Microswitch bracket's function and current existing designs

Function microswitch bracket: The bracket has mainly two functions. One is to provide a secure and safe stopping point for the machine's carriage while also securely holding in place a microswitch in a position which allows the carriage to activate it when it stops as to initiate a subsequent operation of the machine.

Z-shaped brackets: A Z-shaped bracket is – as the name might suggest – a sheet metal bracket that is in the shape of the letter Z. Said bracket can be a great example and starting point for the microswitch bracket that is required as with this type of bracket, two different items can be easily mounted (rubber-pad + microswitch) at different distances and lengths, which can be optimal for the situation as to adjust distances of the pad and switch perfectly.

Traditional microswitch bracket: There is one commonly seen design for microswitch brackets that various manufacturers use. Said design has a flat surface where the microswitch is mounted and a perpendicular to said surface is an extending edge that can be used for holding the bracket in place. A similar design can be used to optimal place the microswitch so that the carriage only slightly touches it.

Health and safety

For Die/Sand casting: molten material should be delivered through a launder system rather than by ladle. Also, material need to be dried before being melted as water residue could lead to explosions due increased pressure due to water vapor.

For SLM: workers must wear respiratory masks when handling the powder to prevent accidental inhalation.

All processes: LEV machines need to be setup to extract toxic elements in the surrounding area (Airborne powder for SLM and oil vapor for Die/Sand casting).

Product: The edges should be rounded to prevent accidental cuts. The rubber pads need to have sufficient shock absorption relative to the carriage's momentum. Additionally, the micro-switch should be places so that the carriage only touches the switch rather than hitting the body as to not damage it.

User: No major user safety concerns, simply do not interact with the bracket when the machine is running as to not get hit by the carriage

Potential manufacturing processes

Sand casting:

A sand made with the shape of the product is created and molten metal fills the mold. After hardening, the metal – in the shape of the product – is extracted by breaking the mold.

Reasons to use for bracket's production:

- Very cheap capital and production costs
- Decent production rate
- Very little waste
- No quantity requirements

Drawbacks specific to the bracket:

- High capital and production costs
- Initial atomization process is needed
- Prone to warping
- Slow production rate

SLM printing:

An additive manufacturing process where powder is gradually laid over one another. Between layering, a laser traces the geometrical shape of the product through a CAD model then melts and joins the powder

Reasons to use for bracket's production:

- Very little waste is produced
- Threads can be directly added
- Negligible porosity; strong parts

Drawbacks specific to the bracket:

- High capital and production costs
- Initial atomization process is needed
- Prone to warping
- Slow production rate

Die Casting:

In die casting processes, molten material is shot into a metallic mold with the shape of the required piece. Once the material hardens, the mold is opened, and the product is extracted

Reasons to use for bracket's production:

- Extremely fast production speed
- Low product porosity; high strength
- Retains mechanical properties

Drawbacks specific to the bracket:

- Very long lead time
- Limited choice of material
- Expensive capital
- Threads need to be made separately.

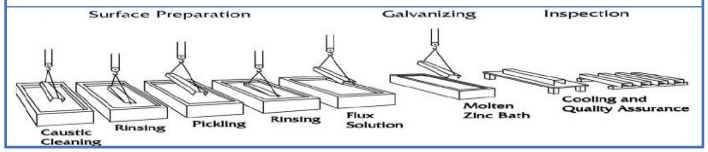
Process of choice: From the states processes, the one that would be chosen is sand casting. Since said brackets are created alongside machines and only for one section, then the required production rate is not particularly fast. As such, its better to save costs through sand casting's cheap capital and production costs. SLM's accuracy and design freedom is not needed for such a simple product and Die Casting's speed and very high strength is also not needed for the same stated processes.

Finishing techniques

Machining (For sand casting): *Because of the high tolerances in sand casting, the final product would be machined so that any inaccuracies are adjusted before the final product is given to the consumer.*

Normalizing (For SLM and Die casting): *In SLM and CNC milling, the material undergoes a lot of thermal stress, causing residual stress on the product, making it weaker. To counteract this, normalizing is done, the metal is heated to a given temperature point, held at that temperature, and then is allowed to cool naturally at either room temperature or outside. This alleviates said residual stresses and toughens up the metal.*

Galvanizing (All processes): *This involves repeatedly dipping and rinsing the material from molten zinc, a rust resistant material, therefore making the material rust-resistant, something that is needed for all the mentioned processes as they all use mild steel, a material with a lot of iron, and therefore can easily rust.*



Sustainability

Raw material: *Aluminum in terms of overall quantity on Earth is extremely abundant, making up approximately 8% of the earth's mast. However, since aluminum is almost never found in its pure form, but is rather extracted from its ore (known as Bauxite). Said extraction process is generally done through an electrolysis process which separates aluminum ion from the impurities. Although the extraction methodology might not be deemed sustainable, relative to the overall quantity and for the purpose of simply manufacturing the bracket, it can be said that the raw material is sustainable.*

Design: *To create a sustainable design, the overall strength of the product needs to withstand the potential constant hits from the machine's carriage. In order to do so, the walls of the design need to be thick as to not break easily. Moreover – as stated in the product safety section – the microswitch should be located in a position where the carriage simply touches the switch rather than hits its body as to not damage it. Additionally, both the rubber pads and micro-switch should be easily removable and replaceable in that either of them gets extremely damaged and is unusable as replacing the entire bracket would be inefficient.*

Manufacturing recyclability: *When it comes to SLM, faults during the printing process means that the material would need to go through the atomization process once again. However, this already is a necessary step for raw materials during the lead time process. Considering that, simply atomizing the faulty batch should not be an issue given that logistic expenses are not severe. All the same, material wastage in sand/die casting processes can simply be remelted within the same facility given that the faulty piece has been dried initially for safety concerns as mentioned in the H&S section.*

Material properties and requirements

Material requirements

- ***Should decently resist damage*** → *Increases longevity and prevents damage caused by impacts from the carriage. (high priority)*
- ***Cheap*** → *The bracket is relatively small aspects of the machine's component and a rather simple product. As such, it should not take up a significant share in the machine's costs. (High priority)*
- ***Easily machinable*** → *As specific tools would not be required in order to accommodate for specific machining requirements, therefore decreasing overall cost. (medium priority)*

Material properties

- ***Good compressive strength*** → *This property is important due to the requirements of resisting damage. Compressive strength was specified as the damage caused by the carriage would be in the form of compressive stress.*
- ***Should be hard*** → *The bracket should not bend nor deform due to hits as that would significantly effect its functionality and could lead to major failures. This contradicts the machinability requirements but it's a worthy tradeoff considering damage resistance's priority is higher than that of machinability.*

End-of-Life recyclability: *Since aluminum is a metal that does not rust nor does it corrode easily, if the bracket were to be severely damaged, recycling the material through a melting and reshaping process should not be a concern. The same could be said about the rubber pads considering rubber – in most forms – is a thermoplastic polymer.*