### Everything you need to know about machine tooling your first product





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Reading time 24 mins

#### **Key Points**

- Machine tooling is the process of designing, cutting, shaping, and forming materials that will be used to produce parts and components.
- When produced and used incorrectly, tooling results in suboptimal parts, which significantly impact product quality and are costly in terms of machine downtime, wasted materials, rejected samples, and tool replacements.
- The tool design process can be broadly divided into design and planning, material selection and preparation, machining, quality control and inspection, assembly and testing.
- Tool design, prototyping, and T1/T2 trials play pivotal roles in ensuring the efficiency and accuracy of the manufacturing process.
- Mould textures can be created on the surfaces of the mould to impart specific visual or tactile characteristics to the final products.
- Adopting a "metal safe" approach is essential to minimise machine tooling errors.
- When samples don't meet expectations, isolate the issue, find the root cause, make immediate corrections, re-test, and document the entire process.
- The choice between the UK and China for tooling manufacturing depends on various factors, e.g. quality and precision, intellectual property protection, cost-effectiveness, and scalability.

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Tooling in manufacturing, also known as machine tooling, is often referred to as the backbone of manufacturing industries – without it, products simply wouldn't exist. In the same way that you can't bake without a cake tin (or may need to have one specially made, depending on the complexity of the cake), tooling is the process of designing, cutting, shaping, and forming materials that will be used to produce parts and components.

When produced and used incorrectly, tooling results in suboptimal parts, greatly impacting product quality. When done correctly, well-made machine tooling speeds up manufacturing and is more economical. Are you looking for a manufacturing partner who can deliver the precision, expertise, and time management that quality tooling requires? Look at <u>our custom hardware design services</u> and <u>book a free consultation</u> with an expert on our team to explain what we can offer you.

Tooling in manufacturing has also been referred to as an Art and Science as it's an intricate dance of machining, shaping and perfecting components for various industries. In this guide, we'll delve deeper into this fascinating world and explain everything you need to know about the stages involved, the tool design and trial process, the differences between machine tooling in the UK and China, how to avoid costly errors and more.

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# The big-picture basics of the tool design process

Tool design in machine tooling is the art and science of crafting the perfect instrument for the job. Whether it's a lathe, milling machine, or a CNC (Computer Numerical Control) system, the tools used in machining are crucial and influence the quality and efficiency of the machining process.

Although tool design will naturally differ from one project to the next, the big-picture process basics will always remain the same:

- 1. **Define objectives:** Start by clearly defining the objectives of the tool. What is the tool intended to do? Understanding the purpose is fundamental.
- 2. **Material selection:** Choose materials that are compatible with machining materials. Consider factors like hardness, wear resistance, and heat resistance.
- 3. **Geometry and shape:** Design the tool's geometry and shape to suit the machining process. The tool's cutting edges, angles, and profiles should be carefully considered for optimal performance.
- 4. **Strength and rigidity:** Ensure the tool is strong and rigid enough to withstand machining forces without deformation. This is vital for precision and tool longevity.
- 5. **Cooling and lubrication:** Plan for cooling and lubrication systems to dissipate heat and reduce friction during machining, prolonging tool life.
- 6. **Safety:** Prioritise safety by incorporating features that protect operators from accidents, such as guards and safety interlocks.

- 7. **Cost efficiency:** Strive for cost-effective designs that minimise material waste, reduce machining time, and maximise tool life.
- 8. **Prototyping and testing:** Before full-scale production, <u>create a prototype and test</u> the tool's functionality and performance.
- 9. **Feedback and iteration:** Gather input from testing and real-world usage to make necessary improvements and iterate the design.
- 10. **Documentation:** Maintain detailed documentation of the tool's design, materials, and specifications for future reference and replication.

These big-picture basics are the foundation of the stages that machine tooling can be broadly divided into. Each step has unique challenges and time requirements.

**Design and planning:** The first stage of machine tooling is design and planning – or defining objectives. It involves conceptualising the product, creating detailed engineering drawings, and determining the materials and tools required. This stage can take anywhere from several days to several weeks, depending on the complexity of the project and the availability of resources.

**Material selection and preparation:** Once the design is finalised, the next step is to select the appropriate materials and prepare them for machining. This can involve cutting, welding, or casting, depending on the project's requirements. Material selection and preparation typically take a few days to a week.

**Machining:** This is the heart of machine tooling, as this is where the actual shaping and cutting of materials occur. This stage can be further broken down into processes like turning, milling, drilling, and grinding, each with its own unique timeline. The time required for machining depends on factors such as the complexity of the part, tolerances, and the type of material. Simple components may be machined in a few hours, while complex parts may take several days or even weeks.

