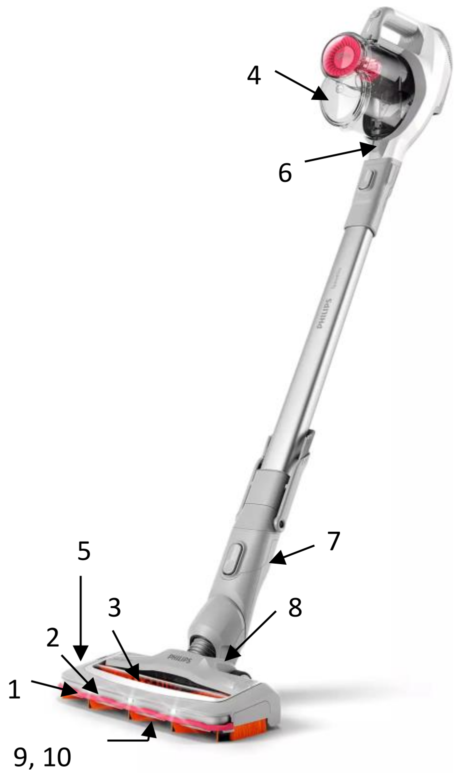
# Supplementary File S2. Illustrative case

To illustrate how the results can be applied in the design of consumer products, we performed an illustrative case. **Error! Reference source not found.** shows the parts that were selected for the illustrative case. In Figure S1, there can be seen where these parts are located in the product to provide further context.




1. Floor nozzle bumper
2. Floor nozzle LED cover
3. Floor nozzle rotating brush
4. Dustbin container
5. Floor nozzle locking cap (other side)
6. Dustbin inlet seal
7. Floor nozzle cable cover
8. Floor nozzle hinge
9. Floor nozzle wheel (bottom)
10. Wheel suspension frame (bottom)

**Figure S1.** The locations of the studied parts in the vacuum cleaner. Base image retrieved from [1].

The manufacturability of these parts as 3D-printed spare parts was assessed by comparing their part requirements against the manufacturing capabilities in Appendix B. Sections S.1-S.10 discuss the applicable requirements for each part, and use colour-coding (see also Table 2 in the paper) to indicate the printability scores. Here, green indicates that the part requirement can likely be met with standard settings or without further redesign, yellow indicates that more careful manufacturing or minor design adjustments are needed, and red indicates that the requirement is (almost) impossible to achieve without major design overhaul. If a requirement is grey, the data quality or availability in Appendix B is too low to assess the printability. It should be noted that the assessments in this study are largely based on observations and assumptions. The designer of a product would be able to make these assessments more accurately due to their involvement in the design process.

## S.1 Floor nozzle bumper

The floor nozzle bumper (see Figure S2) is located at the front of the floor nozzle of the vacuum cleaner. It protrudes from between the top and bottom of the floor nozzle with a tight transition fit.

It is a thin, curved part, made from polypropylene (PP). It has upstanding ridges to position it correctly and hold it in place, and two holes to anchor it. Its function is to protect the rest of the floor nozzle when it hits or scuffs other objects during vacuum cleaning.

**Figure S2.** Floor nozzle bumper.

Table S1 shows the comparison between the specific part requirements and the manufacturing capabilities of additive manufacturing. The design requirements that applied to the part were *Shape, Detail, Accuracy & tolerances, Flexibility, Impact resistance, Abrasion resistance,* and *UV resistance*. The requirements that did not apply to this part were omitted from the table.

For this analysis, we made the following material choices:

- For SLA, we chose durable (PP-like) resin, because this material is a bit more flexible (higher elongation at break) compared to standard or tough resin [2], which will make the part easier to install.
- For SLS, we chose PA11, because this material is a bit more flexible (higher elongation at break) compared to PA12 [3], which will make the part easier to install. Also, it has higher abrasion resistance than PP [4].
- For FDM, we chose ABS, because this material balances strength and flexibility without becoming unreasonably expensive [5].

**Table S1.** Floor nozzle bumper analysis of part requirements and assessment of their feasibility for SLA, SLS, and FDM printing.

| **Part requirements** | | **Manufacturing capabilities** | | |
|---|---|---|---|---|
| Original material: PP | | **SLA**<br>Durable (PP-like*) resin | **SLS**<br>PA11 | **FDM**<br>ABS |
| Shape | Some slight overhang/bridging | Bridging within design rules. | Bridging within design rules. | Bridging within design rules. |
| Detail | Semi-thin walls (2 mm) | Wall thickness and details printable | Wall thickness and details printable | Wall thickness and details printable |
| Accuracy & tolerances | Relatively tight transition fits with other parts (clicked into place, <0.1 mm part clearance). | Required fit achievable with printing accuracy (Industrial SLA: ± 0.15%/± 0.01 mm) | Required fit more difficult to achieve with printing accuracy (SLS: ± 0.3%/± 0.3 mm) | Required fit more difficult to achieve with printing accuracy (Industrial FDM: ± 0.15%/± 0.2 mm) |
| Flexibility | Semi-rigid flexibility required to correctly position the part during assembly. Increased | Durable resin should be able to achieve the semi-rigid flexing strength, especially | PA11 should be able to achieve the semi-rigid flexing strength, especially since it’s only | ABS might be a bit more rigid than the other printing materials, but is likely still sufficient |

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| | flexibility can negotiate lower accuracy. | since it's only required for (easier) assembly. | required for (easier) assembly. | enough for the assembly. If not, nylon could be a suitable option. |
| Impact resistance | Some impact resistance needed to withstand hitting against other objects during vacuum cleaning. | Durable resin should be able to achieve the required impact resistance. | PA11 should be able to achieve the required impact resistance. | ABS should be able to achieve the required impact resistance. |
| Abrasion resistance† | Reasonable abrasion resistance is needed to withstand scuffing against other objects during vacuum cleaning. | Testing needed to verify the abrasion resistance of durable resin over time as the original part already showed wear. | Testing needed to verify the abrasion resistance of PA11 over time as the original part already showed wear. | Testing needed to verify the abrasion resistance over time as the original part already showed wear. |
| UV resistance† | General UV resistance required for indoor-use. | Not UV-stable, post-processing is recommended for better part stability | No issues expected for indoor use | No issues expected for indoor use |
| **Major part requirement(s)** | Sufficient attention should be paid to the accuracy in the design, but it does not limit the printing options as the part fit is loose enough. Additionally, choosing a material with semi-rigid flexibility can ease the accuracy requirements. | | | |
| **Concluding remarks** | The shape, detail, and semi-rigid flexibility/flexural strength should be achievable with all three printing methods. | | | |

* SLA resins are thermosets but often characterized as "thermoplastic-like", e.g., durable resins are "PP-like".

† Insufficient data in Table 4 to conclude.

## S.2 Floor nozzle LED cover

The floor nozzle LED cover (see Figure S) is located at the front of the floor nozzle of the vacuum cleaner. It is inserted in between the top and bottom of the floor nozzle with a clearance fit. It is a thin, curved transparent part, made from polycarbonate (PC), with a thin, upstanding ridge on the top of the long edge. Its function is to protect an LED strip at the front of the floor nozzle, whose directional beam of light is used to reveal hidden dust and dirt.

**Figure S3.** Floor nozzle LED cover. The circle at the top of the figure indicates the location of the enlarged partial overview at the bottom of the figure.

Table S2 shows the comparison between the specific part requirements and the manufacturing capabilities of additive manufacturing. The design requirements that applied to the part were *Shape, Detail, Accuracy & tolerances, Surface finish, Transparency, Impact resistance, Abrasion resistance*, and *UV resistance*. The requirements that did not apply to this part were omitted from the table.

