **Liaise with Primasil to create a Working Prototype** of the agreed design to fit the agreed head size, Design Modifications following testing.

Stage 2:

UK head sizes:
- Creation of 3D CAD models of multiple UK head sizes, the variation depends on the design solution produced in stage one.
- Working with Primasil, to produce relevant mould and tools, pattern, etc. for each UK sizes which can be used for mass production

Far East head sizes:
- Research into Far East head sizes, 3D Rapid Prototyping of a single head,
- Creation of 3D cad models of multiple head sizes for Far East
- Produce relevant mould and tools, pattern, etc. for each Far East sizes

Literature review : See Project Report

Paxman History

Introduction to the Paxman Hair Loss Reduction System
Cooling Caps

Research into Effectiveness of Scalp Cooling

Scalp Cooling Prevention
Paxman Scalp Cooling experiment in UK (1997-2010)
Norwegian observational study (2000-2001)
Netherland Study -1 (2006 - 2010)
Netherland Study – 2 (2006 - 2010)
Research by Massey SM (2004)
Research by Wim PM Breed, Corina JG van den Hurk and Mijke Peerbooms, (2011)

Patent Search

Inventor: Johan Stormby, Malmo, Patent No / Pub No: US 2010/0186436 A1
Inventor: Carole Lee, Patent No / Pub No: US 2002/0058976 A1
Inventor: Yvonne Olofsson, Patent No / Pub No: 6,156,059
Inventor: Freddy Pachys, Patent No / Pub No: 5,603,728
Inventor: Randy Leong, Patent No / Pub No: 5,950,234
Inventor: Robert W. Kramer, Patent No / Pub No: 4,566,455
Inventor: Kenneth J. Maxted, Patent No / Pub No: 5,342,411
Inventor: Pedro J. Fontanez Mayaguez, Patent No / Pub No: US 2008/0184456 A1
Inventor: Ted Nathan Strauss, Patent No / Pub No: US 7,721,349 B1
nventor: Ted Nathan Strauss, Patent No / Pub No: US 7,721,349 B1
Other related patents include

