Redesign of the ATVS-2020

ATS Europe B.V. and ATS Inc.

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Preface

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Preface

At this point I wish to express my thanks and gratitude to Norbert Engelberts, Bahman Tavassoli and everyone else at ATS Europe and ATS, Inc. that helped me, as well as Wessel Wits, who have helped me complete this project.

Thank you all.

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Abstract

Abstract

This report details the design process used to create a new housing for the ATVS-2020, the Automatic Temperature and Velocity Scanner, designed and manufactured by Advanced Thermal Solutions, Inc. ATS has redesigned the internal hardware and wanted a new housing to give it a modern and professional appearance.

To find out more information, research was carried out on its users, the device itself and the market situation. This provided a list of requirements which could be used to guide and evaluate the design work. A number of ideas and concepts were generated, leading to a final design.

The final design consists of a box with an indentation at the front and rounded edges, surrounded with bands of heavier metal, giving the housing a tough appearance. It is made of two parts, each made of folded sheetmetal, spotwelded into a box shape. The two halves can slide onto each other, thus forming the final design.

Introduction

Introduction

This is the report of the bachelor-final of Rik Taatgen, a student of the Bachelor Industrial Design at the University of Twente. It concerns the development of a new housing for the Automatic Temperature and Velocity Scanner device manufactured by ATS, called the ATVS-2020.

Background
This device is used to determine heat levels and air speed by the use of thermistor sensors. This way, only one type of sensor is required to get both results. This is its unique selling point, as no other device has this functionality. However, ATS has determined that the housing of the device looks outdated and in need of a redesign. This project aimed to provide ATS with a new housing that is both modern and functional.

Challenges
A few boundaries influenced design work. A low production number of between 50-100 numbers limited manufacturing techniques. Costs needed to be kept low, and manufacturing time kept short. Usability needed to be high.

Approach
To do this, after project goals and boundaries were established, research was carried out. Three avenues were explored; research on end-users, to determine their experiences with the devices and their wishes for a redesign, personal use research, where the student himself used and examined the device, to gain a working understanding of how to use it, as well as discover any flaws with the current design, and market research, to determine what else is out on the market in related equipment.

After this, the research was analysed to extract data that could then be used to form a list of requirements. This list was subsequently used to think of ways to improve the device, culminating in three concepts of design, showing three ways of shaping the exterior.

The three results would be evaluated, again using the list of requirements to form a final design. This design would take the ideas of the concepts and, through focusing on constructability, ease of assembly, costs and so on, create a final design, to be delivered as a SolidWorks model.

Outline
The final result is a design that seeks to give an appearance of sturdiness, while also being easy to use, easy to assemble and visually pleasing to look at. It consists of two boxes made of sheet-metal, bended and spotwelded into shape, after which the internals can be installed. Four bands encircle the device, made of stronger metal, that can both protect the casing as well as provide an aesthetic appeal. The boxes then simply slide over eachother to form the final design.

H. Taatgen

Action Plan

Actor Analysis

ATS (Advanced Thermal Solutions, Inc.) is an international company with offices in the U.S., the Netherlands and China. Their services include providing Consultancy Services, Cooling Solutions, Test Equipment and Training Services, but they also make and sell equipment for thermal analysis. They have about 35 to 50 employees.

A number of devices in the Automatic Temperature and Velocity Scanner series (eATVS4 / 8 and ATVS2020, see Annex A) have an appearance that ATS is no longer satisfied with. They want a new design for the housing of the device that looks professional and modern.
These scanners are sold to companies that use them to measure air currents and temperature movements on their own products, particularly when such companies have approached ATS for one of their other services mentioned above.

Each device can control a number of sensors which are sensitive to heat and air velocity (4/8 sensors for eATVS4 and eATVS8 and 8/16/24/32 for ATVS2020). The results of measurements are then forwarded to a PC, that can read the information with the supplied software. The housing of the ATVS devices are manufactured by outside companies, although the entire device is assembled internally.

Project Boundaries

The project involves the redesign of the housing of 1 of the 3 related devices in the Automatic Temperature and Velocity Scanner series, namely ATVS 2020. ATS has done a revision of the internal hardware, and wants a new housing for the device that gives it a modern and professional appearance, so these devices will leave a positive impression with potential customers and thus increase sales.

ATS currently sells an average of 50 ATVS devices per year, a small number, specific requirements must be taken into account with respect to manufacturability, since the housing is made by external companies.
On the other hand, ATS has no design language which must be respected, which will increase possible design freedom. This could also give additional value to the project. A striking design could serve as the basis for the design of other ATS products.

Users include companies that want to perform thermal and airstream analysis on their own products. A survey that ATS itself sent to their customers, prior to the start of this project indicated that usability is seen as an important area for improvement.

Action Plan

Goals

The purpose of this assignment is to create a new design for the housing (including lights, switches and the placement of plugs) of the ATVS2020, that gives it a modern and professional look and improves ease of use. A good design will help increase sales and improve the image/brand of ATS as a manufacturer.
Research will be done on end-users through a survey (and any follow-up calls). This, along with research through personal use, will provide insight on how the device is used and identify any problems or areas of improvement in the current design. Market research will be done as well on possible competitors as well as on other devices that are present in similar workplaces to determine what the market conditions are, through use of the internet (supply catalogues and others).

Then, with this information, a list of requirements will be assembled, which will be used to design concepts. From these concepts, a final design is then determined, and delivered to ATS in the from of a SolidWorks model.

Project Questions

1. What do the users think of the device?
    What functions, features or qualities do they find important?
    What functions, features or qualities do they not?

2. What problems are present in the current product in the area of usability?
    How and where is the device placed in their test setup?
    How and where do they store the device when not in use?
    What elements of the current design are considered unclear or clumsy?

3. What style should the device have?
    What do the users think of the current design?
    What other design styles are offered on the market in this area and any similar areas?
    What style characteristics are present or are desired by ATS itself?
    How does ATS want to market itself with this device?

4. What redesign should take place?
    What are the requirements and wishes for the redesign?
    What concepts can be devised that address the needs and wishes?
    Which concept design is best advised to the client?

Action Plan

Glossary

Devices – The ATVS2020 is a machine manufactured by ATS. Datasheets are added as Appendix A.

Users - The various companies that have purchased the device, and employees within the company who use and manage the devices.

Design - The design concerns the housing of the device itself. This does not take into account the software package.

Survey - A list of questions sent to users to get more information or their experiences with the devices. Follow-up calls can be made to request clarification or to request more information.

Strategy

Question	Strategy	Source	Details
1 a	Survey	Personnel	Customers and users
1 b	Survey	Personnel	Customers and users
2 a	Survey	Personnel	Customers and users
	Personal Use	ATVS devices	Personal use of the device
2 b	Survey	Personnel	Customers and users
	Personal Use	ATVS devices	Personal use of the device
2 c	Survey	Personnel	Customers and users
	Personal Use	ATVS devices	Personal use of the device
3 a	Survey	Personnel	Customers and users
3 b	Market Research	Media	Websites, other materials
3 c	Interview	Personnel	Interviews with ATS
3 d	Interview	Personnel	Interviews with ATS
4 a	Interpreting	Research data	From the research, requirements are made.
4 b	Design		Design work.
4 c	Evaluation	Personnel	Evaluation of designs by ATS.

Research

User Research

To determine the experiences of users, research was carried out. This consisted of conducting a survey to customers of ATVs devices. Customers in Europe itself were approached through telephone calls, while customers in the U.S., because of confidentiality reasons, were approached by ATS themselves. Employees of ATS Europe were also approached with these questions.

The survey was written (Appendix B) so that the emphasis on the experiences in the use of the device and the appearance of such devices were presented in an as neutral way as possible. In this way an attempt was made to identify strengths and weaknesses in the current design, along with wishes for new features.

Reactions were unfortunately fewer than expected. Many customers were inaccessible as they were no longer with the company, or the unit was used very little, or simply did not give any detailed answers. Nevertheless, a number of useful results were gained.

Chief among these is the fact that the current housing was considered oldfashioned. All respondents responded positively about an improved appearance.