For this analysis, we made the following material choices:

- For SLA, we chose clear resin as this material can be processed to near optical transparency [2].
- For SLS, we chose PA11 as there are no transparent SLS materials available. PA11 will have better durability as it has higher impact resistance and elongation at break compared to other materials [3].
- For FDM, we chose clear PETG because this material is considered the best filament for the production of transparent parts [6].

**Table S2.** Floor nozzle LED cover analysis of part requirements and assessment of their feasibility for SLA, SLS, and FDM printing.

| **Part requirements** | | **Manufacturing capabilities** | | |
|---|---|---|---|---|
| Original material: PC | | **SLA**<br>Clear resin | **SLS**<br>PA11 | **FDM**<br>Clear PETG |
| Shape | Nothing specific. | No foreseen issues. | No foreseen issues. | No foreseen issues. |
| Detail | Semi-thin part (2 mm) with thin unsupported walls (0.8 mm). | Wall thickness and unsupported walls printable. | Wall thickness and unsupported walls printable. | Wall thickness printable. Unsupported walls could be difficult to print. |
| Accuracy & tolerances | The part has a clearance fit with the floor nozzle top cover. | Required fit achievable with printing accuracy (Industrial SLA: ± 0.15%/± 0.01 mm) | Required fit achievable with printing accuracy (SLS: ± 0.3%/± 0.3 mm) | Required fit achievable with printing accuracy (Industrial FDM: ± 0.15%/± 0.2 mm) |
| Surface finish | Not for technical functioning, but smooth surface finish required to meet transparency requirements. | SLA produces very smooth surfaces after general post-processing. | SLS has a grainy surface. A sufficiently smooth surfaces requires extensive post-processing. | FDM has a rough surface with noticeable layer lines. A sufficiently smooth surfaces requires extensive post-processing. |
| Transparency | Full optical transparency required for technical functioning. | Clear resin can be post-processed to near optical transparency. | Not possible. | Transparent filament available in multiple materials (PETG, PC, PLA). Fully transparent will be challenging due to layer lines along the Z-axis. |
| Impact resistance | A little impact resistance is required to withstand hitting against other objects during vacuum cleaning, but most impact strength will be negotiated by the bumper (see S.1). | Clear resins, like most SLA resins, are generally brittle. However, since the part is protected by the bumper, it could still work out. | PA11 will have sufficient impact resistance, especially with the bumper to protect this part. | PETG will have sufficient impact resistance, especially with the bumper to protect this part. |
| Abrasion resistance† | Some abrasion resistance is needed to withstand scuffing against other objects during vacuum cleaning, but most abrasion will be negotiated by the bumper (see S.1). | Most SLA resins have poor abrasion resistance. Testing will be needed to see if the clear resin is sufficient, although it could work with the bumper to protect the part. | PA11, like most SLS materials, has good wear resistance. This will likely be sufficient, especially with the bumper to protect this part. | PETG has a relatively high hardness [7]. This will likely be sufficient, especially with the bumper to protect this part. |

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| UV resistance† | General UV resistance required for indoor-use. | Not UV-stable, post-processing is recommended for better part stability and to avoid yellowing. | Likely there will be no issues for indoor use | No issues for indoor use |
| **Major part requirement(s)** | The transparency and surface finish of the part are the most important part requirements to ensure that the light of the LED strip can shine through the cover. | | | |
| **Concluding remarks** | The printing options for this part are limited as full transparency is required for technical functioning. This rules out SLS printing and makes it more challenging to use FDM printing. | | | |

† Insufficient data in Table 4 to conclude.

## S.3 Floor nozzle brush

The floor nozzle brush (see

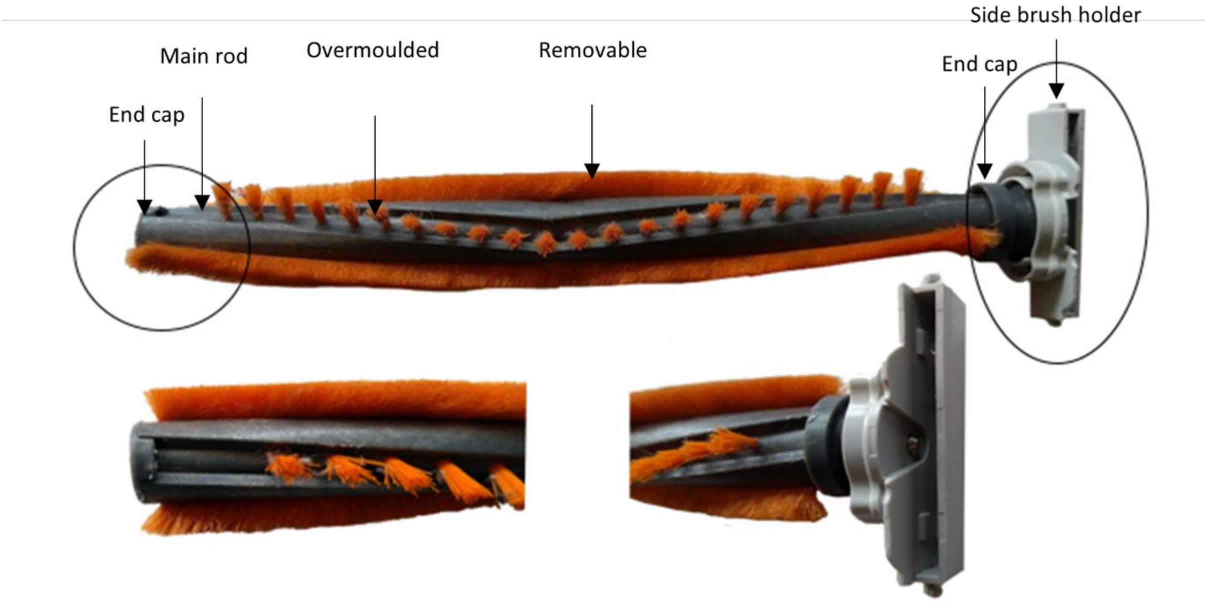


Figure **S**) is located on the inside of the floor nozzle. It is inserted into an opening in the side of the floor nozzle, where one end rests on a ledge inside the floor nozzle. Here, it connects to the motor that rotates the brush when the vacuum cleaner is being used. On the other end, the brush is locked into place on the outside of the floor nozzle with a locking cap (see S.5). The brush has a pin to connect to the locking cap with a clearance fit. The floor nozzle brush is a long, slender part with six different subcomponents, as indicated in