Head Size Research

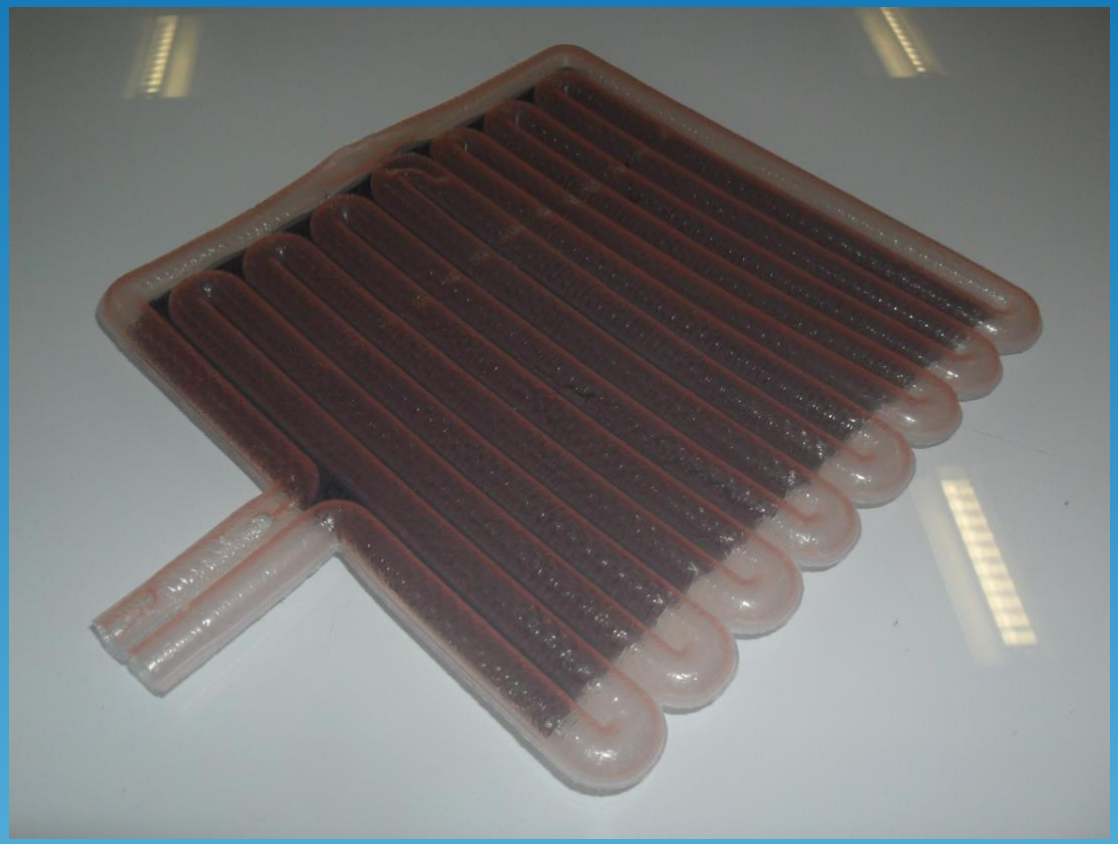
CAESAR Project
Size China *Project*

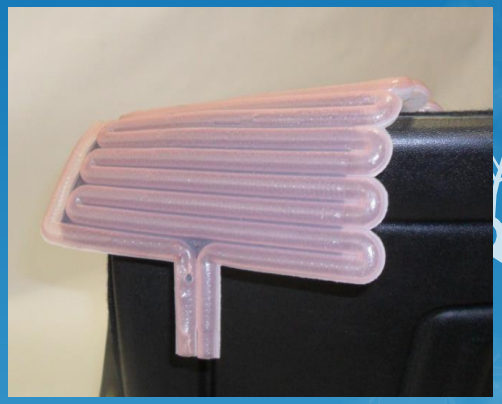
Experiments

Non-contact 3D Laser Scanning and Processing
Concept development
Tool Design
Prototyping
Experiment 2
Future Work

References

Mass Production method:

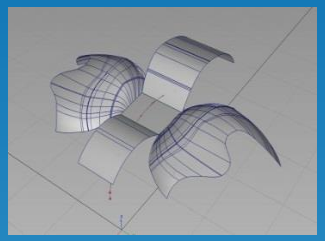


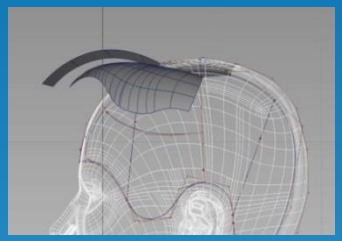


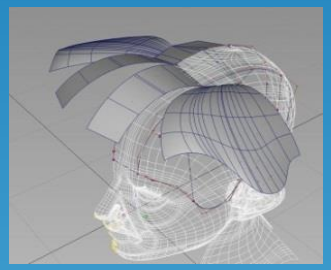
Primasil proposed a new production method which could create hollow form silicon mouldings using a two stage vacuum forming technique.

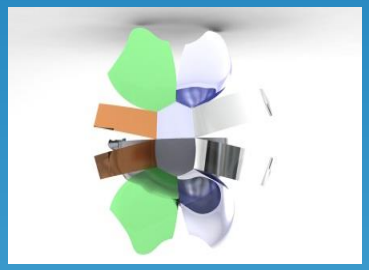
The technique could possibly be used to create a scalp cooler

