A METALCUTTING WHITE PAPER

HOW TO FINE-TUNE YOUR QUOTE REQUEST TO YOUR MAXIMUM ADVANTAGE

FREQUENTLY ASKED QUESTIONS IN SMALL PARTS SOURCING

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Introduction

Parts sourcing can be surprisingly complex, especially when the parts are small. One of the most challenging aspects can be the process of requesting a quote. Arguably, it is also the most important step — one that not only influences which vendor you choose, but also impacts the manufacturing process, your budget and timeline, and the ultimate results. A fully and accurately completed RFQ can mean the different between getting the right vendor to make the part you need at a predictable price, and having a project that runs over budget and past deadline or worse, results in a part that fails.

The purpose of this paper is to provide some RFQ guidelines for engineers, purchasing agents, or anyone who is responsible for obtaining quotes — helping you to tackle some of the common challenges of small parts sourcing, reduce frustration, and maximize the accuracy of your quotes. Using a question and answer format, the paper is designed to remove some of the mystery and help you make more informed decisions about specifications so that you can quickly and painlessly identify the right vendor for your sourcing needs.

Most Common Challenges in Small Parts Sourcing

The building blocks of parts sourcing include ***tolerances***, ***materials***, and ***dimensional accuracy*** — three areas that have a direct impact on the quality of parts and assemblies. Because these specifications are critical to achieving the exact part you need and ensuring it that functions the way you want, they can also be the most problematic.

Whether you are at the design stage or ready to fill out a request for a quote, it is important to keep in mind both the benefits and the limitations of tolerances, materials, and dimensional accuracy in order to create specifications that will help your vendor achieve the best results for your application. Therefore, this section of the paper will take a closer look at some FAQs related to tolerances, materials, and dimensional accuracy.

Specifying Tolerances

Why is specifying the “right” tolerance so important?
Tolerances affect product design, manufacturing, and quality control, making them critical to the successful performance of your end product — and one of the most vital pieces of information in an RFQ. Determining tolerances and the amount of acceptable variation in cut parts is a critical component of the cost of quality.

Why not always ask for the tightest possible tolerance?
It may be tempting to assume that the tightest tolerance possible should be your default choice. But keep in mind that the tighter the tolerance, the higher the cost of production; however, if the tolerance is too loose, the quality of the finished part or assembly may suffer. Therefore, the goal is to strike a balance between over-engineering parts with unnecessarily tight requirements and excessively cutting costs with tolerances that are too loose. In addition, do not lose track of the fact that within a single drawing, there can and ***should*** be both tight and loose tolerances depending on different factors, as described below.

How does a difference in tolerance impact price?
Extending tolerances out just one more decimal point can increase the cost by a factor of two or three. That is because tighter tolerances require greater care in fabricating and inspecting to ensure accuracy. The tighter the tolerance, the more likely there will be added costs because of more frequent quality inspections, more sophisticated or specialized inspection equipment, lower yields of acceptable parts, higher scrap rates, and more raw material use due to part fallout.

How you specify tolerances also affects what tools and machines will be used and the cutting technique that will be employed, which in turn affect costs. So, ask yourself: ***Does the economical method utilize machines with the necessary nominal tolerance capabilities?*** If not, your tight tolerance could result in expensive production methods.

Can I just specify the same tolerance for all of my dimensions?
No. Different dimensions may require different processes to achieve, and not all processes are capable of producing results to the same tolerance. For example, we can achieve precision grinding to ± 0.000010", but that is a cut-off length tolerance that is beyond current cutting capabilities.

Are there standards for tolerances and if so, where do I find them?
There are standards in place for different industries, with tolerances recommended based on factors such as function, material, machine, and process. An online search for handbooks, technical guides, and fact sheets will yield an array of resources that will provide the default tolerances for a variety of products and processes.

Most drawings will name a default tolerance under the heading "Unless Otherwise Specified," indicating that unless a special tolerance value is given, use the default tolerance (varying by the other convention of how many values are presented to the right of the decimal point, even if those values are zero).

Are default tolerances always the way to go?
Not necessarily. Accepting default tolerances without understanding whether they are truly necessary — for example, using a default tolerance just because "that is the way it has always been done" — can needlessly drive up costs. Therefore, always consider the end use of a part to determine which tolerance(s) is the most critical to ensuring proper functionality.

What happens when a part has multiple tolerances that conflict with each other?
It is not uncommon to have a single part with one easily met and loose tolerance coupled with a tight tolerance for another dimension (for example, a loose tolerance of ± 0.0100" for length and a very tight tolerance of ± 0.0010" in perpendicularity). The reality is, you might not be able to achieve both, as specified, in a single part. That is because the rule of thumb is, the tighter tolerance is the one that must guide production, determining the type of machine and tools to be used, and ultimately driving the cost of the part.

When you have one part with different attributes that require tolerances — such as both a diameter and a radius — you need to determine which one is the most challenging tolerance and determine the best way to achieve it in order to see what the cost will be. For instance, a very large corner radius can reduce the diameter, because the part needs to be tumbled a long time to achieve the large radius. This would require a tighter tolerance and eliminate the cost benefit of specifying a looser, overall outer diameter.