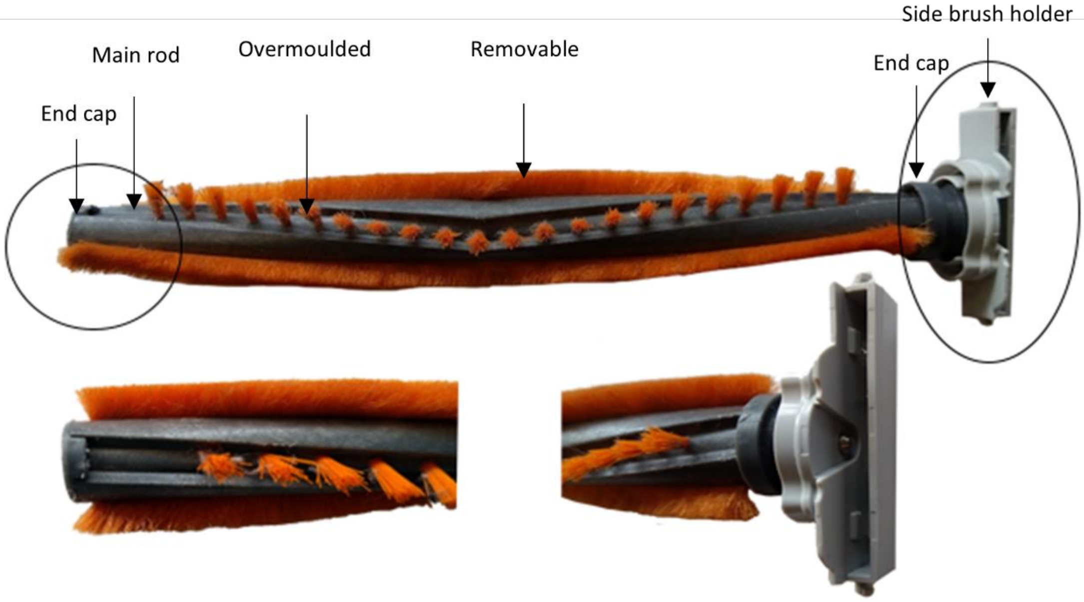


Figure **S**. The main rod, made from nylon (PA), has four grooves running down its side in a subtle V-shape. In two grooves, bushes of overmoulded bristles protrude from the rod, whereas in the other two grooves, two removable lines of bristles have been slid in, using a clearance fit. To prevent the bristles from sliding out, locking caps, made from polypropylene (PP), have been placed on both sides using a non-reversible force-fit. If the locking caps are removed, the bristle lines can be slid out. Finally, on one side, there is a side-brush holder, made from POM, that holds an additional brush and the locking cap. The function of the brush is to improve the pick-up rate of the dirt and debris that is being vacuumed.

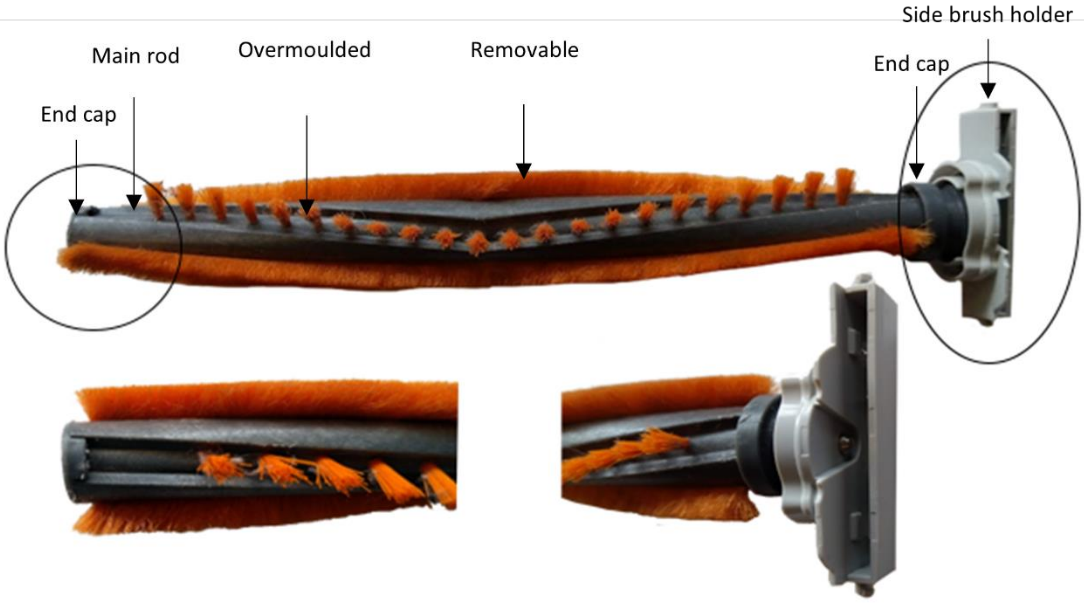


**Figure S4.** Floor nozzle brush with indicated subcomponents. The circles at the top of the figure indicate the locations of the enlarged partial overviews at the bottom of the figure.

Table S3 shows the comparison between the specific part requirements and the manufacturing capabilities of additive manufacturing. The design requirements that applied to the part were *Shape, Detail, Accuracy & tolerances, Multi-material, Surface finish, Impact resistance,* and *Abrasion resistance.* The requirements that did not apply to this part were omitted from the table.

For this analysis, we made the following material choices:

- For SLA, we chose durable resin as this material has high resistance to wear and impact [2].
- For SLS, we chose PA12. PA12 should have sufficient impact strength and abrasion resistance, while being cheaper than PA11. PA11 is also a good option, especially if higher impact or abrasion resistance is required [8,9].
- For FDM, we chose nylon, as it has better impact strength and hardness compared to other filaments [10].

**Table S3.** Floor nozzle brush analysis of part requirements and assessment of their feasibility for SLA, SLS, and FDM printing.

| **Part requirements** | | **Manufacturing capabilities** | | |
|---|---|---|---|---|
| Original material: Nylon+PP+POM | | **SLA**<br>Durable (PP-like*) resin | **SLS**<br>PA12 | **FDM**<br>Nylon |
| Shape | The side brush holder has some overhang/bridging, partially unsupported wall, a narrow and deep cavity for side brush, and a cavity around brush rod attachment. Slight variation in wall thickness. Brush rod has deep cavity at the end, and has ridges | The separate subcomponents are printable, printing in-place not recommended. Determining support placement and removing it from cavities will be challenging. | The separate subcomponents are printable, printing in-place not recommended. Leftover powder easy to remove. Support through unused powder. | The separate subcomponents are printable, printing in-place not recommended. Printing orientation and support placement need to be optimized. Support removal from cavities possible, especially with water soluble support. |

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| | in which the brushes slide. | | | |
| Detail | The part includes some (semi-)thin walls (1-2mm), a thin unsupported wall (1 mm), some thin ribs (not measurable), and a pin (⌀3 mm) with protruding end. | All details are printable. | All details are printable. | Wall thickness, unsupported wall, and ribs are printable. Pin with protruding end could be difficult to print, depending on printing orientation. |
| Accuracy & tolerances | The part has clearance fits with other parts, but tight interference fits between part components if these were to be printed separately. | Required fit with other parts achievable with printing accuracy (Industrial SLA: ± 0.15%/± 0.01 mm). | Required fit with other parts achievable with printing accuracy (SLS: ± 0.3%/± 0.3 mm). Required fit between part components would be challenging. | Required fit with other parts achievable with printing accuracy (Industrial FDM: ± 0.15%/± 0.2 mm). Required fit between part components would be challenging. |
| Multi-material | Multiple different materials were used, likely ABS, POM, nylon bristles, stainless steel pin, and some unknown material blend (filled or fibre-reinforced plastic?). | Multi-material printing is not possible. Some subcomponents are manufacturable separately, but reproducing the overmoulded bristles is not possible. | Multi-material printing is not possible. Some subcomponents are manufacturable separately, but reproducing the overmoulded bristles is not possible. | Multi-material printing is possible, but limited to two materials. Some subcomponents are manufacturable separately, but reproducing the overmoulded bristles is not possible. |
| Surface finish | End cap/side brush holder has a smooth surface, see abrasion resistance. | SLA produces very smooth surfaces after general post-processing. | Rough(er) surface, would need more extensive post-processing. | Rough(er) surface, would need more extensive post-processing. |
| Impact resistance | General impact strength required as brush could hit objects occasionally. | Needs testing to verify impact strength, but tough/durable resins should be able to withstand the occasional impact force. | Needs testing to verify impact strength, but PA11 should be able to withstand the occasional impact force. | Needs testing to verify impact strength, but both ABS and nylon should be able to withstand some occasional impact force. |
| Abrasion resistance† | The brush rod needs to withstand abrasion from dust, sand, hair, etc. Also, the side brush holder is made from very low-friction material. Test to see how critical this level of low-friction is. | Needs testing to verify abrasion resistance of both parts. Self-lubricating properties only available with mSLA. | Needs testing to verify abrasion resistance of both parts. Whether more extensive post-processing or a material with low friction/self-lubrication is required, depends on the criticality for this surface finish. | Needs testing to verify abrasion resistance of both parts. Whether more extensive post-processing or a material with low friction/self-lubrication is required, depends on the criticality for this surface finish. |
| **Major part requirement(s)** | The multi-material aspect is the most important to be able to realize the brushes. Also, the rod needs a reasonable level of abrasion resistance to be able to withstand a constant flow of dirt and debris while vacuuming. Additional abrasion resistance might be required for the side brush holder as well. | | | |
| **Concluding remarks** | The part complexity is too high, and the bristles are not replicable with any printing method. This makes it near impossible to replicate this part with additive manufacturing in an effective manner. To create a printed spare part, extensive redesign and part consolidation would be required, as well as a reconfiguration of the bristles. This will also help to alleviate other requirements that are currently challenging, such as the interference fits between the different part components. | | | |

* SLA resins are thermosets but often characterized as "thermoplastic-like", e.g., durable resins are "PP-like".