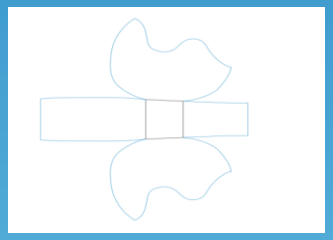
Concept Development

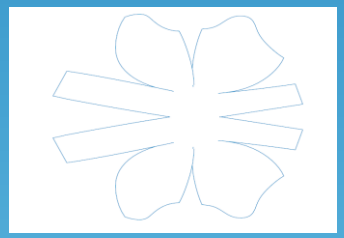






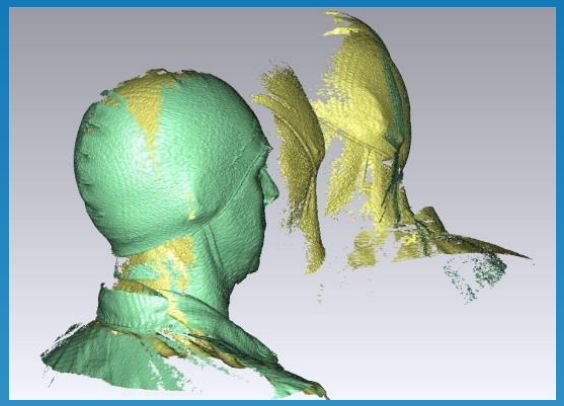


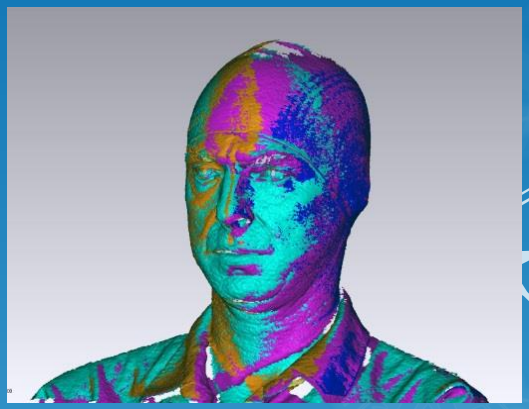


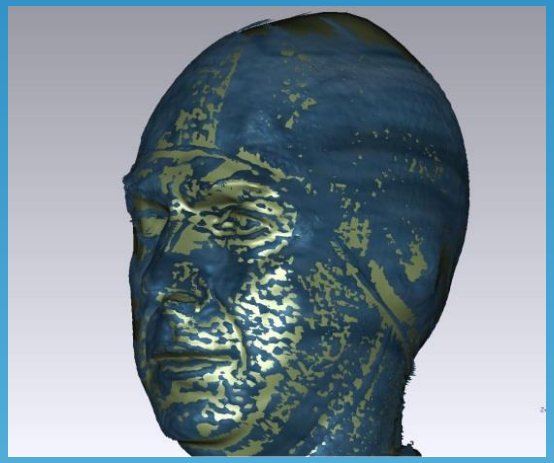


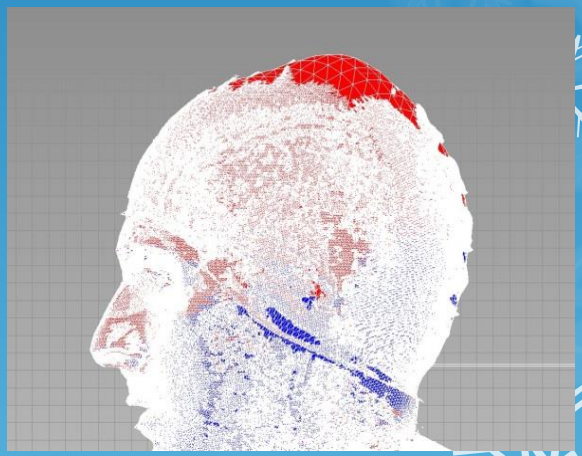
The aim was to achieve a flat silicon moulding which could then be fitted to a 3D head shape.

3D Scanning:



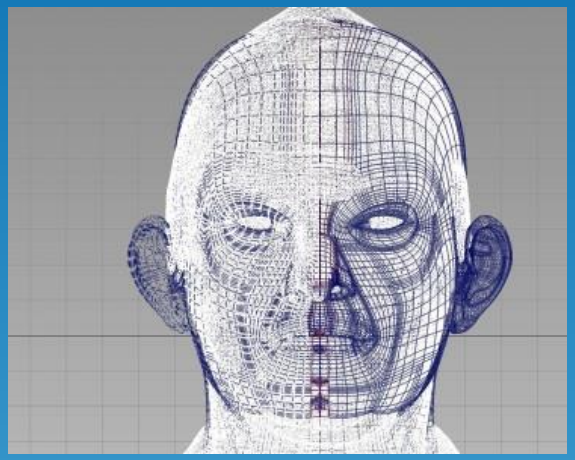


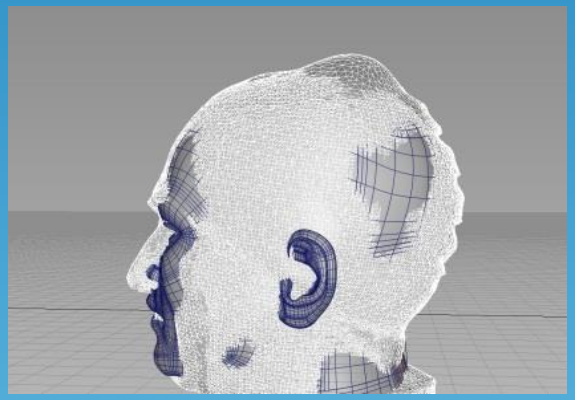


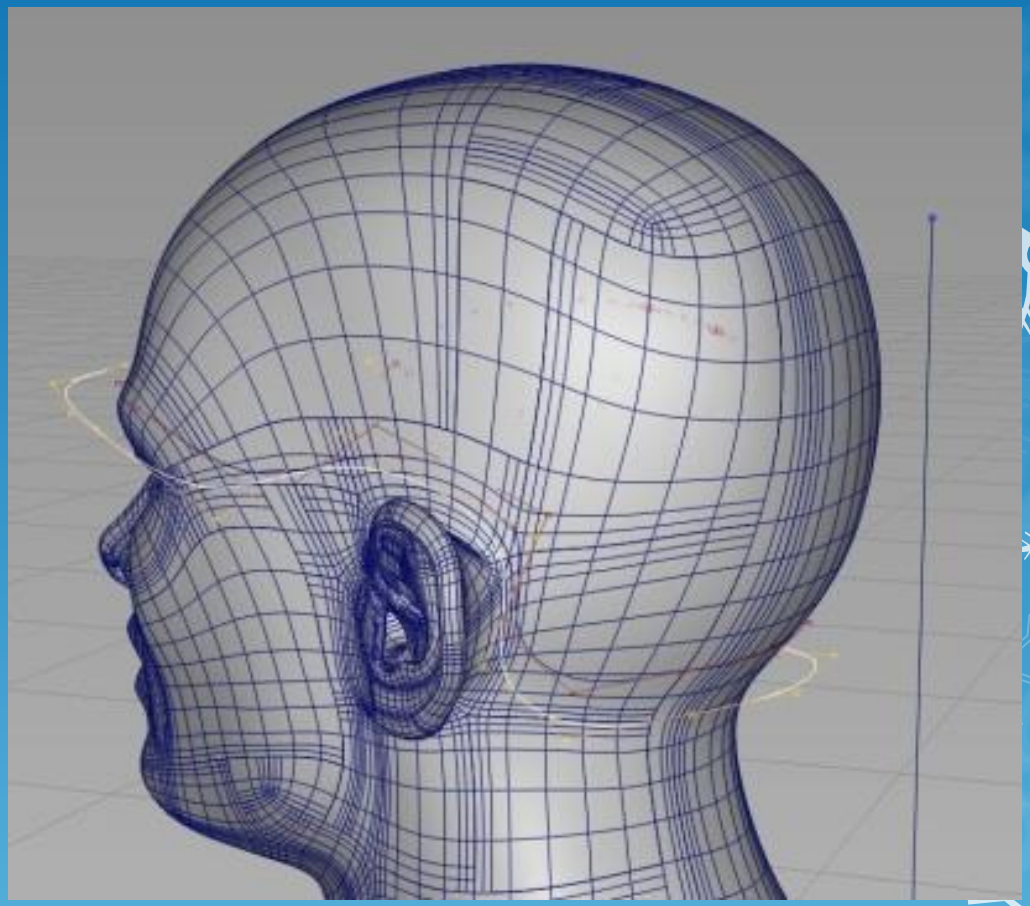


Although over twenty different scans were taken from various angles, only eight scans were used to create an accurate surface as seen in figure. The scanning process took just over an hour. Geomagic Studio software is used for the processing of data including capturing and cleaning.