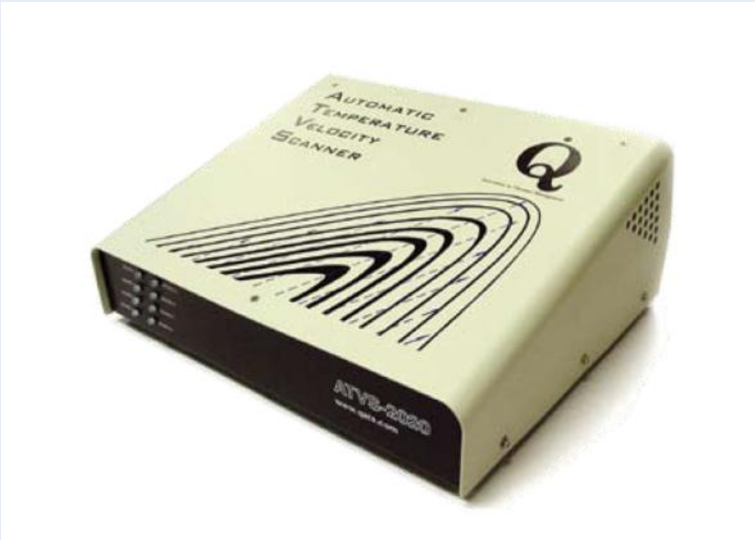


Fig 1. Current design of the ATVS-2020.

Another result involves the placement of the sensor jacks. Since these are on the back in the current design, one must turn the device to install new sensors, which is unwieldy.

Robustness was also seen as a weak point. A few respondents complained about rattling components on the inside and the weakness of the sensors (whose big plug and thin wires caused problems).

Several customers commented that the current ATVs has a sloping top, making it virtually impossible for other devices to be stacked on top. This means that the device needs more space, which is not always available.

A method to check the calibration of the sensors was also identified as a potential point for an added feature. In the current design, the thermistors are calibrated by ATS themselves to ensure accurate measurement values are returned. A method to check whether the calibration is still good would be appreciated.

Positive points included user friendliness and it's unique position on the market, as no other device can both measure heat and air velocity. The overall view of the device was positive, but with room for improvement.

Research

Use Research

To get an idea of how the machine works, some experimenting with the device was done. A simple but typical arrangement was set up at ATS Europe, with a circuit board in a small wind tunnel. Sensors could be placed on the circuit board, after which the device was used to determine heat and air velocity. Also, the device was opened so that the internal components could be viewed.

Clear problems reflected those found in the user survey, such as the placement of the sensor jacks and the dull appearance. The whole experience was judged to be user friendly and intuitive. There was very little explanation or demonstration necessary to begin use and it appears to be fairly foolproof.

Market Research

To determine what else was present in the market area, research was done on similar devices. Since ATVs devices occupy a certain niche, there is little in terms of actual competition to find. As mentioned in the user survey, there is no other device on the market that can perform both functions (heat and air speed measurement).

It was therefore decided to take a broader perspective beyond the immediate market to look to other equipment that would be available in these types of workplaces. Other electronic devices of roughly the same size were also examined concerning their housing, such as office equipment (desktops, printers, etc.), computer equipment (servers etc.), construction equipment (welding and soldering equipment) and music (stereo towers , instrument amplifiers).

Striking similarities include the excessive use of discreet colors and simple design, meant to fit in everywhere and never clash with other equipment or surroundings. This has the drawback that such devices are very anonymous. Identity for such devices is reflected by the use of more subtle design instead of more aggressive eye-catching design.

List of Requirements

After the results of the research were received, they, along with the project requirements and goals set by ATS, were analysed to create a list of requirements and wishes. This list can then be used to form concepts, and be a tool to evaluate the final design. Each item is designed to be clear and definite in the way they can be answered, so as to avoid vagueness which will impede evaluation.

Requirements

Dimensions – There are minimal dimensions, which depend on the size of the internal hardware (200x175x100 mm), and maximum dimensions, related to storage into carrying cases.

Cooling – During use, the temperature inside the unit may not exceed damaging levels.

Stacking – The device must offer the option of being stacked on top of other devices, or having devices stacked on it, without having it interfere with the functionality of the device.

Setup – Setting up a test (attaching sensors and a laptop) should not require the device to be moved (should it have other device stacked on top of it).

Constructability – The device must be able to be fabricated for low numbers of approx.. 50 units a year. Installation of internals and assembly must not take more time than the current unit.

Costs – Costs must not be excessive. Target costs are $300,-.

Parametric 3d model – the final 3d-model must be able to be modified with respect to connection points for the internal hardware.

Market positioning – The device must reflect well on ATS and improve sales with 20%.

Toughness – The device must give the impression of being well-built and strong, and must therefore avoid rattling, loose elements or other features or materials which make it feel weak.

Modernity – The device should give an impression of modern design for the next 10 years.

Safety –The device must comply with safety-regulations, concerning EM-radiation and similar rules for electrical devices. Also, the design must avoid any sharp edges or other dangerous design features.

User friendliness – The device should be able to be used in its standard capacity, with a 5 minute explanation or demonstration. Signals on the device should be clear about what is happening inside the device.

Concepts

Wishes

User friendliness – The device should be able to be used in its standard capacity, without explanation or demonstration.

Modernity – The device should give an impression of modern design for the next 15 years.

Market positioning – The device must reflect well on ATS and improve sales with 40%.

Design style – The design of the device can be used to influence other designs for ATS devices.

Calibration system – A system to (roughly) check calibration of sensors can be included.

Design Ideas

Next, a number of design ideas were formed, based on the list of requirements. These are intended to be a stepping stone to actual concepts, and are typically focused to solve a specific problem without involving any others. As such, they may be exaggerated or impractical on their own, but can be helpful in generating usable concepts. They are basically explorations of possible solutions. Included here are the shell, input jacks, logotypes, colours and patterns ideas, which were used in the actual concepts.

Shell

This concept idea builds on the requests for a stronger tougher looking exterior. And takes inspiration from industrial machinery designs. It involves surrounding the internal components and casing with a shell or outer casing. Other factors to keep in mind are access to controls and plugs, cost of manufacture and the ability to stack, or be stacked with other devices.

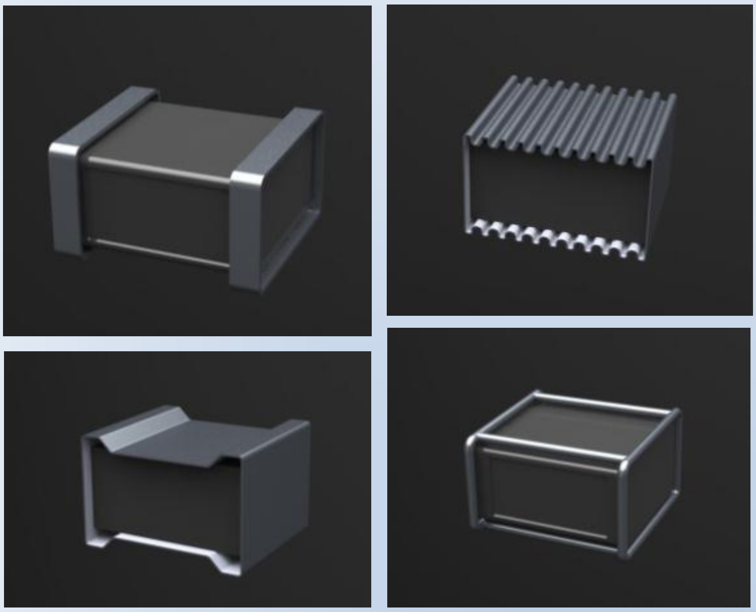


Fig 2. Different variations of shells.

A variety of ways to accomplish this are possible: The most straight forward is physically surrounding the casing with bands of metal (aluminium for instance), in the shape of broad strips, tubes or profiles.

Alternatively, shapes in the exterior casing could provide a stronger image. Protruding ribs or corrugation might give such an impression while being potentially easier to manufacture.

Concepts

Control, input and jacks.

This idea regards the placement of a number of features on the ATVS that the user interacts with. These are:

· Power LED, that shows whether the device has power.