† Insufficient data in Table 4 to conclude

## S.4 Dustbin container

The dustbin container (see **Figure S**) is located at the top of the vacuum cleaner. It is fitted into the handle with a transition fit. Inside the handle, one end of the container connects to the vacuum rod through the dustbin seal, which is fitted with a transition fit. A lid is fitted on top of the dustbin, using a transition fit with additional seal and fastened with a snap fit. Also, a vortex finder can be placed inside the dustbin by rotating it onto the base with a transition fit. The dustbin container is a big, transparent part, made from glass-filled ABS. It has a double-cylinder shape, interior channels, and strengthening ribs. Its function is to store the dust and debris that is collected during vacuuming.

**Figure S5.** Dustbin container side-view and top-view.

Table S4 shows the comparison between the specific part requirements and the manufacturing capabilities of additive manufacturing. The design requirements that applied to the part were *Shape, Detail, Accuracy & tolerances, Surface finish, Transparency, Impact resistance, Abrasion resistance, Water resistance, UV resistance,* and *Chemical resistance.* The requirements that did not apply to this part were omitted from the table.

For this analysis, we made the following material choices:

- For SLA, we chose clear resin. This material can be processed to near optical transparency [2]. Additional tinting of the resin could be done to achieve the same colour.
- PA11 for SLS, as there are no transparent SLS materials available. This material has superior impact resistance compared to other SLS materials [8,9].
- Clear PC for FDM printing. This material is known for its high impact resistance and transparency. If needed, PC can be reinforced with glass or carbon fibres for increased strength [11].

**Table S4.** Dustbin container - analysis of part requirements and assessment of their feasibility for SLA, SLS, and FDM printing.

| Part requirements | Manufacturing capabilities |
|---|---|

| Original material: Glass-filled ABS | | **SLA**<br>Clear resin | **SLS**<br>PA11 | **FDM**<br>PC (clear) |
|---|---|---|---|---|
| Shape | The shape includes an internal channel at the inlet, as well as some overhang/bridging at the bottom. | Support material could be challenging to remove from inside the internal channel. | Support material (loose powder) can be removed easily. | Support material could be challenging to remove from inside the internal channel. This can be solved by using soluble support. |
| Detail | The part has semi-thin walls (2 mm), ribs (1.5 mm), and embossed text (0.5 mm wide, <1 mm high). | The wall thicknesses, ribs, and embossed text are all printable. | The wall thicknesses are ribs are printable. The embossed text might wear off during post-processing, so at least 1 mm would be recommended. | The wall thicknesses are ribs are printable. For the embossed text, a height of at least 1.2-1.5 mm would be recommended. |
| Accuracy & tolerances | The part has multiple transition fits with other parts. | Required fit achievable with printing accuracy (Industrial SLA: ± 0.15%/± 0.01 mm) | Required fit more difficult to achieve with printing accuracy (SLS: ± 0.3%/± 0.3 mm). | Required fit more difficult to achieve with printing accuracy (Industrial FDM: ± 0.15%/± 0.2 mm). |
| Surface finish | Not for technical functioning, but smooth surface finish required to meet transparency requirements. | SLA produces very smooth surfaces after general post-processing. | SLS has a grainy surface. A sufficiently smooth surfaces requires extensive post-processing. | FDM has a rough surface with noticeable layer lines. A sufficiently smooth surfaces requires extensive post-processing. |
| Transparency | The dustbin should be reasonably transparent to allow the user to check the dustbin contents. | SLA parts in clear resin can be processed to near-optical transparency, which is more than sufficient for this application. | It is currently not possible to print transparent parts with SLS printing. | FDM parts will be translucent at best, even with transparent filament, due to the layer lines. More extensive post-processing will be needed to get sufficiently transparent part. |
| Impact resistance | The dustbin should have high impact resistance so it does not shatter if the vacuum cleaner falls over. | Clear resins are generally brittle. Testing is needed to see if it can withstand drop tests, or whether an alternative material or additional reinforcement is needed. | PA11 has good impact resistance, but testing is needed to see if it can withstand drop tests. Also, the porosity might affect the impact resistance of the part, so post-processing is recommended. | PC has good impact resistance, but testing is needed to see if it can withstand drop tests. Also, the layer adhesion might weaken the impact resistance of the part. |
| Abrasion resistance† | Minor abrasion resistance required on the contact surfaces where the vortex finder, lid, and the handle are connected in the assembled product. | Most SLA materials have poor abrasion resistance. Testing is needed to see if clear resin can withstand this minor abrasion during repeated (dis)assembly. | Most SLS materials, including PA, have good wear resistance. Testing is still recommended to see if it can withstand repeated (dis)assembly of parts. | PC filament has a relatively high resistance to scratching [11]. Testing is still recommended to see if it can withstand repeated (dis)assembly of parts. |
| Water resistance | The water absorption of the material shouldn't be too high so the dustbin can be rinsed or washed occasionally. | The water absorption rate of the specific clear resin should be checked, but this should be fine for occasional exposure. | PA11 has a slightly higher water absorption rate, and SLS prints are porous. However, with standard post-processing, it should be fine for occasional exposure. | PC is very hygroscopic. To avoid any issues, it might be recommendable to do some more extensive post-processing (e.g., coating). |

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|---|---|---|---|---|
| UV resistance† | General UV resistance required for indoor-use. | SLA resins are not UV-stable, post-processing is recommended for better part stability. | No issues expected for indoor use | PC is not resistant to UV rays, post-processing is recommended for better part stability. |
| Chemical resistance | General chemical resistance required to withstand cleaning agents when the dustbin is washed occasionally. | The chemical resistance of SLA resins is sufficient to withstand the occasional use of cleaning agents. | The chemical resistance of PA11 is sufficient to withstand the occasional use of cleaning agents. | The chemical resistance of PC is sufficient to withstand the occasional use of cleaning agents. |
| **Major part requirement(s)** | The dustbin requires considerable impact resistance so it will survive a fall if it is dropped or if the vacuum falls over. Additionally, the dustbin has a complex shape that incorporates several important features, such as the internal channel on which the vortex finder is mounted. | | | |
| **Concluding remarks** | The inlet cavity's complex shape could make it difficult to remove support material for SLA and FDM printing, whereas the transparency of the part cannot be realized with SLS printing. | | | |

† Insufficient data in Table 4 to conclude.

## S.5 Floor nozzle brush locking cap

The floor nozzle brush locking cap (see **Figure S**) is located at the side of the floor nozzle. It is clipped onto the floor nozzle brush with a clearance fit. To fit the locking cap into place, it needs to be fitted over pins with key-shaped ends on the floor nozzle brush. Then, it can be snapped down to lock onto the bottom part of the floor nozzle with a snap-fit-like transition fit. It is a thin, bracket-like part made from ABS. It has a key-shaped hole at both ends, and a thin wall in the middle that acts as a snap fit. Its function is to lock the floor nozzle brush into place.

**Figure S6.** Floor nozzle brush locking cap. The circles at the sides of the figure indicate the locations of the enlarged partial overviews at the bottom of the figure.