3D NURBs Surface Creation

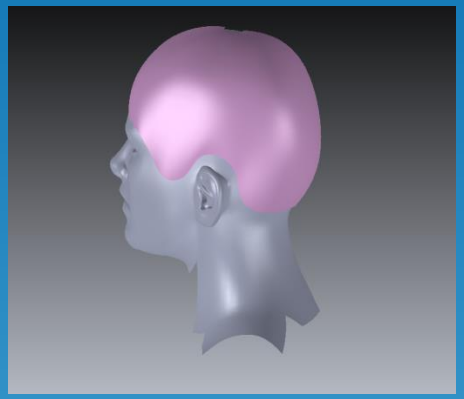


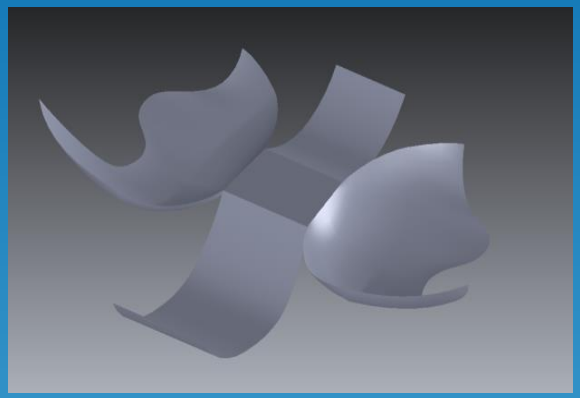


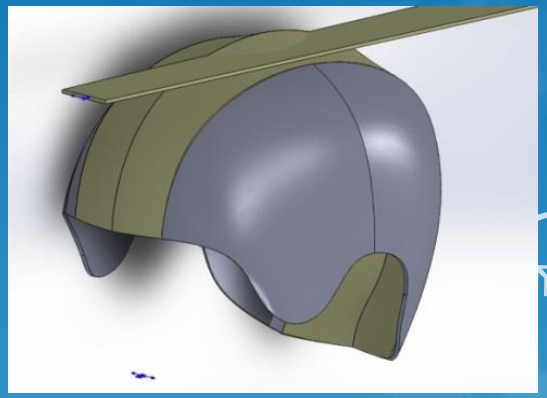


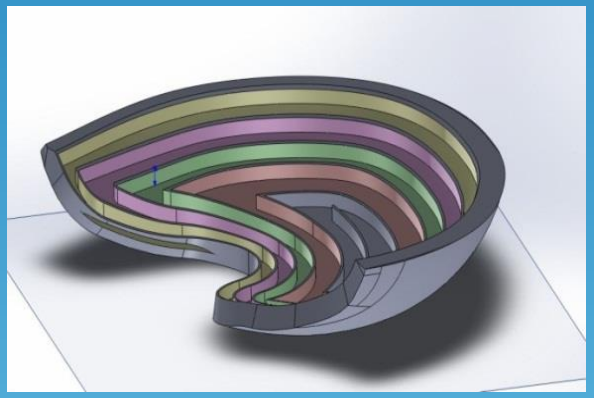
The 3d scanned data enabled the team to construct a 3D surface of a full head which was used as a reference to construct a NURBs surface . This process involves using a standard 3D human head and modifying the head shape to fit the scan data.