· Power jack, for attaching the power cable.

· Power switch, to turn the device on.

· Output jack, that connects the device to the PC.

· Sensor jacks, which connect the device with the sensors.

· Sensor/panel LEDs, which show if a panel is working. These are fixed to the PCI bracket.

These features need to be distributed on the device in such a way as to provide maximum ease-of-use to the user. Some users keep the device in its carrying case, and only remove it when necessary, while others keep it out permanently, but only hook it up to sensors and a PC when they engage in testing. Additionally, sides and top should be kept clear, so the device has a small frontal profile, which needs less space in smaller workplaces. By using a simple cardboard mockup, an optimal distribution (purely in the area of usability) of these features was determined.

The following division is suggested.

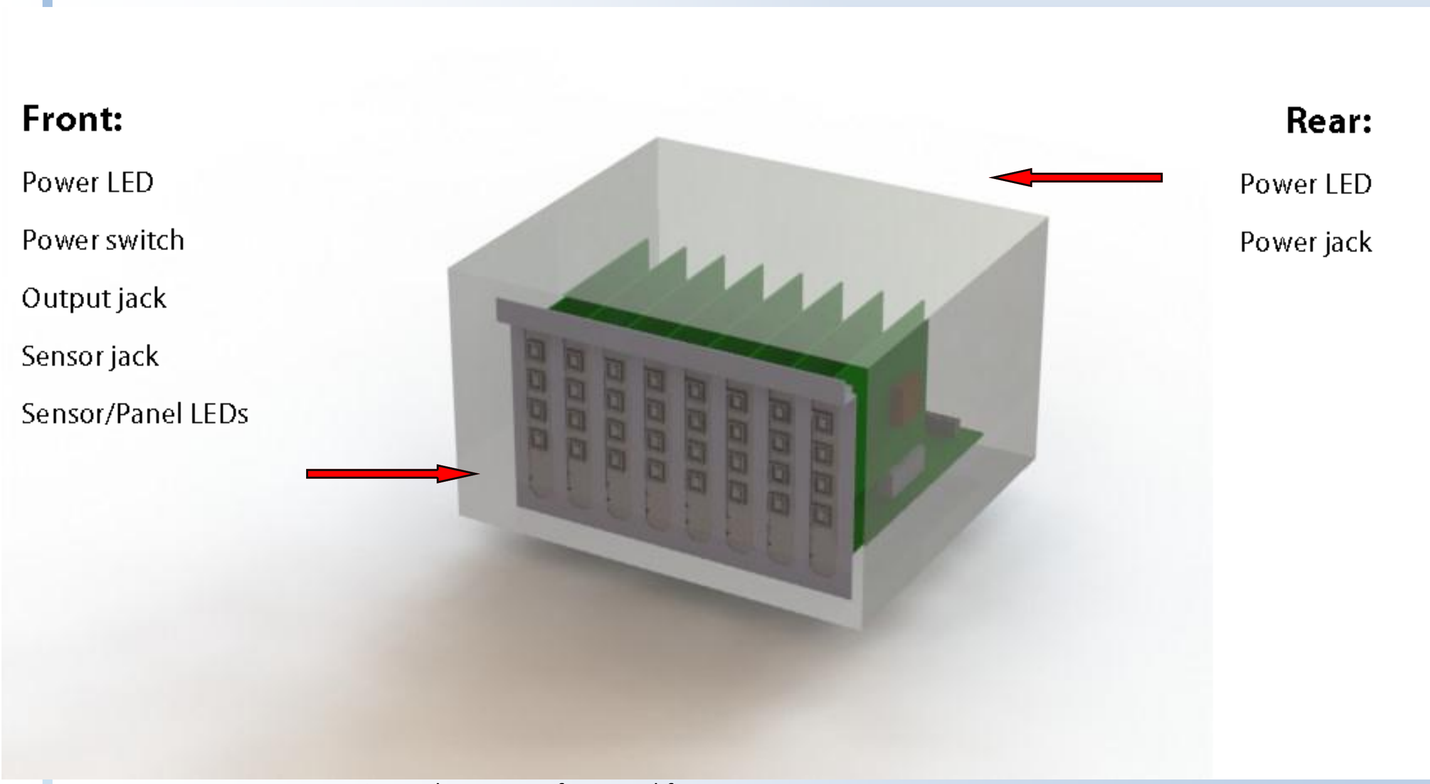


Fig 3. Placement of external features.

Concepts

Colours and Patterns

Many devices in workplaces like this are blandly coloured, featuring colours such as beige or white.

Giving the device a unique colour or pattern can easily and at very little cost make the device stand out, and make it recognizable not only amongst other equipment, but also more memorable for potential customers who might see the device used by others.

Even small details can be used for this purpose, such as for instance airvents.

Logotype

In the current ATVS device, the logos and text are a clear area for improvement. Updating the logotype is an easy way to make people remember the device, and gives it a professional and modern impression, which will ultimately reflect well on ATS as a manufacturer. Presented here are a few ideas:

Fig 4. Logo’s.

Concepts

Generated Concepts

Concept 1

This concept is based on the shell idea. The panels on the sides, top and bottom edges (the shell) cover the front and back and protects the interface. This gives a robust appearance. In order to enhance this impression, the cooling holes are applied on the front and back, rather than the sides or the top. This strengthens the notion that the shell is stronger than the front and rear panels.

Another element of this design is the fact that the front profile is not square. If the device is stacked, the front is the only thing that really stands out, and an interesting shape will help the device be extra noticeable.

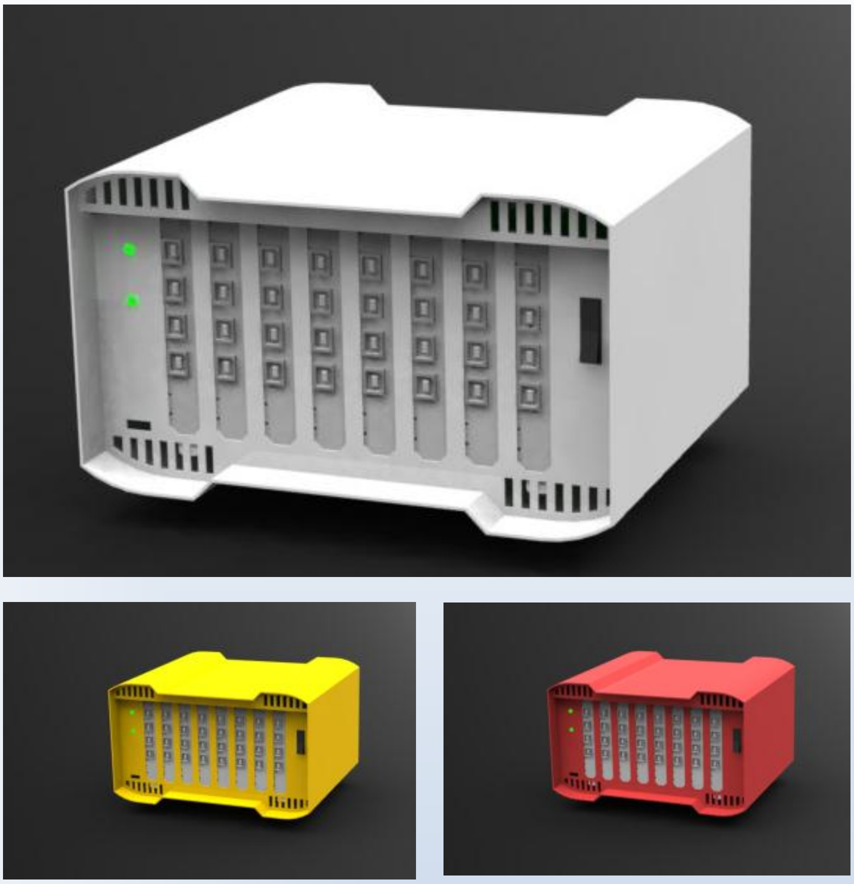


Fig 5. Concept 1 with variations in colour.

This concept also includes the previously mentioned layout of external components, with controls on the front panel.

Colour variations can make the design even more noticeable as shown in the image on the right.