**Table S5** shows the comparison between the specific part requirements and the manufacturing capabilities of additive manufacturing. The design requirements that applied to the part were *Shape, Detail, Accuracy & tolerances, Surface finish, Strength, Flexibility, Abrasion resistance*, and *UV resistance*. The requirements that did not apply to this part were omitted from the table.
For this analysis, we made the following material choices:

- For SLA, we chose durable resin, because this material is more ductile compared to standard or tough resin [2], which will make the part easier to install.

- For SLS, we chose PA11, because this material is a bit more flexible (higher elongation at break) compared to PA12 and PP [3], which will make the part easier to install.
- For FDM, we chose nylon 12, because this material is strong and tough with just enough flex [12], which will make the part easier to install.

**Table S5.** Floor nozzle brush locking cap - analysis of part requirements and assessment of their feasibility for SLA, SLS, and FDM printing.

| **Part requirements** | | **Manufacturing capabilities** | | |
|---|---|---|---|---|
| Original material: ABS | | **SLA**<br>Durable (PP-like*) resin | **SLS**<br>PA11 | **FDM**<br>Nylon 12 |
| Shape | The part has some overhang. | The overhang is printable. | The overhang is printable. | The overhang is printable. |
| Detail | Two keyhole shaped holes (roughly ⌀ 3 mm), thin walls (1.5 mm) around the holes, and a thin unsupported wall that acts as snap-fit-like closure (1.5 mm). | The holes, wall thickness, and unsupported wall are printable. | The wall thickness and unsupported wall are printable. Likely, post-processing is needed for the holes. | Wall thickness and unsupported wall are printable. Likely, post-processing is needed the holes. |
| Accuracy & tolerances | Clearance fit with pins in other part, but the keyhole shape makes dimensional accuracy and symmetry more important. | Required fit with other parts achievable with printing accuracy (Industrial SLA: ± 0.15%/± 0.01 mm). | Required fit with other parts achievable with printing accuracy (SLS: ± 0.3%/± 0.3 mm). Achieving an accurate hole shape could be more challenging. | Required fit with other parts achievable with printing accuracy (Industrial FDM: ± 0.15%/± 0.2 mm). Achieving an accurate hole shape could be more challenging, depending on the print orientation. |
| Surface finish | A smooth surface is required on the snap fits and in the holes for smooth operation. | SLA produces very smooth surfaces after general post-processing. | Coarse surface finish after printing. Likely, more extensive post-processing is needed to achieve the correct smoothness | Rough(er) surface after printing due to layer lines. Likely, more extensive post-processing is needed to achieve the correct smoothness, depending on printing orientation. |
| Strength | The part needs to withstand considerable flexural force during (dis)assembly of the part. | Needs testing to verify mechanical performance. | Needs testing to verify mechanical performance. | Needs testing to verify mechanical performance. |
| Flexibility | Semi-rigid flexibility is required to correctly position the part during assembly. This will alleviate (part of) the flexural force. | Durable resin likely has sufficient semi-rigid flexibility. | PA11 likely has sufficient semi-rigid flexibility. | Nylon 12 filament likely has sufficient semi-rigid flexibility, but testing for anisotropic effects is recommended. |
| Abrasion resistance† | High abrasion resistance required for the snap-fit-like closure. Also, the holes need reasonable abrasion resistance. | Needs testing to verify abrasion resistance. | Needs testing to verify abrasion resistance. | Needs testing to verify abrasion resistance. |
| UV resistance† | General UV resistance for indoor-use is required. | Not UV-stable, post-processing | No issues for indoor use | No issues for indoor use |

| | | | | |
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| | | recommended for better part stability, although part is mostly hidden. | | |
| **Major part requirement(s)** | The part needs to have relatively high flexural strength and semi-rigid flexibility, as it needs to bend during assembly to be able to get it over both pins. Additionally, the key-shaped holes need the right level of accuracy and detail to be printed successfully. | | | |
| **Concluding remarks** | The part is printable but needs high flexural strength for (dis)assembly. This might cause the thin walls around the holes to fail, especially if the part is disassembled multiple times during use. Also, achieving an accurate keyhole shape will require more careful and extensive post-processing in SLS and FDM printing. | | | |

* SLA resins are thermosets but often characterized as "thermoplastic-like", e.g., durable resins are "PP-like".

† Insufficient data in Table 4 to conclude

## S.6 Dustbin inlet seal

The dustbin inlet seal (see **Figure S**) is located inside the dustbin. It is compressed within the dustbin inlet where it connects to the vacuum rod with an interference fit. It is a circular, flexible part made from Polydimethylsiloxane (PDMS, or silicone). It has an overhanging edge, as well as a thicker part on one end. Its function is to seal the connection between the vacuum rod and the dustbin.

**Figure S7.** Dustbin inlet seal.

**Table S6** shows the comparison between the specific part requirements and the manufacturing capabilities of additive manufacturing. The design requirements that applied to the part were *Shape, Detail, Accuracy & tolerances, Water-/airtightness, Surface finish, Strength, Flexibility, Elasticity,* and *Abrasion resistance.* The requirements that did not apply to this part were omitted from the table.

For this analysis, we made the following material choices:

- For SLA, we chose rebound resin, because this material has the highest tear strength and elongation [13].
- For SLS, we chose TPU, because this is the most common flexible material, suitable for gaskets and seals [13].
- For FDM, we chose TPE, because this filament is the most elastic option [13].

**Table S6.** Dustbin inlet seal - analysis of part requirements and assessment of their feasibility for SLA, SLS, and FDM printing.

| Part requirements | | Manufacturing capabilities | | |
|---|---|---|---|---|
| Original material: PDMS (Silicone) | | **SLA**<br>Rebound resin | **SLS**<br>TPU | **FDM**<br>TPE |
| Shape | The part has a complex overhang/near-cavity in two locations that could make it more complex to remove support. | The support might be challenging to remove from underneath the overhangs. | The support material (loose powder) can be removed easily. | The support might be challenging to remove from underneath the overhangs. Water-soluble support could solve this. |
| Detail | The part has some thin walls (1-2 mm) and a few thick unsupported walls (3 mm) | All walls are printable. | All walls are printable. | Thinnest walls (1mm) might be difficult to print, the other walls are printable. |
| Accuracy & tolerances | The part has an interference fit with the dustbin and a clearance fit with dustbin inlet (linked to elasticity). | The fits are feasible with the accuracy of industrial SLA printing (± 0.15%/± 0.01 mm). | The fit is feasible with the accuracy of SLS printing (± 0.3%/± 0.3 mm), if sufficient elasticity can be generated. | The fit is feasible with the accuracy of industrial FDM printing (± 0.15%/± 0.2 mm) , if sufficient elasticity can be generated. |
| Water-/air-tightness | Since it's a seal, the part should be reasonable airtight. | SLA printed parts have virtually no porosity | SLS printed parts have some porosity, but not sufficient enough to pose a problem. | FDM printed parts have some porosity, but not sufficient enough to pose a problem. |
| Surface finish | The part needs a smooth surface to lower friction when (dis)assembling the part. A rough surface might give too much friction during installing. | SLA produces very smooth surfaces after general post-processing. | SLS parts have a powdery surface finish which could give some friction. Additional post-processing might be needed. | FDM parts have a rougher surface finish due to the printing lines, which could give some friction. Additional post-processing might be needed. |
| Strength | The part needs high flexural and tensile strength (with low flexural and tensile modulus) to install the part. Incorrect disassembly could result in excessive tensile strength. | Testing is needed to verify the mechanical performance of the part. | Testing is needed to verify the mechanical performance of the part. | Testing is needed to verify the mechanical performance of the part. |
| Flexibility | High flexibility (high flexural strength, low flexural modulus) is needed to install part. Also, the flanges are pushed down when the dustbin is pushed into the vacuum cleaner handle. | SLA can provide silicone-like flexibility, but additional testing will be needed to see whether this is sufficient. | SLS can only provide rubber-like flexibility, which will be insufficient, especially in the thicker parts. | FDM can provide silicone-like flexibility, but additional testing will be needed to see whether this is sufficient. |
| Elasticity | Reasonable elasticity (high tensile and tear strength, low tensile modulus) is needed to stretch the part around the inlet. Some compressibility is needed when part is pushed into the inlet cavity in the dustbin. | SLA can provide silicone-like elasticity, but additional testing is needed to see whether this is sufficient. | SLS can only provide rubber-like elasticity, which will be insufficient. | FDM can provide silicone-like elasticity, but additional testing is needed to see whether this is sufficient. |