**Quality control and inspection:** Ensuring the precision and quality of machined components is crucial. Quality control and inspection involve measuring tools like callipers, micrometres and coordinate measuring machines (CMMs) to verify that the finished parts meet the specified tolerances. This stage can take anywhere from a few hours to a few days, depending on the number of components and the required level of precision.

**Assembly and Testing:** In some cases, machined components are assembled into larger systems or products. This assembly process can range from a few hours to several days, depending on the complexity of the assembly. After assembly, testing and quality assurance procedures are carried out to ensure that the final product functions as intended.

### The finer details of machine tooling:

Once you can visualise the big picture and how the stages of tooling manufacturing fit together, you can focus on the finer details and practicalities of bringing new tool design into practical use. Within the realm of machine tooling, tool design and T1/T2 trials play pivotal roles in ensuring the efficiency

and accuracy of the manufacturing process. Tool design is what results in:

- Precision: The design of a tool directly influences its accuracy. A well-designed tool ensures that the desired cuts, shapes, and finishes are achieved with consistency.
- Efficiency: Efficient tool designs reduce waste, minimise downtime, and enhance the overall productivity of the machining process.
- Tool life: The right tool design can extend the lifespan of cutting tools, reducing maintenance costs and tool replacement frequency.
- Material compatibility: Tools must be designed with the specific material to be machined in mind. Proper tool design ensures compatibility with the material's properties, such as hardness and brittleness.
- Safety: Designing tools with safety in mind minimises the risk of accidents and injuries during machining operations.

#### T1 Trials: Prototyping and Validation

T1 trials, also known as Tool Tryout or First Article Inspection, are the first crucial steps in bringing a new tool design into practical use. During the T1 trial phase, you'll conduct:

- Prototyping: The initial tool design is used to create a prototype or sample part. This
  prototype serves as a proof of concept to test the tool's functionality and its ability to
  meet design specifications.
- Validation: The machined prototype is rigorously inspected and measured to verify whether it meets the desired tolerances and surface finish. Any deviations or issues are noted and addressed.
- Adjustments: Based on the results of the T1 trials, adjustments are made to the tool design, if necessary. This can involve modifying tool geometry, feed rates, or cutting parameters.

#### T2 Trials: Fine-Tuning and Optimisation

Once the T1 trials have been completed, the tool design undergoes further refinement in the T2 trial phase:

- Fine-Tuning: The tool design is fine-tuned to address any issues or shortcomings identified during the T1 trials. This might involve adjusting tool angles, coatings, or other parameters.
- Optimisation: Cutting parameters, such as cutting speed, depth of cut, and feed rate, are optimised to achieve the best possible results in terms of efficiency and quality.

• Testing: Multiple samples are machined using the refined tool design and optimised parameters. These samples are subjected to rigorous testing to ensure that they consistently meet the required specifications.

By emphasising the importance of tool design and the meticulousness of T1 and T2 trials, your manufacturers and engineers can achieve the highest levels of quality and efficiency in their machining processes, ultimately delivering superior machined samples and components to your customers.

### Mould textures and surface finishings

Mould textures in machine tooling refer to the specific surface finishes or textures applied to the cavity or core of a mould used in various manufacturing processes, such as injection moulding, blow moulding, or die casting. These textures are not added to the mould itself but instead created on the surfaces of the mould to impart specific visual or tactile characteristics to the final products.

#### Purpose of mould textures:

- Aesthetic appeal: They enhance the visual appearance of the final product by creating unique surface patterns, such as wood grain, leather texture, or fine stippling, which can mimic natural materials or provide decorative effects.
- Functional properties: Some textures are designed to serve operational purposes, such as reducing friction, improving grip, or facilitating the release of the moulded part from the mould cavity.
- Hiding imperfections: Textures can help hide flaws or blemishes on the moulded surface, making them especially useful in applications where cosmetic appearance is critical.

#### When are mould textures applied?

Mould textures are typically added during the mould design and manufacturing process before the mould is used for production. The specific stage at which they are applied may vary depending on the manufacturing method and the complexity of the mould:

- Mould design: The initial design phase is where the decision to include texture is made. Texture patterns and specifications are determined, and the mould design is modified accordingly.
- Mould machining: If the mould is machined from a solid block of metal, the texture patterns can be created directly on the mould's surfaces during the machining process. This is done using specialised tooling, such as engraving or etching tools.