Construction-wise, the shell consists of a single strip of metal, folded and welded so that it forms a sort of tube. The front and rear panels are also a single internal structure, which at the bottom are connected to each other. All the internal components are secured to this plate. To service the device, the shell can simply be unscrewed and the internal structure can slide out of the shell. Assembly works on roughly the same way.

Concepts

Generated Concepts

Concept 2

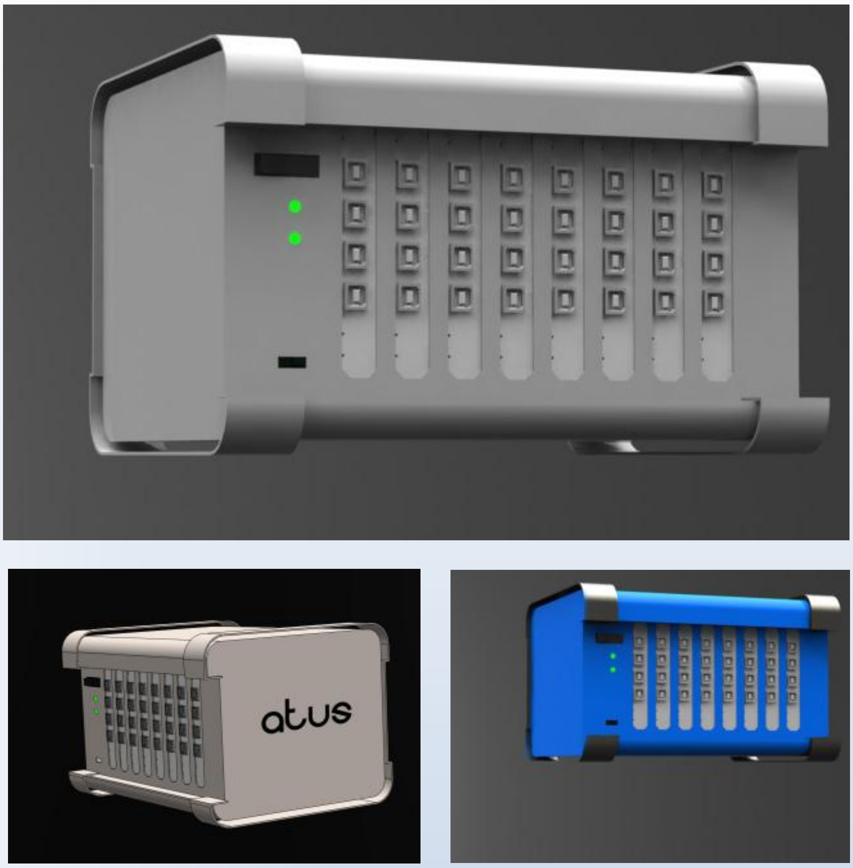


Fig 6. Concept 2 with logotype airvents and contrasting bands.

This concept also makes use of the shell idea, but in a slightly more elaborate way. Two bands encircle the outer edges of the housing. These bands are made of thicker metal to give an extra sturdy and striking appearance.

Another idea that is integrated in this concept is the use of a logotype as cooling vents. This combines a striking element with a functional element.

Although this concept has a square front profile, the sunken front and larger curves at the extreme edges (that are copied by the bands) give it a more interesting appearance.

These bands can also be used to add colour in a more subtle way. By leaving the bands unpainted, or colouring them a different colour than the body, the protective appearance of these bands can be highlighted.

Like Concept 1 it also includes the desired layout of components, with front panel controls.

In the area of construction, this device can be made in roughly the same way as the first concept. In this case, it is the sides that slide out. The front, top, bottom and back are a single structure. The bands attach to that structure.

Concepts

Generated Concepts

Concept 3

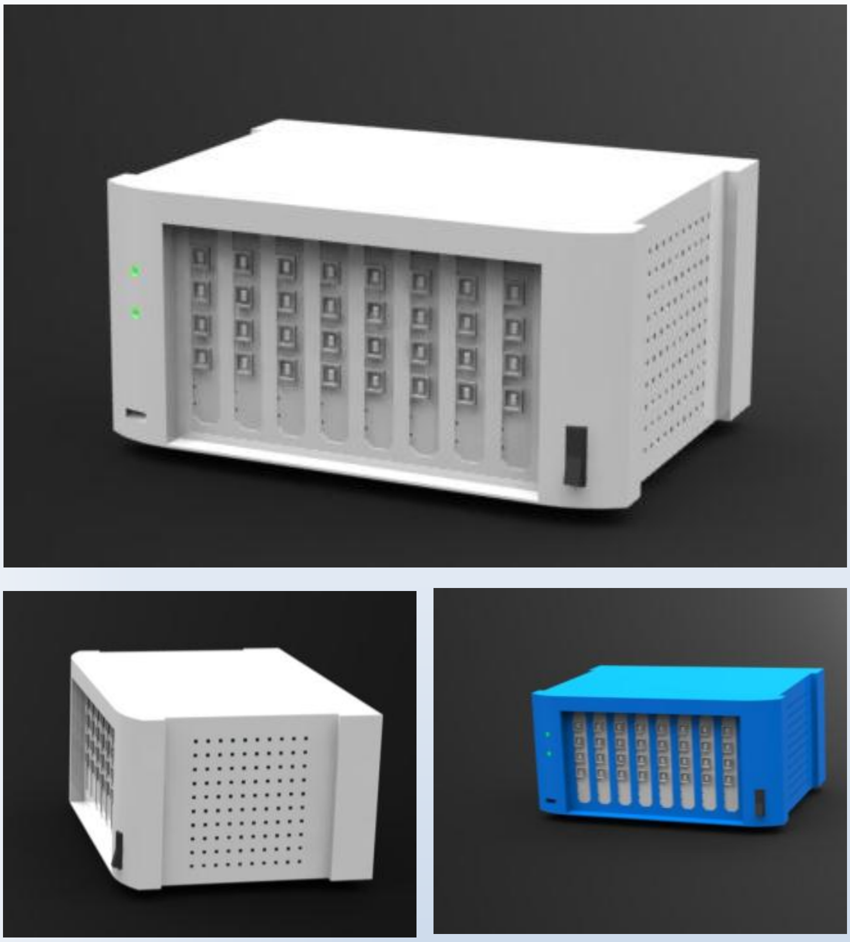


Fig 7. Concept 3 with square vents and bright colour.

This concept is designed with compactness in mind. The sides have indentations to allow cooling, even if other devices are put next to it, and the buttons, lights and jacks are also deeply sunken into the housing.

A gentle curve at the front gives it a little identity and prevents it from simply being a square box.

The cooling holes are square, to highlight the square corners of the design and are organized in a wide pattern in order to give it a robust appearance.

Like Concept 1 and 2 it also contains the desired layout of components, with front panel controls.

Mechanically, this is a design of two parts. The top and sides are connected to each other as a single sheet of metal, which by means of spot welding is made into a box. Such a folding box can be made accurately with the aid of laser cutting, and precalculated bends. The bottom plate is where all the parts are mounted. The "top box" is simply assembled in top of the bottom plate by means of bolts.

Concepts

Concept Choice

The final concept has become a combination of different elements of the generated concepts, but is most affected by concept 2. The surrounding bands were chosen by the clients, who described them as eye-catching.

The concept choice focused mostly on constructability, ease of assembly and a modern and appealing exterior appearance. The list of requirements was consulted to select the most appropriate elements out of the concepts.

Toughness

The bands of concept 2 give it a tough and strong appearance, more so than the other concepts. The final design also takes on elements of concept 3, namely the wide square cooling holes, for its stronger and tougher look than normal cooling vents or the logotype cooling vents. For these to be placed in indented sides as in concept 3 was impractical because of space requirements and manufacturability concerns.

Constructability

In terms of construction, the final design takes after concept 3 for the purposes of manufacturability (the sliding system was seen as difficult and costly to implement properly). The housing consists of an upper half and a lower half, which are assembled on top of each other. These halves are made as folding boxes, which are cut out by lasers, folded and then welded. This makes the design more robust and simpler to make than a sliding system. Some compromises had to made in the name of manufacturability and ease of assembly. Due to the structure of the internal components, it was decided to place the USB port on the back. That way, no panel mounted USB connector has to be installed, which will simplify assembly.