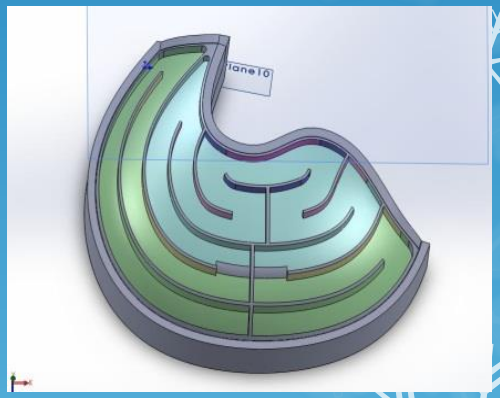
Chosen Concept





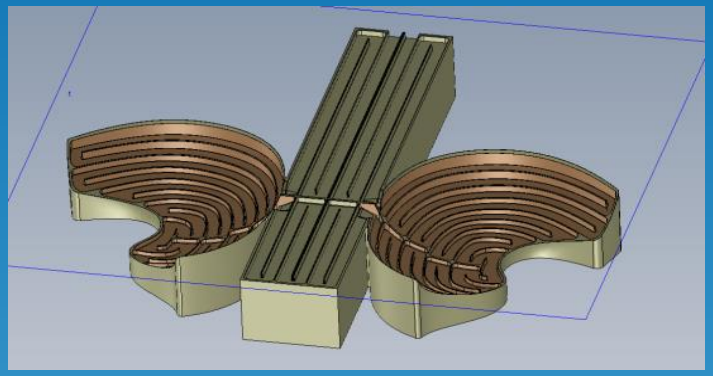


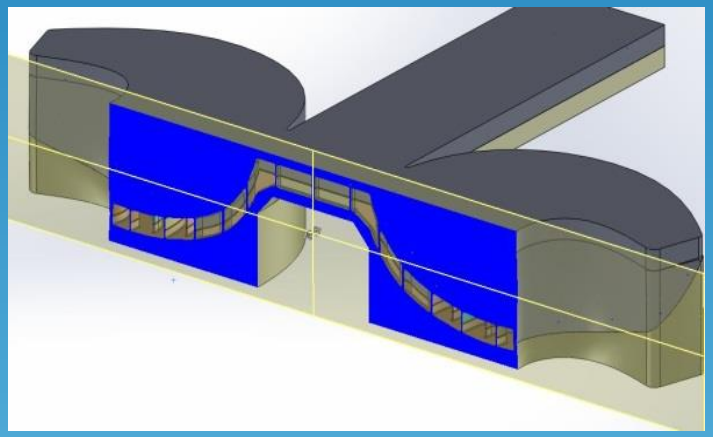


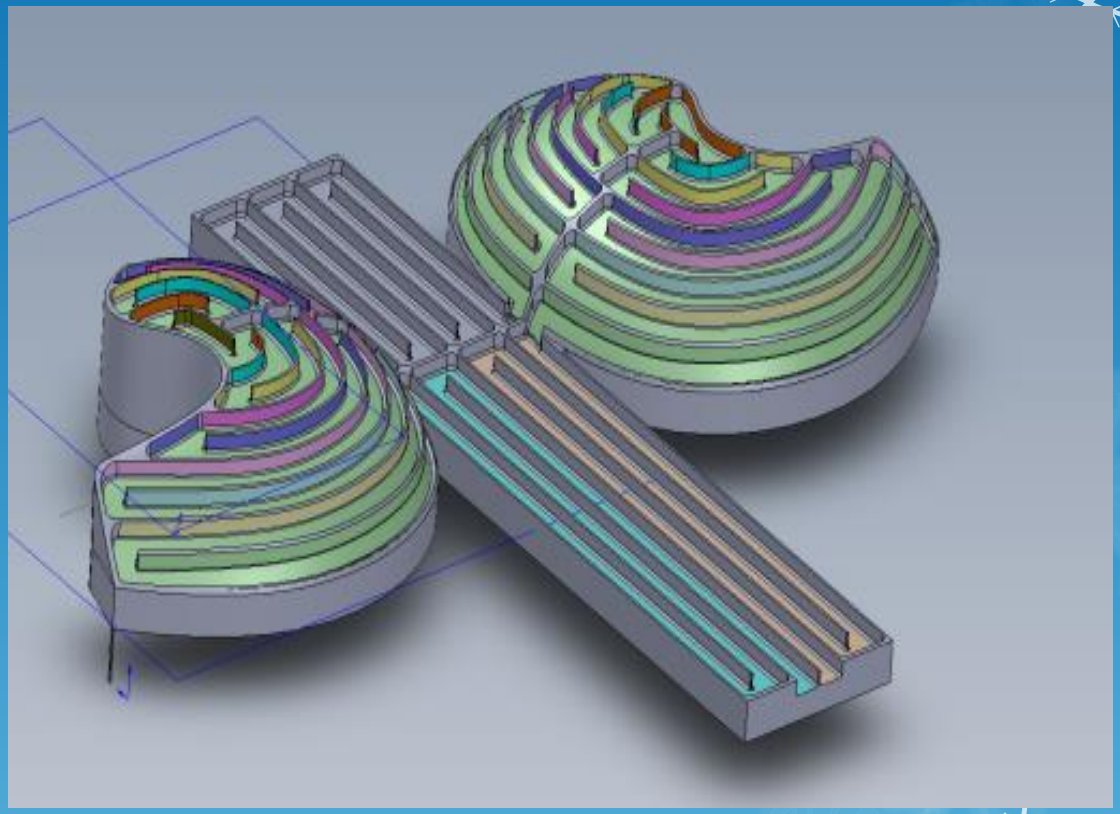


After the concept chosen the team started working on a method to create surfaces which could be **converted in to a tool** where hollow channels could be created. Using the 3D **NURBs surfaces 3D solid model** created which was used to construct the grooves required for the moulding process.