- Surface treatment: In some cases, moulds are created using surface treatments after machining. This may involve techniques like chemical etching, EDM (Electrical Discharge Machining), or laser texturing to create the desired surface finish.
- Texture insert or overlay: For more complex and intricate textures, it may be more practical to use texture inserts or overlays that can be added to the mould surface. These inserts are designed separately and can be attached to the mould as needed.
- Testing and refinement: After the initial application of textures, the mould may go through testing and refinement stages to ensure that the surfaces meet the desired specifications and quality standards.

It's important to note that the choice of mould texture and its application depends on the specific requirements of the product being manufactured. Different industries and applications may have unique texture preferences to achieve the desired appearance and functionality.

# Errors in machine tooling and how to avoid costly mistakes

In the world of machine tooling, precision and accuracy are paramount. Any mistakes or errors in the process can result in costly and far-reaching consequences. Here are some of the costs associated with these errors:

- 1. **Material waste:** Precision machining often involves expensive materials like highgrade metals. Mistakes can lead to excessive material wastage, significantly increasing production costs.
- Machine downtime: When errors occur, machines may need to be taken offline for troubleshooting, repairs, or adjustments. This downtime results in lost production hours and potential missed deadlines.
- Rejection and rework: If the machined samples don't meet the required specifications, they may be rejected or require rework. This not only adds to production time but also increases labour costs.
- Tool replacement: Errors can lead to premature wear and damage to cutting tools, necessitating their replacement sooner than expected, which can be a significant expense.
- 5. **Quality repercussions:** Mistakes in machine tooling can tarnish a company's reputation for producing high-quality products, potentially resulting in the loss of

### Being metal safe: preventing errors

In machine tooling, the term "metal safe" or "metal on/metal off" emphasises the importance of avoiding metal-to-metal contact, particularly between cutting tools and the workpiece being machined. Being "metal safe" is crucial to prevent damage to both the cutting tools and the workpiece while ensuring the quality and precision of the machining process.

**Metal On (or Tool On):** When referring to "metal on," it means that the cutting tool should be in contact with the workpiece during the machining operation. This contact is necessary for the tool to remove material shape and create the desired features on the workpiece.

**Metal Off (or Tool Off):** Conversely, "metal off" signifies that the cutting tool should not make unnecessary or unintended contact with the workpiece or other metal surfaces. Metal-to-metal contact, especially unintended or excessive contact, can result in various issues.

Actions that can be implemented in the workspace to avoid damage or injury:

**Prevent tool wear:** Excessive metal-to-metal contact can lead to accelerated wear and damage to the cutting tools. Tools may become dull or chipped, reducing their effectiveness and requiring more frequent replacement.

**Minimise workpiece damage:** Unintended metal-to-metal contact can cause surface imperfections, scratches, or burrs on the workpiece. This can compromise the quality and appearance of the finished product.

**Maintain precision:** Maintaining a proper gap or clearance between the cutting tool and the workpiece is essential for achieving precise machining results. If the tool gets too close, it can result in dimensional inaccuracies.

**Avoid machine damage:** Metal-to-metal contact can also damage the machine itself, particularly the spindle, tool holder, and other components. This can lead to costly repairs and downtime.

**Be thorough:** Plan meticulously, including tool selection, machine setup, and cutting parameters. Comprehensive planning can reduce the risk of errors.

**Prioritise quality control:** Implement stringent quality control measures at every stage of machining to catch errors early and prevent them from compounding.

**Employee training:** Ensure that operators are well-trained in machine operation, tool handling, and quality inspection to minimise human errors.

**Regular maintenance:** Maintain machines and tools regularly to prevent unexpected breakdowns or errors caused by wear and tear.

To ensure `metal safe' machining, operators and machinists must carefully set up the machining process, including tool offsets, toolpath programming, and clearance values. CNC (Computer Numerical Control) machines, which are prevalent in modern machining, rely on precise toolpath

programming to maintain a safe distance between the tool and the workpiece.

Additionally, tool selection and toolpath strategies should be chosen to minimise the risk of metal-tometal contact. Proper tool geometry, tool coatings, and cutting parameters are also crucial to maintaining a metal-safe environment.

To minimise errors in machine tooling, adopting a "metal safe" approach is essential. This means carefully controlling and monitoring the interaction between the cutting tools and the workpiece to prevent damage, ensure precision, and maintain the overall integrity of the machining process.

### What to do when samples aren't right

Even with the best precautions, there may still be instances when samples don't meet expectations. Here are some recommendations for what to do if/when that happens:

- 1. **Isolate the issue:** Identify the specific aspect of the sample that doesn't meet specifications. Is it a dimensional issue, surface finish, or another factor?
- 2. **Root cause analysis:** Investigate the root cause of the problem. Was it a design flaw, tooling issue, or machine error?
- 3. **Immediate corrections:** If the issue is identified, make immediate corrections to the process. This might involve adjusting cutting parameters, tool selection, or even redesigning the tool.
- 4. **Re-testing:** After corrections, re-test the process and the sample to ensure that the issue has been resolved.
- 5. **Documentation:** Document the entire process, including the issue, corrective actions, and results. This documentation is valuable for future reference and continuous improvement.