Costs

The top half/bottom half design of concept 3 was seen as cheaper and easier to implement that the sliding system employed by the other two. While the bands of concept 2 are costlier to implement than a clean look, they were seen as having added value, and worth the extra cost.

Modernity and Market Positioning

A blue color was chosen for the body (although different colors are of course easy to achieve) with bare-metal bands in order to give it a striking appearance, which helps it stand out amongst other products.

Final Design

Implementation

Transforming the chosen concept into a final design required a rethinking of the way it was assembled. Constructability and the need to prevent costs from spiraling out of control tempered the desire to stick to the shape of original concept.

Fig 8. Render of the final design

The use of folding to create the boxes was an obvious route to take, but determining tolerances and bend lines to make the devices fit was a learning experience. Precalculated bends can be determined however as a result of mechanics and experience. In this particular case, SolidWorks provided a means to determine where these bends should be placed, and what tolerances should be put into place.

Care was taken to ensure the device was compact but not so small as to impair assembly. As can be seen in the image on the bottom (with the top removed as it would be during assembly or maintenance), a healthy amount of room (30mm between the edges of the motherboard and the housing wall) is available to maneuver in.

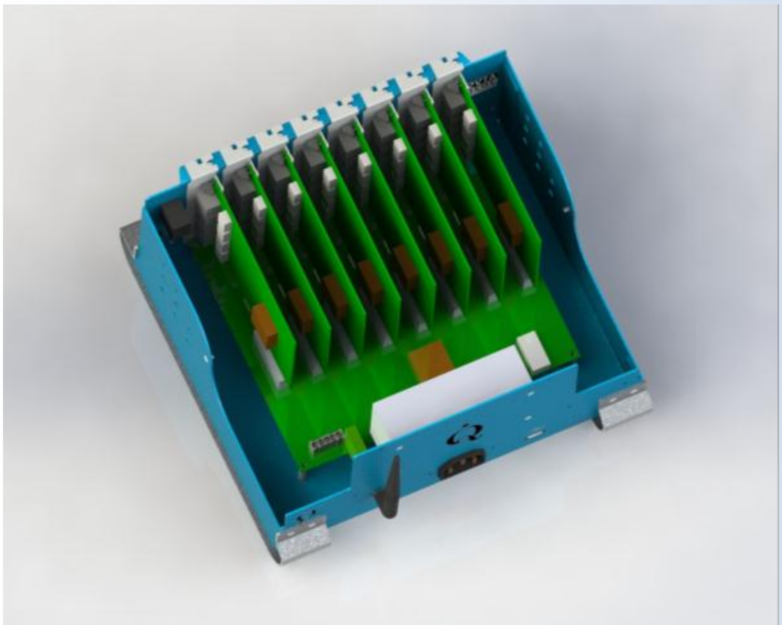


Fig 9. Render of the final design—interior

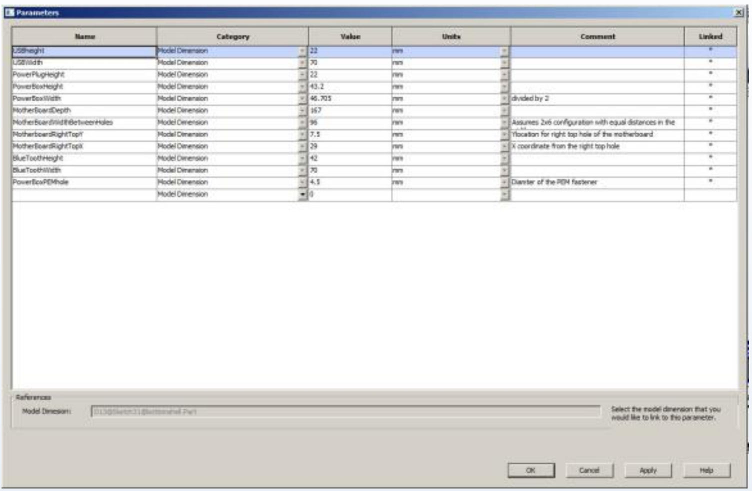
To limit the amount of screws required to assemble the device, but still maintain electromagnetic emissions prevention, EM gaskets were employed. These are also present on the current ATVS unit.

Please see Appendix D to see where these gaskets can be placed.

Final Design

Parametric values were added to enable ATS to modify the placement of certain components, namely, the holes for the motherboard, the USB port, the wireless port, the power plug and the holes for the power supply box. All internal components are placed on the bottom half. This means that the top half can be easily attached or removed, which eases assembly.

Instructions in Appendix C explain how to access these in the SolidWorks model.



Name	Category	Value	Units	Comment	Linked
USBheight	Model Dimension	22	mm		*
USBWidth	Model Dimension	70	mm		*
PowerPlugHeight	Model Dimension	22	mm		*
PowerBoxHeight	Model Dimension	43.2	mm		*
PowerBoxWidth	Model Dimension	46.705	mm	divided by 2	*
MotherBoardDepth	Model Dimension	167	mm		*
MotherBoardWidthBetweenHoles	Model Dimension	96	mm	Assumes 2x6 configuration with equal distances in the	*
MotherboardRightTopY	Model Dimension	7.5	mm	Ylocation for right top hole of the motherboard	*
MotherBoardRightTopX	Model Dimension	29	mm	X coordinate from the right top hole	*
BlueToothHeight	Model Dimension	42	mm		*
BlueToothWidth	Model Dimension	70	mm		*
PowerBoxPEMhole	Model Dimension	4.5	mm	Diamter of the PEM fastener	*
	Model Dimension	0			

Fig 10. Parametric values

Graphics were added to identify the device. The graphic at the top combines the old ATVS design (the arcs and arrows, and the placement of the logo's and text) with the new ATS logo. The font of that ATS logo (twentieth century condensed) was subsequently used in every instance of text on the device, to give a unified style.

Cooling vents on the side were placed to follow the curved line that separates the two halves. In this way, the straight flat sides are made a little more interesting.

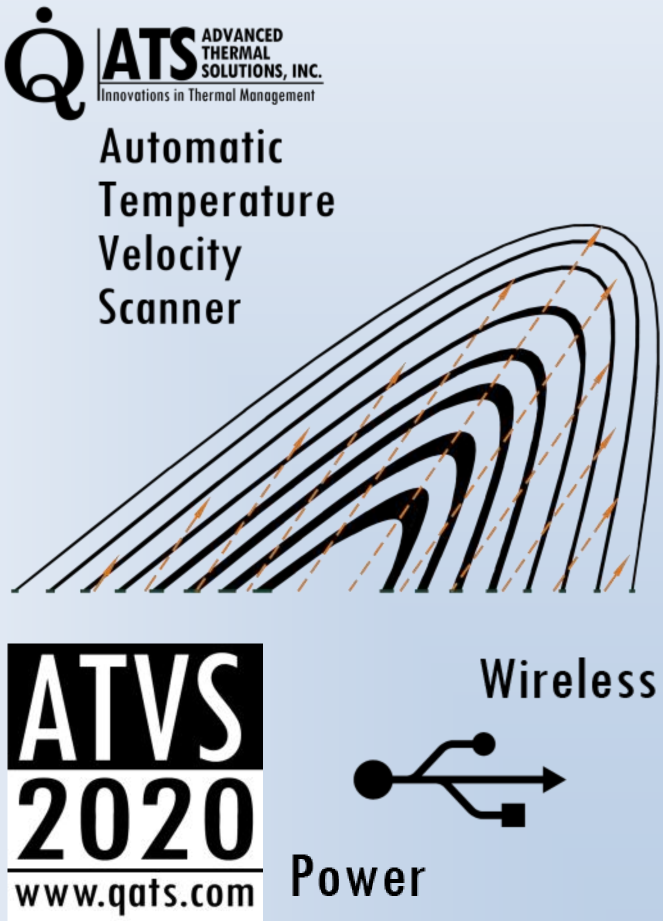


Fig 11. Various graphics showing logo's and text.