Tool Design

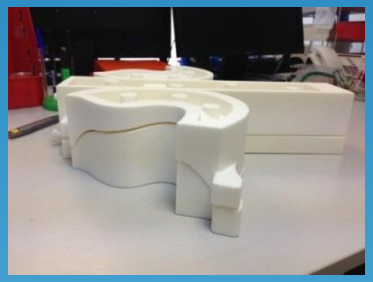


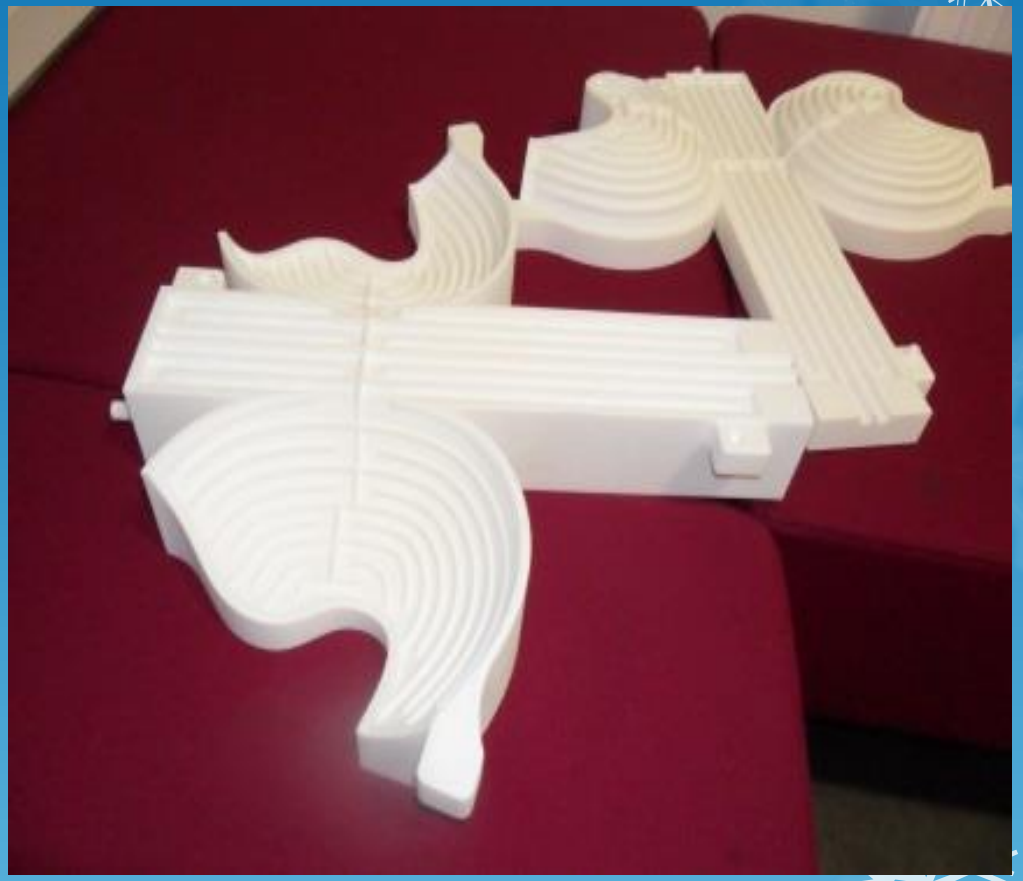




A 3D Computer model for male and female tool of the mould was created. The two parts assemble to produce the channels with **1.0mm** dividers. Each tool half has 5mm channels giving a total internal tube diameter of 10mm.

Prototyping





Thermal Properties:

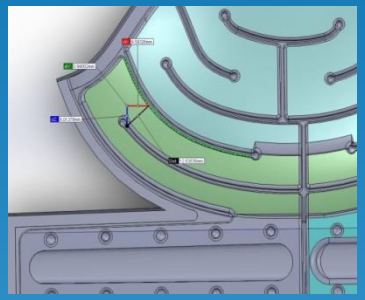
Melting point	DIN 53736	172 - 180	°C
Vicat softening temperature B/50	DIN EN ISO 306	163	°C
Vicat softening temperature A/50	DIN EN ISO 306	181	°C

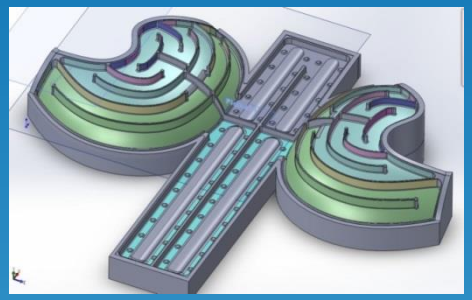
The tool was produced using a **EOS 3D laser sintering machine** and **PA2200 material**.
(Fine Polyamide PA 2200 for EOSINT P).
Normally the tool would CNC manufactured in Aluminium at a much higher cost.