# The cost-benefit of tooling in the UK vs. China

The choice between the UK and China for tooling manufacturing depends on various factors, including your specific needs, cost considerations, quality requirements, lead times, and strategic goals. Both countries have their own advantages and disadvantages in the field of tooling manufacturing, and your decision should be based on a careful assessment of these factors. Here's a comparison to help you make an informed decision:

### Why choose the UK for tooling manufacturing

- Quality and Precision: The UK is known for its high-quality manufacturing and precision engineering. We have a strong tradition of craftsmanship and adherence to strict quality standards, work ethics, and labour laws, making us a reliable choice for precision tooling.
- 2. **Proximity to markets:** If your primary market is in Europe, the UK offers proximity, reducing shipping times and costs compared to countries outside the EU.
- 3. **Intellectual Property Protection:** The UK has robust intellectual property protection laws, which can be advantageous if your tooling involves proprietary technology or designs.
- 4. **Communication:** Language and cultural similarities make communication easier for businesses based in English-speaking countries, including the United States.
- 5. **Shorter Lead Times:** Proximity to European markets can result in shorter lead times, especially for customers within the EU.

# Challenges of tooling manufacturing in the UK

- 1. **Higher labour and operational costs:** The cost of labour and overall operating costs in the UK tend to be higher compared to countries like China, which can impact the cost-effectiveness of tooling production.
- 2. **Limited capacity:** The UK may have limited manufacturing capacity, especially for large-scale tooling projects, which could result in longer lead times.
- 3. **Limited specialisation:** While the UK excels in precision engineering, it may not offer the same level of specialisation in certain types of tooling as China, which has a more extensive industrial base.

# Advantages of choosing China for tooling manufacturing:

- 1. **Cost-effective manufacturing:** China is known for its cost-effective manufacturing, offering competitive labour and operational costs, which can lead to significant savings for large-scale tooling projects.
- 2. **Wide Range of Capabilities:** China has a vast and diverse industrial base, which means that you can find specialised manufacturers for a wide range of tooling types, including high-volume production.
- 3. **Scalability:** China's manufacturing ecosystem is highly scalable, making it suitable for projects of various sizes, from small runs to large-scale production.
- 4. **Lower material costs:** China often offers access to raw materials at a lower price, which can contribute to cost savings.

### **Challenges of manufacturing in China**

- 1. **Quality control:** Ensuring consistent quality and adherence to specifications can be a challenge in China, and it may require close oversight and quality control measures.
- 2. **Lead times:** Longer lead times may be a concern when shipping tooling and products from China, especially if your primary market is outside of Asia.
- 3. **Intellectual property concerns:** Intellectual property protection can be a concern in China, so it's essential to have proper legal safeguards in place.

The choice between the UK and China for tooling manufacturing depends on your specific needs, budget, and priorities. In addition, if factors such as reducing your product's carbon footprint and environmental impact are important to you, manufacturing closer to home could also be a deciding factor. Ultimately, it's crucial to conduct thorough due diligence, consider all relevant factors, and <u>explore a combination of both options with a local manufacturing partner</u> who is better placed to help you meet your tooling manufacturing requirements.

### The Art & Science of Machine Tooling:

### **Concluding Tips**

Machine tooling is a meticulous and time-consuming process that plays a vital role in the manufacturing industry, and we hope that this guide has given you both a broad and in-depth understanding of what this process entails.

Each stage of machine tooling, from design and planning to assembly and testing, requires careful consideration and expertise. Because the time needed for each step can vary widely depending on the complexity of the project and the materials involved, it's essential that you work with experienced manufacturing partners to save time.

By recognising the intricate dance and connected interplay of these stages, project managers, product engineers, and manufacturers can make informed decisions to optimise processes, meet deadlines and deliver high-quality products.

Are you ready to take tooling to a new level? Contact us to schedule a free consultation and discover how our state-of-the-art technology and years of industry experience can elevate your precision, efficiency, and productivity – ensuring you achieve the highest quality results every time!

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### FAQ's

### What is tooling in the manufacturing process?

Tooling refers to the process of designing and engineering the tools that are required for manufacturing parts or components. This process includes various stages such as tool design, validation trials like T1 and T2, and making necessary adjustments before mass production begins.