Final Design

Constructability

An important part for the design of any product is to make sure it can be built. In this design, bent sheetmetal is used to create boxes. Given that this design would be made out of thin steel or aluminium, and is fairly small, no exceptionally strong bending tools are required to construct the various components. In addition, low production numbers mean that manual construction can be employed.

All in all, this means that the design can have some rather complex folds. The images presented here indicate in which order the top half can be folded.

To start, a sheet metal blank is cut out using a laser cutter. The larger round bends are performed first, as these are more difficult to do. From then on, bends are performed from the center outward. To finish, overlapping parts are spotwelded shut.

The bottom half and the bands are built in the same way. Appendix C has instructions on how to look at various states of bending and flattening of the model in SolidWorks.

The sidepanels, which ensure there is overlap between the top and bottom halves are spotwelded onto the top half. To ensure a good fit, the screwhole on the sidepanels are drilled after the spotwelding.

Painting should accomplished last of all, to prevent the coating from being damaged by the production process.

The different components are then shipped to ATS, where most of the internals can simply be screwed into the panels, thus reducing assembly time. ATS's own redesign of the internal components also vastly reduces the number of contacts that need to be soldered. All in all, assembly time at ATS is likely to be reduced compared to the current design.

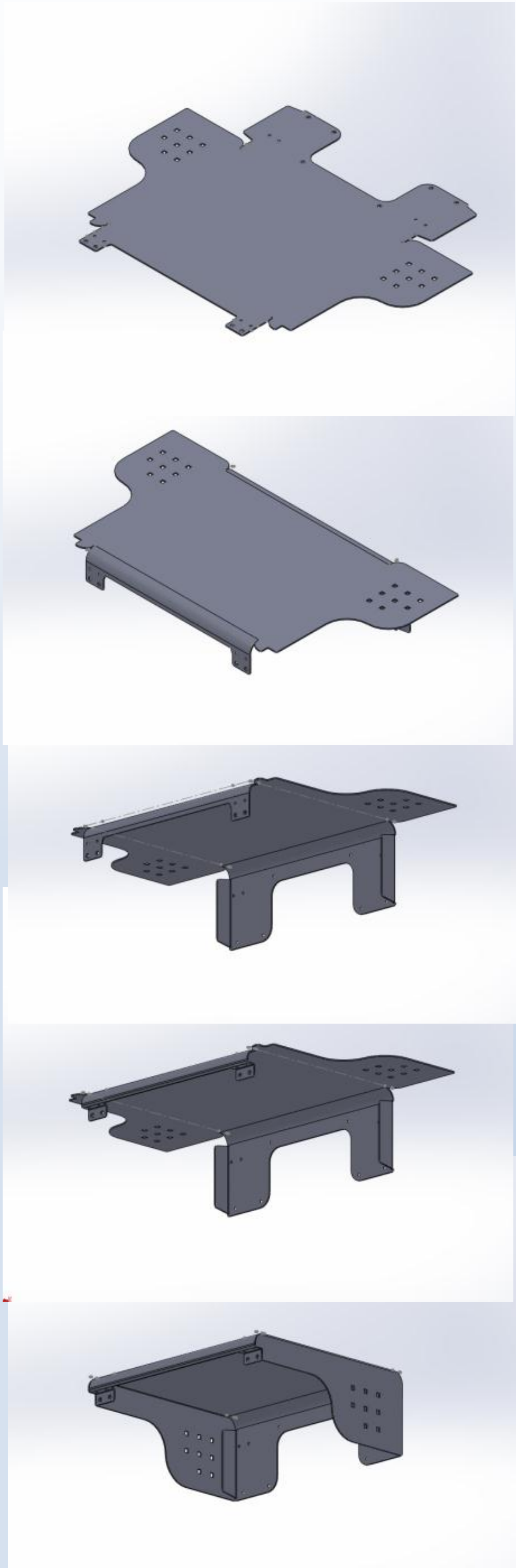


Fig 12. Bending order of the top half.

Final Design

Evaluation

To evaluate if the design of the device is successful, ideally a real-world test should be performed. However, since a working prototype is still a ways removed from being made, we must resort to evaluating the design model. To do this, we shall see if it fulfills the list of requirements.

Dimensions – It encapsulates the minimal dimensions, and is still smaller than the current ATVS-2020 unit.

Cooling – It possesses roughly the same cooling vent area as the previous design, which had no issues in this regard.

Stacking – It is flat on the top, and the bands ensure that the body is not harmed by placing anything on top.

Setup – By placing most of the controls on the front, especially the sensor jacks, the device does not have to be turned around or moved during testing, when sensors are to be added or removed.

Constructability – Constructability was taken into account during the design. While more complex, it should be possible to build for low production numbers.

Costs – It is more complex to make than the original, and may cost a slight bit more to make. This was difficult to avoid considering the simplicity of the previous design.

Parametric 3d model – parametric values can be altered in regards to the undetermined internal hardware.

Market positioning – The design was well received by ATS during the design. Whether it will increase market sales is of course unknown until after it has been brought to market.

Toughness – The bands give it a strong appearance, and the new internal hardware should be more resilient due to the far more limited amount of soldering required, as well as stronger sensor jacks.

Modernity – The design avoids anonymity, and has some interesting design elements. This might help it be interesting for a longer period of time.

Safety –The device is compliant with EM-demands, and care has been taken to eliminate any sharp edges.

User friendliness – The original device was already considered easy to use and understand. There is no reason to assume the new device will be any different, since it does not change much in this regard.

Calibration system – The idea to include a system like this was discussed, but dismissed as impractical. However, in the new design for the sensor jacks, the sensors can be read to see when they were last calibrated.

Final Design

Conclusion and Recommendations

Conclusion

The final design seems to hold up to the list of requirements, even though many of the requirements cannot be evaluated yet, either because of a lack of a prototype, or because they can only be determined after manufacturing has been started. Therefore projections have been used to evaluate these requirements.

Informally, the design has received favourable remarks regarding its appearance. It has a distinctive appearance which might be used to inform future housing designs.

Recommendations

Before production can be undertaken, prototyping might be necessary to work out final kinks and determine an assembly and manufacturing order. Possibly some minor changes might be necessary. Additionally, prototyping can be used to test usability and safety (especially regarding EM-fields)

Design-wise, the device can be issued in different colours. Perhaps resellers might wish to have it painted in their house colours.

The design can also be used to inform future designs of ATS units to give a cohesive look within the entire product range.

Appendix A: ATVS 2020 datasheet

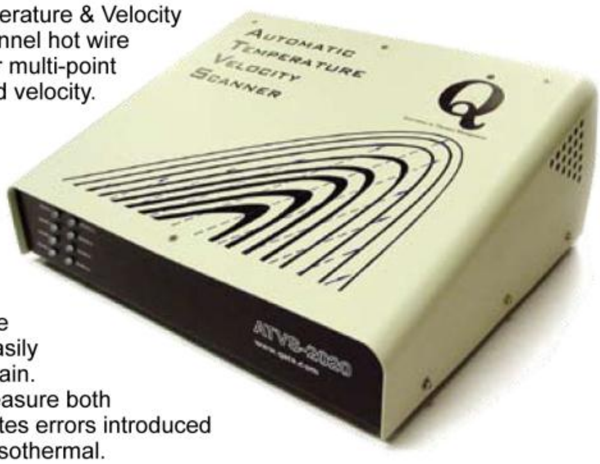
ADVANCED THERMAL SOLUTIONS, INC.
Innovations in Thermal Management®

TEMPERATURE & VELOCITY MEASUREMENT

ATVS-2020™

AUTOMATIC TEMPERATURE AND VELOCITY SCANNER

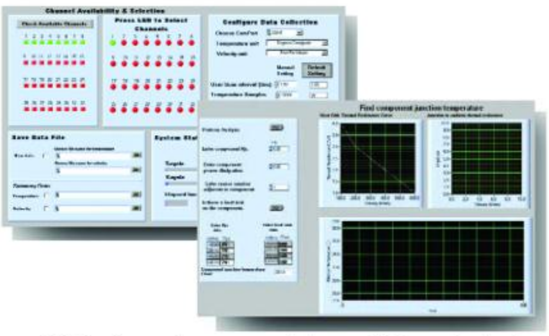
The ATVS-2020 Automatic Temperature & Velocity Scanner is a patented, multi-channel hot wire anemometer system for single or multi-point measuring of air temperature and velocity. Each sensor measures both temperature and velocity, which eliminates errors introduced as a result of the flow being non-isothermal.