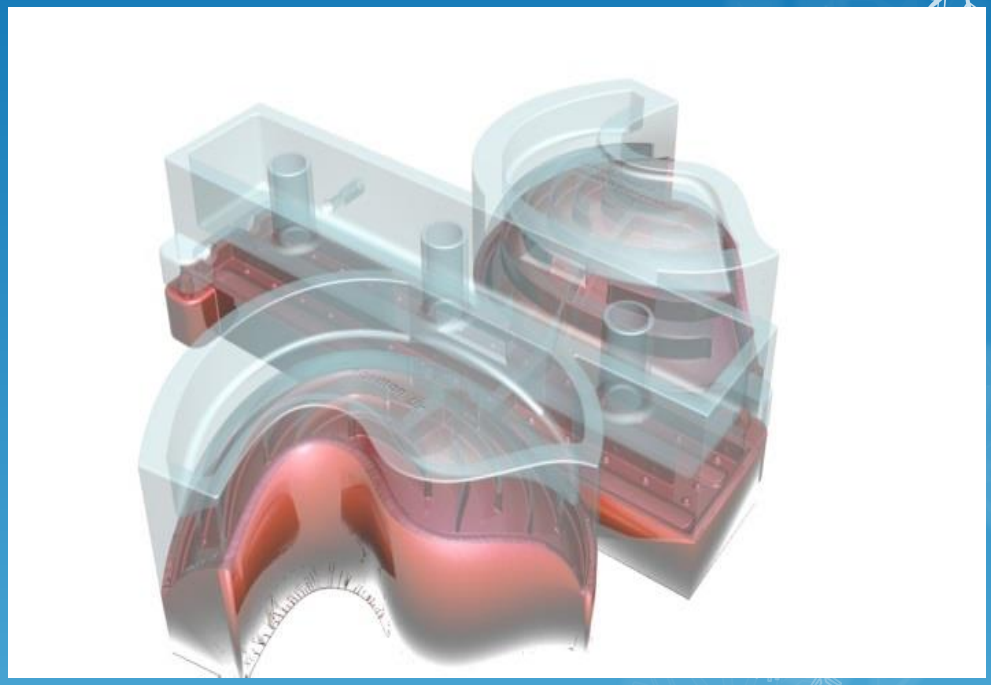
First Product Prototype

Although the principle of the method was successful, the sheet silicon thickness used had to be increased because of tearing during moulding. The extra thickness led to problems with internal channel bonding and reduced flexibility.

Experiment 2



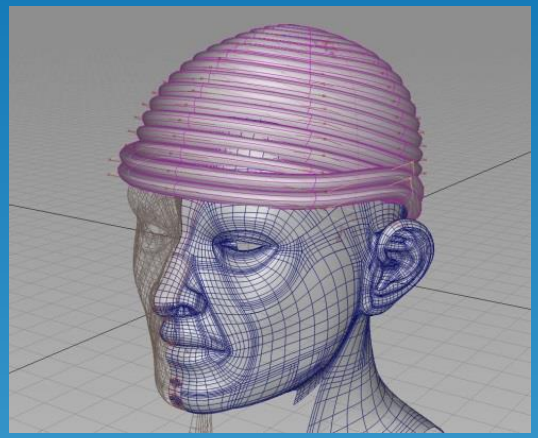


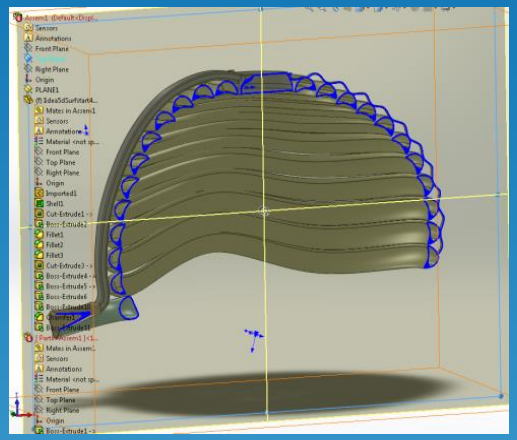


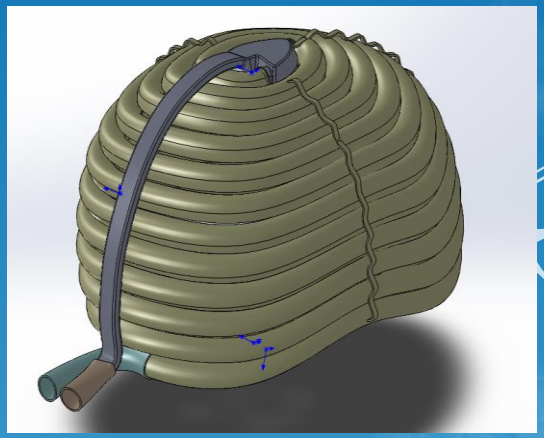
To rectify the tearing problem a second redesigned tool was produced with larger channels of 15mm which reduced the number of channels.

We are awaiting the next prototypes

Future Work







We are also looking at alternative production methods.

One method involves bespoke 3D printed caps in a soft, flexible rubber material for individual use. Reducing 3D printing cost may make this route viable with further development.

Questions / Comments