### What does the tooling stage encompass?

The tooling stage covers several key phases, including the initial design of the tool, T1 and T2 trials for validation, adjustments based on the trials, and the addition of mould textures. It's a comprehensive approach to ensure that the tool is effective and precise for mass production.

### Why is the tooling process important?

The tooling process is vital for manufacturing as it lays the foundation for the production of parts or components. Proper tooling ensures precision, efficiency, and quality in the final product. Errors in this process can have costly repercussions down the line.

### How long does each stage of the tooling process take?

The duration of each stage in the tooling process can vary, but generally, tool design can take a few weeks, while T1 and T2 trials might take another few weeks each. If samples are not quite right, this can introduce additional time for corrections.

#### What are T1 and T2 trials in the tooling process?

T1 and T2 trials are validation stages within the tooling process. T1 is usually the first test run for tooling and helps identify initial issues. T2 follows with further refinements, ensuring that the tool meets all specifications and quality standards.

#### When are mould textures added in the tooling process?

Mould textures are generally added after the T2 trials and before final production. This is to ensure that the tooling is correct and the texture will not introduce complications or imperfections in the final product.

#### Which is better for tooling, the UK or China?

Both the UK and China have their pros and cons for tooling. The UK is often associated with highquality tooling and quicker communication but may have higher costs. China offers cost-effectiveness but may have longer lead times and potential quality issues.

#### Who is responsible for correcting mistakes in the tooling process?

Generally, it's the responsibility of the tooling engineer or the tooling department to correct mistakes. Errors in tooling can be costly, both in terms of time and finances, so it's crucial for the team to rectify these as soon as possible.

### What happens when samples from the tooling process aren't quite right?

When samples are not up to spec, the tooling process goes back to the drawing board for revisions, which could be minor adjustments or a significant redesign. This extends the timeline and may increase costs.

### How are tooling errors handled in terms of cost?

The cost of mistakes in tooling can be significant and is generally absorbed by the company or passed onto the client in the form of delayed delivery or increased costs. Being 'metal safe' can reduce the impact of these errors.

### What does 'metal safe' mean in the tooling process?

Being 'metal safe' means designing the tool in a way that allows for easier adjustments, especially in the removal of metal, to correct errors. This approach makes it less costly to make changes later in the process.

### Why do tooling processes use trials like T1 and T2?

Trials such as T1 and T2 are used to validate the tool design and functionality before entering production. They help identify any flaws or inefficiencies early on, saving time and money in the long run.

### How is tool design different from the actual tooling process?

Tool design is the initial stage where the tool's specifications, dimensions, and functionalities are determined. The actual tooling process involves creating the tool based on this design and then running it through trials to validate its effectiveness.

### When is the best time to add mould textures in tooling?

The ideal time to add mould textures is after the validation trials but before mass production begins. This ensures that the textures do not introduce complications and are consistent with the final product's quality.

#### Which stages are involved in the tooling process?

The key stages in the tooling process typically include tool design, T1 and T2 trials, and the addition of mould textures. After these stages are successfully completed, mass production can commence.

#### Who is typically involved in the tooling process?

Various professionals, such as tooling engineers, designers, and production staff, are involved in the tooling process. Each has a specific role, such as designing the tool, conducting trials, or overseeing production.

#### What should be done if the T1 trial results are unsatisfactory?

If the T1 trial results are not up to par, revisions to the tool design or adjustments to the tool itself are required. This could set back the timeline and necessitate further validation through additional trials.

#### How do you decide between T1 and T2 trials?

T1 is the first validation stage and helps identify glaring issues. If the T1 trial is successful and only minor adjustments are needed, the process moves to the T2 trial for further refinement and final validation.

#### When is 'metal on/metal off' relevant in the tooling process?

The 'metal on/metal off' concept is most relevant when adjustments are needed, particularly when being 'metal safe'. It refers to whether metal needs to be added or removed to correct any mistakes,

with 'metal off' being more manageable and cost-effective.

### Which factors influence the cost of the tooling process?

The complexity of the tool design, the materials used, and the number of validation stages like T1 and T2 trials are significant factors that influence the cost. Errors and required adjustments can also add to the expenses.

### Who bears the cost when mistakes are made in the tooling process?

The burden of the cost usually falls on the client, although this could be negotiated with the manufacturer depending on the terms of the contract. Mistakes can lead to delays and extra expenses, affecting the overall budget.

### What is the significance of being 'metal safe' in terms of cost?

Being 'metal safe' can mitigate the financial impact of errors in the tooling process. By allowing for easier metal removal during adjustments, this approach can save time and reduce the cost associated with tool modifications.