The unique, patented sensors are designed to be flexible, robust and low profile to minimize flow disturbance. They can be easily placed anywhere in the test domain. The use of a single sensor to measure both temperature and velocity eliminates errors introduced as a result of the flow being nonisothermal.

The ATVS-2020 is a scientific instrument. Great care is taken in the calibration process of each sensor. The system can accommodate up to 32 channels (sensors) for easy and accurate mapping of the velocity and temperature fields of the test domain.

The ATVS-2020 is a portable system that can handle a variety of thermal measurement tasks. It requires a PC for operation and uses the stageVIEW™ software for data acquisition and reporting.



stageVIEW software for automated data aquisition and reduction.

OVERALL DIMENSIONS (D X W X H)
27.9 cm x 34.3 cm x 13.5 cm
(11" x 13.5" x 5.3")

TEMPERATURE RANGE
-30°C to 150°C (-22°F to 302°F) (±1°C)

FLOW RANGE
0 to 51 m/s (0 to 10,000 FT/MIN) (± 2%)

NUMBER OF CHANNELS
32

SOFTWARE
stageVIEW

POWER
110V or 220V

WEIGHT
5 kg (10 lbs.)

FEATURES:

- **Single Sensor Technology**
  The only system that can measure both temperature and air velocity with a single sensor
- **Accuracy and Ease of Use**
  Offers research quality results with the ease of use of hand-held meter
- **Up to 32 Sensors**
  For single point measurement of air velocity & temperature
- **PCB Testing**
  Test actual or simulated PCBs for thermal and flow distribution
- **High & Low Speed Calibration**
  Sensors are calibrated for both low (natural convection) and high velocity flows from 0 to 51 m/s (10,000 ft/min)
- **stageVIEW Software**
  For autmated data acquisition, reporting and special thermal analysis module for quick evaluation of component temperature
- **Sensor Ports**
  Measure pressure, velocity- and temperature through the ports holes

For further technical information, please contact Advanced Thermal Solutions, Inc. at **1-781-769-2800** or **www.qats.com**

89-27 ACCESS ROAD, NORWOOD, MA 02062 USA | T: 781.769. 2800 F: 781.769.9979 | WWW.QATS.COM

Appendix B: Survey

Customer Questionnaire on the eATVS-4/8 and the ATVS-2020 devices.

Advanced Thermal Solutions is currently having a renewal of the industrial design of their Automatic Temperature Velocity Scanners, known under the name eATVS-4, eATVS-8 and ATSV-2020.

The current ATVS devices are being redesigned to, amongst other reasons, increase user-friendliness and user satisfaction with the devices. To that end, we are asking customers to answer a few questions about how they are experiencing the devices. Your assistance and responses are appreciated and can help us make a better product.

-Please fill in your company name and the ATVS device you've purchased (eATVS-4, eATVS-8 or ATSV-2020)

-In what way (or for what tasks) do you use the device?

-How frequently do you use the device?

-Do you have any issues with setting up the device?

-Do you have any issues with storing the device?

-Are there elements or functions of the device that you find difficult to use or understand?

-Are there elements or functions of the device that you find annoying or ill-thought out?

-Are there elements or functions of the device that you find well-designed or pleasant to use?

-What sort of impression does the current design of the device give? For instance, does it look or feel modern or oldfashioned, rough or fragile, etcetera?

-Are there elements or functions that you find pleasant in broadly similar devices or machines in your working area which is not present in the current design of the device?

-Finally, are there features or elements that you would like to see in this device, or do you have any other comments?

Thank you for your time.

Appendix B: Survey

Results

-Please fill in your company name and the ATVS device you've purchased (eATVS-4, eATVS-8 or ATSV-2020)

Anite Telecom

-In what way (or for what tasks) do you use the device?

Monitoring airflow in prototypes

-How frequently do you use the device?

1/year

-Do you have any issues with setting up the device?

No

-Do you have any issues with storing the device?

No

-Are there elements or functions of the device that you find difficult to use or understand?

No

-Are there elements or functions of the device that you find annoying or ill-thought out?

The cables are delicate and fiddly, wires get tangled

-Are there elements or functions of the device that you find well-designed or pleasant to use?

Software control is good, easy to use

-What sort of impression does the current design of the device give? For instance, does it look or feel modern or oldfashioned, rough or fragile, etcetera?

Oldfashioned, the connectors make it look functional

-Are there elements or functions that you find pleasant in broadly similar devices or machines in your working area which is not present in the current design of the device?

No

-Finally, are there features or elements that you would like to see in this device, or do you have any other comments?

A handheld version would be appreciated and easier to use.

A calibration function, even if only a rough one.

Appendix B: Survey

Results

-Please fill in your company name and the ATVS device you've purchased (eATVS-4, eATVS-8 or ATSV-2020)

Caltech A.B.

-In what way (or for what tasks) do you use the device?

Simulating airflows for e.g. transformers

-How frequently do you use the device?

1/month to rarely

-Do you have any issues with setting up the device?

No

-Do you have any issues with storing the device?

No

-Are there elements or functions of the device that you find difficult to use or understand?

No

-Are there elements or functions of the device that you find annoying or ill-thought out?

No

-Are there elements or functions of the device that you find well-designed or pleasant to use?

Easy to use

-What sort of impression does the current design of the device give? For instance, does it look or feel modern or oldfashioned, rough or fragile, etcetera?

Fancy, but with room for improvement

-Are there elements or functions that you find pleasant in broadly similar devices or machines in your working area which is not present in the current design of the device?

No

-Finally, are there features or elements that you would like to see in this device, or do you have any other comments?

No

Appendix B: Survey

Results

-Please fill in your company name and the ATVS device you've purchased (eATVS-4, eATVS-8 or ATSV-2020)

MicroMass—Waters

-In what way (or for what tasks) do you use the device?

Chromatographs and mass spectrometers

-How frequently do you use the device?

1/year

-Do you have any issues with setting up the device?

No

-Do you have any issues with storing the device?

No

-Are there elements or functions of the device that you find difficult to use or understand?

No

-Are there elements or functions of the device that you find annoying or ill-thought out?

Wires are fragile

-Are there elements or functions of the device that you find well-designed or pleasant to use?

Easy to use

-What sort of impression does the current design of the device give? For instance, does it look or feel modern or oldfashioned, rough or fragile, etcetera?

Oldfashioned

-Are there elements or functions that you find pleasant in broadly similar devices or machines in your working area which is not present in the current design of the device?

No

-Finally, are there features or elements that you would like to see in this device, or do you have any other comments?

No

Appendix B: Survey

Results

-Please fill in your company name and the ATVS device you've purchased (eATVS-4, eATVS-8 or ATSV-2020)

Agusta Westland

-In what way (or for what tasks) do you use the device?

Development of environmental controls

-How frequently do you use the device?

1 or 2/year, but sometimes up to 4 times a year

-Do you have any issues with setting up the device?

No

-Do you have any issues with storing the device?

We leave the device in place.

-Are there elements or functions of the device that you find difficult to use or understand?

No

-Are there elements or functions of the device that you find annoying or ill-thought out?

Wires are fragile, power supply failed (seems to be an isolated case)

-Are there elements or functions of the device that you find well-designed or pleasant to use?

Easy to use, Synchronization of dataplots in real time.

-What sort of impression does the current design of the device give? For instance, does it look or feel modern or oldfashioned, rough or fragile, etcetera?

Looks okay but oldfashioned, with room for improvement

-Are there elements or functions that you find pleasant in broadly similar devices or machines in your working area which is not present in the current design of the device?

No

-Finally, are there features or elements that you would like to see in this device, or do you have any other comments?