| | | | | |
|---|---|---|---|---|
| Abrasion resistance† | Some abrasion resistance is needed when installing the part in the dustbin inlet, but this is not expected to happen frequently. | No foreseen issues. | No foreseen issues. | No foreseen issues. |
| **Major part requirement(s)** | The part requires high flexibility and elasticity, as well as reasonable tensile strength, as it needs to be stretched over the dustbin inlet to be assembled. | | | |
| **Concluding remarks** | The combination of thin walls and the tensile strength, flexibility and elasticity needed for the part (dis)assembly will be very difficult to achieve, especially for SLS. | | | |

† Insufficient data in Table 4 to conclude.

## C7. Floor nozzle cable cover

The floor nozzle cable cover is located at the back of the floor nozzle. It is attached onto the other housing parts of the floor nozzle with a transition fit with multiple ribs and two screw bosses, as well as two snap-fits-like pins and two screws to fasten it (both clearance fits). It is a concave enclosure part made from ABS. It has internal ribs and walls to strengthen it, two screw bosses, and two snap-fits. Its function is to protect the cables inside the floor nozzle.

**Figure S8.** Floor nozzle cable cover. The circle at the top of the figure indicates the location of the enlarged partial overview at the right of the figure.

**Table S7** shows the comparison between the specific part requirements and the manufacturing capabilities of additive manufacturing. The design requirements that applied to the part were *Shape, Detail, Accuracy & tolerances, Surface finish, Strength, Impact resistance,* and *UV resistance.* The requirements that did not apply to this part were omitted from the table.

For this analysis, we made the following material choices:

- For SLA, we chose tough (ABS-like) resin, because this material has good toughness and is suitable for snap-fit joints [2], similar to the angular pins on this part.
- For SLS, we chose PA12, because this material is suitable for durable housing parts [8].
- For FDM, we chose nylon, because this material has good strength, durability, and impact resistance [5].

**Table S7.** Floor nozzle cable cover - analysis of part requirements and assessment of their feasibility for SLA, SLS, and FDM printing.

| **Part requirements** | | **Manufacturing capabilities** | | |
|---|---|---|---|---|
| Original material: ABS | | **SLA**<br>Tough (ABS-like*) resin | **SLS**<br>PA12 | **FDM**<br>Nylon |
| Shape | The part has considerable overhang under the concave shape, and some overhang under the screw holes and angular pins. | The shape is printable. | The shape is printable. | The shape is printable, but printing orientation and support placement need to be optimized. |
| Detail | Thin walls (1-2 mm), two angular pins, very thin ribs/details (0.5-1 mm), and two screw bosses (ca. ⌀ 10 mm). | All details are printable | The wall thickness, angular pins, and screw bosses are printable, the very thin ribs are likely to fail. | The wall thickness is printable but weak, and the angular pins and ribs are likely difficult to print, depending on printing orientation. The bosses are printable. |
| Accuracy & tolerances | High accuracy is required to fit the part correctly at the multiple attachment points, using both tight transition fits and clearance fits. | The required fit is achievable with printing accuracy (Industrial SLA: ± 0.15%/± 0.01 mm) | The required fit is more difficult to achieve with printing accuracy (SLS: ± 0.3%/± 0.3 mm) | The required fit is more difficult to achieve with printing accuracy (Industrial FDM: ± 0.15%/± 0.2 mm) |
| Surface finish | The snap fits of the cable cover should have a smooth surface finish for easy assembly. | SLA produces very smooth surfaces after general post-processing. | SLS has a grainy surface. A sufficiently smooth surfaces requires extensive post-processing. | FDM has a rough surface with noticeable layer lines. A sufficiently smooth surfaces requires extensive post-processing. |
| Strength | Relatively high (flexural) part strength required during (dis)assembly for the snap fit, although disassembly is likely kept to a minimum. | Testing is needed to verify the flexural strength of tough resin, but it will likely suffice, especially with minimal (dis)assembly during use. | Testing is needed to verify the flexural strength of PA12, but it will likely suffice, especially with minimal (dis)assembly during use. | Testing is needed to verify the flexural strength of nylon, but it will likely suffice, especially with minimal (dis)assembly during use Thinner walls are likely too weak, depending on printing orientation. |
| Impact resistance | The cable cover should have reasonable impact resistance so it does not break if the vacuum cleaner falls over. | Testing is needed to verify the impact resistance of tough resin, but it will likely suffice. | Testing is needed to verify the impact resistance of PA12, but it will likely suffice. | Testing is needed to verify the impact resistance of nylon, but it will likely suffice. |
| UV resistance† | General UV resistance is required for indoor-use. | SLA parts are not UV-stable, post-processing recommended for better part stability | No issues for indoor use | No issues for indoor use |
| **Major part** | The part requires high printing accuracy as there are many points where the cover it connects to the | | | |

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| **requirement(s)** | other housing parts. Additionally, the part needs to have reasonable impact resistance to withstand general use, as well as reasonable flexural strength to install the part. However, after assembly, the flexural strength is not as important. |
| **Concluding remarks** | The part is printable, but further testing is required to see if the flexural strength for assembly and the general impact strength are sufficient. |

* SLA resins are thermosets but often characterized as "thermoplastic-like", e.g., durable resins are "PP-like".
† Insufficient data in Table 4 to conclude.

## C8. Floor nozzle hinge

The floor nozzle hinge (see **Figure S**) is located inside the floor nozzle. It is fitted into the bottom half of the floor nozzle and the rod connector of the floor nozzle rotates around the pin of the hinge, both with a clearance fit. It is a small, flat part made from POM. It has multiple ribs on the inside, two small pins, and a screw hole on one side. It's function is to allow the floor nozzle to rotate in relation to the vacuum cleaner rod.

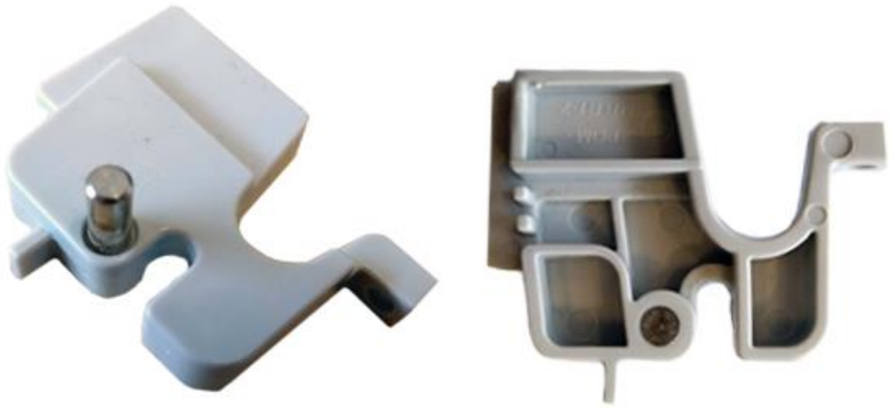

**Figure S9.** Floor nozzle hinge.

**Table S8** shows the comparison between the specific part requirements and the manufacturing capabilities of additive manufacturing. The design requirements that applied to the part were Shape, Detail, Accuracy & tolerances, Multi-material, Surface finish, and Abrasion resistance. The requirements that did not apply to this part were omitted from the table.