### How long should the tool design stage take in the tooling process?

The tool design stage usually takes a few weeks, depending on the complexity of the tool and the specific requirements of the project. This stage is crucial for setting the groundwork for the subsequent phases and ensuring a smooth tooling process.

### When should you expect the first samples from the tooling process?

First samples are generally produced after the T1 trial, which comes after the tool design stage. The time can vary, but you could expect samples several weeks into the tooling process, assuming there are no significant delays.

### How long do T1 trials usually take?

T1 trials can vary in length but generally take a few weeks to complete. This includes the time for setting up the trial, running the tests, and evaluating the results to ensure that the tool meets the initial specifications.

### What is the typical duration for T2 trials in the tooling process?

T2 trials usually take a similar amount of time as T1 trials, perhaps a few weeks. The process involves more refined testing and often multiple iterations to confirm the tool's quality and readiness for production.

### How much time should be allocated for adjustments if samples aren't right?

If samples require adjustments, this could add a few more weeks to the tooling timeline. The exact time depends on the nature and extent of the changes needed.

### When should mould textures be added to avoid delays?

Mould textures should be added after the T2 trials and before the onset of mass production to avoid delays. Planning for this in advance can help ensure that it doesn't elongate the overall timeline.

#### How long does it take to rectify a mistake in the tooling process?

The time required to correct a mistake can vary significantly depending on the nature of the error. Minor adjustments may take a week or two, while more significant issues could add several weeks to the process.

#### What is the average duration of the entire tooling process from

### design to production?

The entire tooling process can span several months, from initial design to full-scale production. The timeline includes design, T1 and T2 trials, sample evaluations, and any necessary adjustments.

#### When is it too late to make adjustments in the tooling process?

Making adjustments becomes increasingly difficult and costly as you move closer to the production stage. It's generally considered too late to make significant changes once mass production has begun.

# How long should you expect the tooling process to take in the UK vs. China?

In the UK, you might expect a quicker turnaround due to closer communication and established quality standards, perhaps a few months, depending on complexity. In China, while often more cost-effective, the process could take longer due to extended lead times and potential quality checks.

### How much time does being 'metal safe' save in the tooling process?

Being 'metal safe' can save considerable time during the adjustment phase, potentially reducing the timeframe by a week or two. This approach allows for quicker and more efficient modifications to the tool.

# When is the best time to conduct cost assessments in the tooling process?

Cost assessments should be ongoing but are particularly crucial after the T1 and T2 trials. This is when any adjustments and their associated costs can be most accurately determined, helping to keep the project on budget.

### Which stage in the tooling process is most time-sensitive?

The trial stages, particularly T1 and T2, are often the most time-sensitive because they directly influence the rest of the timeline. Delays in these phases can push back production and increase costs.

### How long does it typically take to add mould textures to a tool?

The process of adding mould textures can take a week or two, depending on the complexity of the texture and the quality requirements. It's a critical step that adds to the overall timeline but is essential for the final product's quality.

### When should you expect to start mass production after the tooling process?

Mass production generally commences after the successful completion of the T2 trials and the addition of mould textures. Depending on the project's complexity and any required adjustments, this could be several months into the process.

#### What does altering a tool involve if it is metal-safe?

If a tool is 'metal safe,' alterations generally involve removing small amounts of metal to adjust the tool's features or dimensions. This is typically a quicker and less costly process, as it's easier to remove metal than to add it back.

#### How is welding used in altering a tool?

Welding is often employed when a tool is not 'metal safe' and needs additional material for adjustments. In this method, the material is welded onto the tool, and then the welded portion is machined again to achieve the correct specifications.

### What does creating an insert involve in the tooling process?

Creating an insert involves engineering a separate piece that can be fitted into the existing tool. This is usually machined out to the required dimensions and is used when it's not feasible or cost-effective to alter the original tool itself.

# What is the difference between machining more out of the tool and creating an insert?

Machining more out of the tool removes material to make adjustments and is easier when the tool is 'metal safe.' Creating an insert, on the other hand, involves adding a new component to the existing tool and is more common when it's not possible or practical to remove material from the original tool.

#### What are the pros and cons of welding up a tool for alterations?

Welding up a tool can provide the additional material needed for making adjustments, but it is generally more time-consuming and costly. The welded areas also require careful machining to ensure that they meet the tool's original specifications.

#### What are the benefits of being 'metal safe' in tool alterations?

Being 'metal safe' allows for more straightforward adjustments through material removal, which is usually quicker and less expensive. This approach can help keep the tooling process on schedule and within budget.

#### What is the process of machining a piece again in tool alterations?

Machining a piece again involves removing or adding material to the tool to meet the correct specifications. This can be done either by directly machining the tool itself or by machining an insert that will be added to the existing tool.