No

Appendix B: Survey

Results

-Please fill in your company name and the ATVS device you've purchased (eATVS-4, eATVS-8 or ATSV-2020)

ATS Europe

-In what way (or for what tasks) do you use the device?

Various

-How frequently do you use the device?

Varies

-Do you have any issues with setting up the device?

No

-Do you have any issues with storing the device?

No

-Are there elements or functions of the device that you find difficult to use or understand?

No

-Are there elements or functions of the device that you find annoying or ill-thought out?

Wires are fragile, rattling sounds, use of plastic spacers

-Are there elements or functions of the device that you find well-designed or pleasant to use?

Easy to use, improved software

-What sort of impression does the current design of the device give? For instance, does it look or feel modern or oldfashioned, rough or fragile, etcetera?

Oldfashioned, especially in light of a redesign

-Are there elements or functions that you find pleasant in broadly similar devices or machines in your working area which is not present in the current design of the device?

-

-Finally, are there features or elements that you would like to see in this device, or do you have any other comments?

A rough calibration unit to determine if the sensors are still calibrated

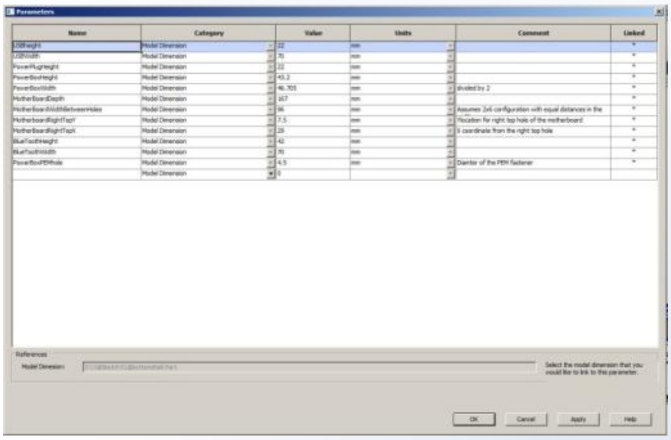
Appendix C: SolidWorks model instructions

To access the design parameters.

-Open the “bottom shell” part in SolidWorks. It is the only part which needs the parametric holes.

-Click on Insert – Design Study – Parameters

You should get this:



Clicking on the parameters will light up the associated dimension on the model itself. To change the values, you can either edit the ‘value’ column in the parameters window, or edit them directly in SolidWorks.

To access the flat parts / folding lines

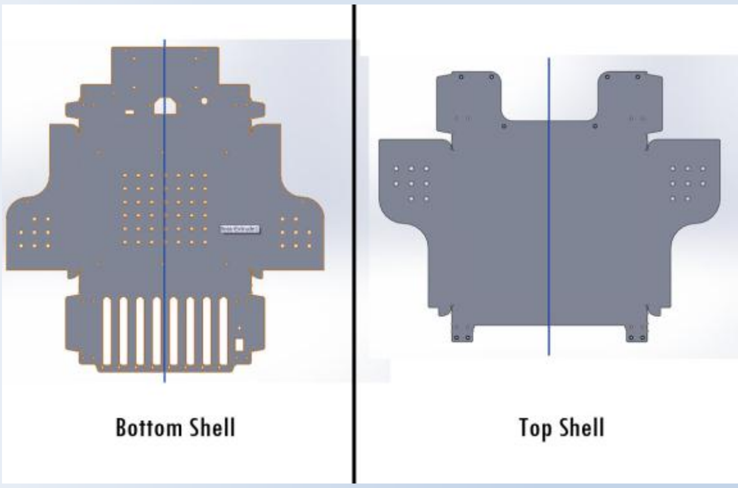
-Open either “bottom shell” or “top shell”.

-At the bottom of the feature tree, you’ll see a suppressed feature called ‘flat-pattern-1’.

-Unsuppressing it will give you the flat sheet metal parts (image on the right), which are the parts which need to be cut out by laser.

-Additionally, by expanding ‘flat-pattern-1’ in the feature tree, all the various folds will become visible (generally called something like ‘Flatten-<SharpBend23>’)

Suppressing one or more of these will bend the part at the associated bend.



Appendix D: EM gaskets

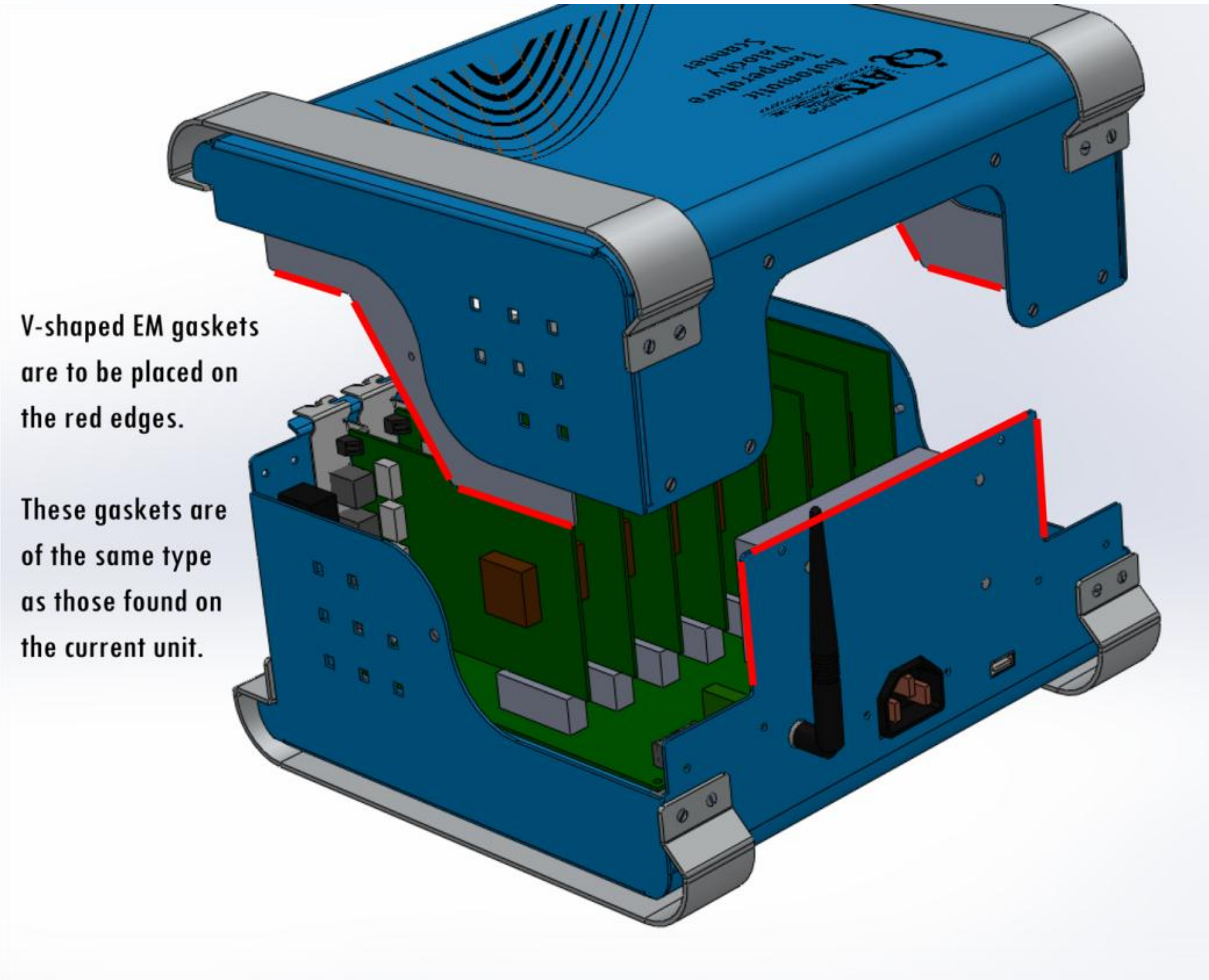


Fig. EMI Gaskets—Image taken from Laird Technologies

http://lairdtech.thomasnet.com/viewitems/askets-and-metal-grounding-products-clip-on-series/all-purpose-series?