For this analysis, we made the following material choices:

- For SLA, we chose durable (PP-like) resin, because this is the most wear-resistant resin [2].
- For SLS, we chose PA12, because it has good abrasion resistance and a low friction coefficient [14].
- For FDM, we chose nylon 66, because this is a more abrasion-resistant material [15].

**Table S8.** Floor nozzle hinge - analysis of part requirements and assessment of their feasibility for SLA, SLS, and FDM printing.

| **Part requirements** | **Manufacturing capabilities** | | |
|---|---|---|---|
| | **SLA** | **SLS** | **FDM** |
| Original material: POM + metal pin insert | Durable (PP-like*) resin | PA12 | Nylon 66 |

| | | | | |
|---|---|---|---|---|
| Shape | The hinge has some overhang/bridging on the backside. | The part is printable, and the support and leftover resin should be easy to remove. | The part is printable, and the support and leftover powder should be easy to remove. | The part is printable, and the support should be easy to remove. |
| Detail | The hinge has some semi-thin walls (2 mm), one semi-thin unsupported wall (2 mm), and some thin pins (2 mm), thin wall (1mm), and thin ribs (1-1.5 mm). | All details are printable. | All details are printable. | The wall thickness, unsupported wall, and ribs are printable. The pins and thin walls could be difficult to print, depending on printing orientation. |
| Accuracy & tolerances | The hinge has clearance fits with the floor nozzle top cover, upper floor nozzle part, and with the screws. | The fit is feasible with the accuracy of industrial SLA printing (± 0.15%/± 0.01 mm). | The fit is feasible with the accuracy of SLS printing (± 0.3%/± 0.3 mm) | The fit is feasible with the accuracy of industrial FDM printing (± 0.15%/± 0.2 mm) |
| Multi-material | The hinge has two materials: POM for the main part, and (likely) stainless steel for the metal pin. | For SLA, multi-material printing is not possible, but the metal pin could be placed as an insert after printing. Testing is needed to verify the adhesion between the printed part and the insert. | For SLS, multi-material printing is not possible, but the metal pin could be placed as an insert after printing. Testing is needed to verify the adhesion between the printed part and the insert. | For FDM, multi-material printing is possible, but not recommended here. The metal pin could be placed as an insert after printing. Testing is needed to verify the adhesion between the part and the insert. |
| Surface finish | The hinge has a smooth surface on the side where the rod connector rubs against it during rotation. | SLA produces very smooth surfaces after general post-processing. | SLS has a coarse surface finish after printing. Likely, more extensive post-processing is needed to achieve the correct smoothness | FDM has a rough surface after printing due to layer lines. Likely, more extensive post-processing is needed to achieve the correct smoothness, depending on printing orientation. |
| Abrasion resistance† | The hinge needs high abrasion resistance on the side where the rod connector rubs against it during rotation. The part is made from a very low-friction material. | Needs testing to verify abrasion resistance of the part. Durable resin should be sufficient as it is suitable for low-friction moving parts | Needs testing to verify abrasion resistance of the part. PA12 should be sufficient as it has a low friction coefficient. | Needs testing to verify abrasion resistance of the part. |
| **Major part requirement(s)** | The hinge rubs constantly against the upper part of the floor nozzle during use. To prevent the part wearing down too quickly, it is important that it has a smooth surface finish and high abrasion resistance. Additionally, the part should be compatible with a metal insert after printing. | | | |
| **Concluding remarks** | The metal pin insert makes it more complex to reproduce the part with additive manufacturing. The metal pin needs to bond with the printed part, which might be more difficult to realize after printing. Also, a higher abrasion resistance might be needed to replicate POM's low friction coefficient. This could be done either with a glass-filled or self-lubricating material, or with external lubrication. | | | |

* SLA resins are thermosets but often characterized as "thermoplastic-like", e.g., durable resins are "PP-like".

† Insufficient data in Table 4 to conclude.

## C9. Floor nozzle wheel

The floor nozzle wheel (see **Figure S1**) is located on the underside of the floor nozzle. It is mounted on an axle with a transition fit. It is a small, round part, consisting of a hub and a tyre, made from PP and LDPE respectively. It has a hole in the middle, as well as a rather complex inner structure to hold the hub and tyre together. Its function is to allow the floor nozzle to freely move across the floor without damaging it.

**Figure S1.** Floor nozzle wheel intact (left) and with separate tyre and hub (right).

**Table S9** shows the comparison between the specific part requirements and the manufacturing capabilities of additive manufacturing. The design requirements that applied to the part were Shape, Detail, Accuracy & tolerances, Multi-material, Surface finish, Flexibility, Elasticity, and Abrasion resistance. The requirements that did not apply to this part were omitted from the table.

For this analysis, we made the following material choices:

- For SLA, we chose tough (ABS-like) and flexible (rubber-like) resin. We chose tough resin for the hub, because this is more sturdy than standard resin [2]. Also, we chose flexible resin for the tyre, because this resin can simulate rubber-like, soft-touch parts [2].
- For SLS, we chose PA12 and TPU. We chose PA12 for the hub, because this material is a versatile general purpose material [16]. Also, we chose TPU for the tyre, because this material is suitable for flexible soft-touch parts [16].
- For SLS, we chose ABS and TPU. We chose ABS for the hub, because this this filament is impact- and wear resistant at low cost [17]. Also, we chose TPU for the tyre, because this is a flexible material with good durability and abrasion resistance [17].

**Table S9.** Floor nozzle wheel - analysis of part requirements and assessment of their feasibility for SLA, SLS, and FDM printing.

| **Part requirements** | | **Manufacturing capabilities** | | |
|---|---|---|---|---|
| Original material: PP + LDPE | | **SLA**<br>Tough (ABS-like*) + flexible (rubber-like*) resins | **SLS**<br>PA12 + TPU | **FDM**<br>ABS + TPU |
| Shape | The wheel hub has some cavities in between the strengthening ribs, and overhang/bridging on one side as it has a middle plane. The tyre has considerable overhang, but this is supported by the wheel hub (see Multi-material). | The bridging distance of the middle plane cannot be printed without support, and removing support could be difficult. | The cavities and bridging of the wheel hub are all supported by the unsintered powder, which can be removed easily after printing. | The bridging distance of the middle plane can be printed without support. Soluble support could be used to get a more structurally sound part with a better finish, as removing standard support will be difficult. |
| Detail | The wheel hub has some semi-thin ribs (1.5 mm) and a hole (⌀ 3 mm) for the wheel axle. | All details are printable. | All details are printable. | All details are printable. |
| Accuracy & tolerances | The hole is connected to the metal axle with a transition fit (axle easy to push out, but wheel does not rotate on axle). | Required fit achievable with printing accuracy (Industrial SLA: ± 0.15%/± 0.01 mm) | Required fit more difficult to achieve with printing accuracy (SLS: ± 0.3%/± 0.3 mm) | Required fit more difficult to achieve with printing accuracy (Industrial FDM: ± 0.15%/± 0.2 mm). The recommended printing orientation is with the hole along the Z-axis for a more accurate hole shape. |
| Multi-material | The wheel has a rigid wheel hub and a flexible tyre, which are connected via an interlocking shape. | For SLA, multi-material printing is not possible. Considerable redesign of the two components is needed to be able to fit them together after printing, or to merge them into a mono-material part. | For SLS, multi-material printing is not possible. Considerable redesign of the two components is needed to be able to fit them together after printing, or to merge them into a mono-material part. | For FDM, multi-material printing is possible. The printed part can use the original interlocking design, possibly with some minor adjustments to optimize it for FDM printing. |
| Surface finish | The wheel hub has a smooth surface finish so the metal axle can be slid in without too much friction. The tyre requires a soft-touch finish to prevent damage to the floor and to provide the right friction (see also Elasticity). | Both smooth and soft-touch finish is possible. | For the hub, the standard finish of SLS is grainy, but this will likely still be smooth enough to slide in the axle. Soft-touch finish of tyre is possible. | The standard finish of FDM is rough due to layer lines, but this will likely still be smooth enough to slide in the axle. Soft-touch finish of the tyre is possible. Additional post-processing could be used to remove the visible layer lines if needed. |
| Elasticity | A compressible rubber-like material is required to create additional friction. | For SLA, it is possible to print rubber-like materials with low hardness. | For SLS, it is possible to print rubber-like materials with low hardness. | For FDM, it is possible to print rubber-like materials with low hardness. |
| Impact resistance | The wheel should have reasonable impact resistance to withstand | Tough resin should be resilient enough to handle the impact | PA12 should be resilient enough to handle the impact forces that can be | ABS should be resilient enough to handle the impact forces that can be |