### How does the choice of alteration method affect the tooling timeline?

The method of alteration, be it machining the tool, welding, or creating an insert, significantly affects the timeline. Direct machining when 'metal safe' is often quicker, while welding and insert creation can add weeks to the tooling process.

### What is the cost implication of using an insert for tool alteration?

Using an insert can be costly in terms of both materials and labour. It requires engineering a separate component and then fitting it into the existing tool, all of which adds to the overall cost of the tooling process.

# When is it more appropriate to machine more out of the tool instead of creating an insert?

Machining more out of the tool is generally more appropriate when the tool is 'metal safe' and minor adjustments are needed. It's usually quicker and less costly compared to creating an insert.

### How does being 'metal safe' affect the cost of tool alterations?

Being 'metal safe' often results in cost savings as it allows for easier adjustments through material removal. This avoids the need for more complex and time-consuming methods like welding or creating an insert, thus keeping costs lower.

### What is the typical process for creating an insert in tool alterations?

The typical process for creating an insert involves first identifying the area of the tool that needs adjustment. A separate piece is then engineered and machined to the required dimensions, after which it is fitted into the existing tool for further trials or production.

# What are the implications of choosing to weld up a tool for the overall tooling process?

Choosing to weld up a tool generally extends the timeline and increases the cost of the tooling process. It also adds complexity as the welded areas need to be carefully machined to ensure they meet the original specifications.

### What factors influence the choice of alteration method in tooling?

Factors such as the nature and extent of the required adjustments, whether the tool is 'metal safe,' and cost implications, all influence the choice of alteration method. Timeline considerations also play a significant role in this decision.

### How does the choice of alteration method impact the final product quality?

The alteration method can significantly impact the final product's quality. For instance, poorly executed welding or an ill-fitting insert could result in imperfections in the final component, affecting overall quality.

# What is the significance of being 'metal safe' in terms of tool longevity?

Being 'metal safe' can extend the tool's lifespan as it allows for easier adjustments over time. This adaptability can be particularly beneficial for long-term projects where the tool may need periodic modifications.

### How much should you expect the tooling process to cost?

The cost of the tooling process can vary widely depending on factors like the complexity of the tool, materials used, and the labour rates. In the UK, you could expect to pay more for higher quality and quicker turnaround, while costs may be lower but lead times longer in China.

### At what point do you select things like colour, material, and finish?

Colour, material, and finish are usually selected during the design stage but finalised after the T1 and T2 trials. This allows for any necessary adjustments based on the trial outcomes before proceeding to mass production.

### What kinds of finishes are there in the tooling process?

The finishes can range from high-gloss to matte and textured surfaces. Some common finishes include polishing, bead blasting, and chemical treatments, each offering different aesthetic and functional properties.

### How do you specify the colour you want in the tooling process?

Colour specifications often use standard colour codes, such as Pantone or RAL systems, to ensure uniformity. Providing a sample for colour matching is also common, especially for custom colours.

### How does transportation affect lead time for tooling products between the UK and China?

In the UK, delivery is usually by road, making it much quicker. When ordering from China, especially in large quantities, products are commonly shipped by boat, which can be considerably slower unless you opt for more expensive air freight.

### What are the cost implications of choosing different finishes in the tooling process?

Different finishes can vary significantly in cost. For example, a high-gloss finish might require more labour-intensive polishing, thus raising the cost. Textured finishes, meanwhile, could be less expensive but still meet certain functional requirements.

### How do you verify the colour and finish before mass production?

Samples produced after the T2 trials usually serve as the final verification for colour and finish. It's essential to closely inspect these samples to ensure they meet the specified requirements before proceeding to mass production.

# How does the choice of material affect the tooling process timeline?

Certain materials may require specialised machining or treatments, thereby affecting the timeline. For example, harder materials may take longer to machine, while softer materials might be quicker but require additional steps for durability.

### When should you finalise the choice of material in the tooling process?

The material choice should ideally be finalised at the design stage but certainly no later than the T1 trials. This ensures that any material-specific challenges can be addressed early in the process.

### What are the implications of choosing a specialised finish in terms of lead time?

Specialised finishes may require additional time for procurement and application, thereby extending the lead time. For example, unique chemical treatments or custom textures could add weeks to the tooling process.

### How do you ensure the chosen material is fit for purpose in the tooling process?

Material suitability is generally verified through the T1 and T2 trials, where the tool's performance and the resultant samples are rigorously tested. If the material proves to be inappropriate, adjustments can be made before mass production.

### How is colour consistency ensured throughout the tooling process?

Colour consistency is maintained through rigorous quality checks, often using standardised colour codes as a reference. Samples are typically reviewed to ensure they match the specified colour before proceeding to mass production.

# What are the logistics considerations when ordering tooling products from China?

When ordering from China, consider the time and cost implications of shipping. Sea freight is more economical but slower, often taking several weeks. Air freight is quicker but substantially more expensive.

### How do you estimate shipping times for tooling products from the UK and China?

In the UK, shipping times are generally shorter, often just a few days, as most goods are transported by road. From China, sea freight can take several weeks, while air freight may take about a week but at a higher cost.

### What are the quality assurance steps in the tooling process?

Quality assurance typically involves multiple checks throughout the tooling process, including during the T1 and T2 trials and final sample evaluation. Rigorous testing ensures the tool meets all design specifications and quality standards.

#### At what stage are mould textures usually finalised?

Mould textures are usually finalised after the T2 trials. This allows time for any adjustments based on the trial results and ensures that the textures are ready for mass production.

# What factors influence the choice of shipping method when ordering tooling products from China?

Factors like lead time requirements, cost considerations, and the size and weight of the shipment all influence the choice between sea and air freight when ordering from China.

### How do shipping considerations impact the overall cost of tooling?

Shipping can significantly impact the overall cost, especially when ordering from China. Sea freight, while more economical, has a longer lead time, whereas air freight, though quicker, can substantially increase the overall cost.

### What are the advantages of local sourcing for tooling products in the UK?

Local sourcing in the UK offers advantages like quicker delivery times, easier communication, and potentially higher quality standards. While often more expensive, the benefits may outweigh the cost, especially for complex or time-sensitive projects.

### How do you account for potential delays in the tooling process when ordering from China?

When ordering from China, it's wise to build in extra time for potential delays, whether due to shipping, quality checks, or unforeseen issues. This helps ensure that your overall project timeline remains on track.

### What is tooling in the context of injection moulding?

Tooling in injection moulding refers to the large metal mould, typically made of aluminium or steel, that forms the shape of the plastic part. The tooling is placed in an injection moulding machine, a large press that clamps the mould halves together. Hot molten plastic is then injected into the mould, and cooling channels help speed up the cooling process.

### Why is the tooling design so complex in injection moulding?

Tooling design for injection moulding is intricate due to various factors such as the flow of molten plastic, cooling uniformity, and points of entry into the mould. The complexity ensures that the finished product has the requisite strength and is free from defects. Hence, tooling design is considered an art requiring years of expertise.

### How does cooling play a role in the tooling process?

Cooling is critical in the tooling process to expedite the hardening of the plastic. Cooling channels circulate cold water through the mould, ensuring uniform cooling. Inadequate or uneven cooling can lead to weaker parts and visible defects, affecting the quality of the final product.

### Why is experience crucial for toolmakers in injection moulding?

Tooling design is an intricate process that takes years to master. Many toolmakers you encounter in this field are highly experienced and have spent considerable time perfecting their craft. Their expertise ensures the tooling process is executed efficiently and effectively, producing high-quality parts.

### How does the tooling process impact the strength and integrity of the final plastic part?

The tooling process directly affects the quality of the finished product. Factors like how the molten plastic flows, where it enters the mould, and how uniformly it cools are critical. Any shortcomings in these areas can result in parts that are weaker and may show defects.

### What are the common materials used for tooling in injection moulding?

In injection moulding, the most commonly used materials for tooling are aluminium and steel. Aluminium is often chosen for its excellent heat conductivity, facilitating faster cooling, while steel is known for its durability, especially for high-volume production.

### What kinds of expertise do toolmakers need to have?

Toolmakers in injection moulding need to be proficient in areas like material science, fluid dynamics, and thermal properties to design effective tooling. The complexity of the task necessitates a deep understanding of how molten plastic behaves and how to ensure uniform cooling.

### Why is the injection pressure so high in the tooling process?

High injection pressure in the tooling process ensures that the molten plastic fills the mould completely and uniformly. This is vital for producing a high-quality product, as insufficient pressure can lead to incomplete or flawed parts.

### What are the challenges associated with improper cooling during the tooling process?

Improper cooling during the tooling process can result in defects like warping, sink marks, or internal stresses in the plastic part. These defects compromise the part's structural integrity and can lead to failure in its intended application.

#### Why is tooling often considered an art form?

Tooling is often considered an art form because it requires a high level of expertise and creativity to solve complex challenges. Each mould is unique, requiring a tailored approach to ensure optimal flow, cooling, and ultimately, product quality. The expertise involved often takes years to acquire and perfect.

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