| | | | | |
|---|---|---|---|---|
| | shocks and impact during use. | forces that can be expected, especially with the tyre around it. | expected, especially with the tyre around it. | expected, especially with the tyre around it. |
| Abrasion resistance† | The tyre needs high abrasion resistance so it does not wear down during use. | Needs testing to verify abrasion resistance of the material over time. | Needs testing to verify abrasion resistance of the material over time. | Needs testing to verify abrasion resistance of the material over time. |
| **Major part requirement(s)** | The tyre needs to have good abrasion resistance to prevent the it wearing down during use. Also, a soft-touch surface is needed to ensure the wheels do not damage the floor and provide the right friction. This friction is important to prevent the floor nozzle slipping over smooth floors during use. | | | |
| **Concluding remarks** | The two materials (soft and rigid) have different functional requirements, which makes the part more complex to print. Either a multi-material or multi-component part is needed, or it should be investigated whether it is possible to redesign the part into a mono-material part. Here, it is important to ensure that the hub will still have enough grip on the axle, and that the hole is not stretched over time due to the large friction forces on the wheel. | | | |

* SLA resins are thermosets but often characterized as "thermoplastic-like", e.g., durable resins are "PP-like".
† Insufficient data in Table 4 to conclude.

## S.10 Floor nozzle wheel suspension frame

The floor nozzle wheel suspension frame is located at the underside of the floor nozzle. It is clicked into the underside of the floor nozzle with two snap fits (interference fit). On the other end, a metal axle holding the wheel can be mounted with a freely rotating clearance fit. It is a small, triangular part, made from PTFE (also known as Teflon). It has two snap fits on one end, and a hole on the other. Its function is to connect the wheel to the floor nozzle.

**Figure S2.** Floor nozzle wheel suspension frame

**Table S10** shows the comparison between the specific part requirements and the manufacturing capabilities of additive manufacturing. The design requirements that applied to the part were *Shape, Detail, Accuracy & tolerances, Surface finish, Strength, Flexibility, Impact resistance, Abrasion resistance*, and *Fatigue resistance*. The requirements that did not apply to this part were omitted from the table.

For this analysis, we made the following material choices:

- For SLA, we chose durable (PP-like) resin , because this resin is most suitable for making snap-fits [18].

- For SLS, we chose PA11, because this material is ideal for more ductile applications such as snap-fits [19].
- For FDM, we chose nylon , because this material has good strength and strain resistance, which makes it more suitable for snap-fits [18,20].

**Table S10.** Floor nozzle wheel suspension frame - analysis of part requirements and assessment of their feasibility for SLA, SLS, and FDM printing.

| **Part requirements** | | **Manufacturing capabilities** | | |
|---|---|---|---|---|
| Original material: PTFE (Teflon) | | **SLA**<br>Durable (PP-like*) resin | **SLS**<br>PA11 | **FDM**<br>Nylon |
| Shape | The suspension frame has some overhang and a minor cavity. | The part is printable, and the support and leftover resin should be easy to remove. | The part is printable, and the support and leftover powder should be easy to remove. | The part is printable, and the support should be easy to remove, especially with water soluble support. |
| Detail | The suspension frame has some semi-thin walls (2 mm), two thin snap fits (1 mm), and one boss with a hole (roughly ⌀ 3 mm) for wheel axle. | All details are printable. | All details are printable. | All details are printable, but the printing orientation of the snap fits should be optimized. |
| Accuracy & tolerances | The suspension frame has a clearance fit with the wheel axle, and a snap fit with the floor nozzle bottom. | The required fits can be achieved with the printing accuracy of industrial SLA (±0.15%/± 0.01 mm). | The required fit for snap-fits might be more challenging to achieve with the printing accuracy of SLS (± 0.3%/± 0.3 mm). | The required fit for snap-fits might be more challenging to achieve with the printing accuracy of industrial FDM (± 0.15%/± 0.2 mm). |
| Surface finish | The snap fits need a smooth finish for easy assembly. | SLA parts have a smooth surface finish after general post-processing. | SLS parts have a grainy surface finish after printing. Likely, the snap fits need more extensive post-processing to achieve the correct smoothness. | FDM parts have a rough, layered surface after printing. Likely, the snap fits need more extensive post-processing to achieve the correct smoothness. |
| Strength | The snap fits need high flexural strength during assembly of the part, but the part is not often (dis)assembled. | Needs testing to verify the mechanical performance of the snap fits. | Needs testing to verify the mechanical performance of the snap fits. | Needs testing to verify mechanical performance of the snap fits. The printing orientation is important, as snap fits will break off easily if printed along the Z-axis. |
| Flexibility | The snap-fits need semi-rigid flexibility to be able to hold shape after multiple (dis)assemblies. | Needs testing to verify the mechanical performance of the snap fits. | Needs testing to verify the mechanical performance of the snap fits. | Needs testing to verify mechanical performance of the snap fits. The printing orientation is important, as snap fits will break off easily if printed along the Z-axis. |
| Impact resistance | The suspension frame needs general impact strength during use. | Needs testing to verify the mechanical performance of the snap fits. | Needs testing to verify the mechanical performance of the snap fits. | Needs testing to verify mechanical performance of the snap fits. |
| Abrasion | The snap fits need general | Needs testing to verify | Needs testing to verify | Needs testing to verify |

| | | | | |
|---|---|---|---|---|
| resistance† | abrasion resistance to withstand wear during multiple (dis)assembly cycles. | the mechanical performance, but durable resin has good wear resistance and should suffice. | the mechanical performance, but PA11 has good wear resistance and should suffice. | the mechanical performance, but nylon has good wear resistance and should suffice. |
| Fatigue resistance† | The snap fits need general fatigue resistance to withstand multiple (dis)assembly cycles. | Needs testing to verify the mechanical performance of the snap fits, depending on the number of expected (dis)assembly cycles. | Needs testing to verify the mechanical performance of the snap fits, depending on the number of expected (dis)assembly cycles. | Needs testing to verify the mechanical performance of the snap fits, depending on the number of expected (dis)assembly cycles. |
| **Major part requirement(s)** | The flexural strength and semi-rigid flexibility required by the snap-fits are very important to ensure that the part can be assembled correctly. It depends on the number of expected (dis)assembly cycles how high the required strength and semi-rigid flexibility should be. If a high number of (dis)assembly cycles is expected, fatigue and abrasion resistance could become more prominent requirements. | | | |
| **Concluding remarks** | The required flexural force and fatigue resistance for the snap-fits will be challenging to replicate for most printing methods, especially for FDM due to the anisotropy of the printed parts. | | | |

* SLA resins are thermosets but often characterized as “thermoplastic-like”, e.g., durable resins are “PP-like”.

† Insufficient data in Table 4 to conclude

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