How do I distinguish between critical and non-critical tolerances?
You can distinguish between critical and non-critical tolerances by carefully considering the end use, where the part is going, and what the part needs to accomplish. Before you commit to a tight tolerance, consider:

- How does the part function in its end use?
- What tolerances are important for the environment in which the part will be used?
- Does the part interact with any other part or parts? If not, you might not need such a tight tolerance. If so, you need to be aware of the potential for tolerance buildup.
- If the same part has different attributes requiring tolerances — such as both a diameter and a radius — which is the more critical dimension?
- Are you willing to test a slightly out-of-spec part to see if a looser tolerance will work for your application?

There are times when tight tolerances are absolutely necessary to make sure that a product works as intended. For example, if dimensional tolerances expressed in decimal places go much further than initially expected, small variations in each part's dimensions can multiply (especially with complex assemblies), resulting in tolerance buildup and unacceptable variations in the intended design.

Frequently, tolerances require compromise. For example, you might need to specify a tighter length tolerance in order to hold a tight diameter. Or with a loose length and tight perpendicularity, you might need to choose between loosening the perpendicularity or making ALL of the other tolerances — including the length — tighter in order to achieve the required perpendicularity.

What should I do if I am unsure or just don't know what tolerance to use?
A good vendor should have the expertise and be willing to walk you through the decision points to help you identify what is critical and determine the proper tolerance for your parts. Just ask.

Specifying Material Choices

Who should source the raw materials for my parts — my vendor or me?
If your vendor has to provide the raw material for your parts, that will have an impact on their cost and your quoted price. If you provide your own raw material, that puts you in control of the source and how much you want to spend.

In addition, as the one who knows all the details of a part's design and end use, you are in the best position to define the goals and select the material with the right chemistry for your application. If you are a third-party buyer or a purchasing agent who is not very familiar with the part design and what it needs to accomplish, going back to the engineer and getting those details will go along way toward helping you pick the right material and source.

Can my vendor recommend a material?
While a technical rep or metal shop cannot tell you which specific type and grade of material will work best for your part, the vendor can point you in the right direction ***IF*** you have provided all the details of your application and what you need your part to do. For example, a vendor might suggest either 304 or 316 stainless steel, depending on whether machinability or chemical resistance is more important.

Can I make my parts from any size material?
You can, but it will be more expensive because any non-standard materials may be difficult to get, may have to be manufactured by special order, and will increase production time. Wherever possible, it is best to use a standard material; in the U.S, there are industry standard sizes of tubes and plates that are readily available in various materials. In addition, this is a concern that should carry over to thinking about your needs in the future. Even if a material can be custom made now, in 5 or 10 years a manufacturer may discontinue it due to low demand or high cost.

I only need a few feet of material for R&D — does it matter whether I use a standard size?
Sourcing a special size for just a few feet of material can make for a very pricey minimum order. When your purpose is to validate a design, it is recommended that you use readily available, standard size material.That way, you can reserve the added cost of a special order for the final product and a proven design.

Can a standard size material be adapted to the size I need for R&D?
Yes. For example, you could take a standard size solid rod of the correct length you need and have it machined into a tube of the size you want for purposes of testing/validation. While that would require removing a lot of metal from the piece and add the cost of machining, it might still be less expensive than a special order. You'd have to work with your vendor to decide what is feasible and within your budget.

Can I ask for a specific measurement within a standard tolerance range — for example, 14 gauge stainless steel that is 0.078" thick?
Generally, the goal for manufacturers is to achieve material that is at the central, nominal tolerance. Asking for a material to be at the high or low end of the tolerance range might still require a special order; it is, in effect, asking for a tighter tolerance, which means a higher cost. However, it is generally easier to ask for raw materials at the low end of the range, because

while it is possible to remove small amounts of material to reach the requested size, it is not possible to add material back in to reach an upper tolerance.

Are there any additional issues when ordering material from different suppliers?
In the international marketplace, suppliers in different areas of the world may use different codes for identifying materials. In addition, the chemical composition of materials may not be consistent across the globe. If a slight discrepancy in material composition will make a difference in the functionality of your end part, then this is an issue to be aware of when sourcing raw material. Additionally, internationally sourced material may be measured in a different unit of measurement, leading to the issue of converting tolerances and other conversion problems.

My company is making a part using a drawing from an overseas subsidiary we acquired. Are there any special issues I need to be aware of?
Drawings from different countries may use metallurgical type designations that are not universal. There are tables available online that can be helpful; however, there is no guarantee they are accurate, and at this time there is no one unifying source that provides definitive cross references and translations for material sizes, gauges, chemical composition, and so on.

How can I control for material surface issues?
Drawings often request that a part surface be "free of defects" or otherwise indicate that no material surface imperfections are acceptable. However, virtually every material has surface issues if you look closely enough. For example, the surface of a cut-off tube may look uniform at 10x magnification, but at 500x using a scanning electron microscope (SEM), imperfections in the grain alignment will be revealed. Therefore, when asking for a material surface to be "free of defects," drawings and purchase orders need specify at what magnification ratio the surface needs to be examined.

It is also important to specify the inspection method to be used. For instance, optical microscopes can rely on various light sources, the angle of which can cause shadows and reflections that may increase or decrease the perceived size of draw lines, cracks, gouges, dents, and other imperfections, as well as discolorations. Other factors that can affect surface appearance include the color temperature of the light and the absence of light, as with an SEM.

How does material surface inspection affect cost?
When choosing a magnification level and method, it is important to make sure it makes sense with your end use. Since there is added cost involved in closer examination, you want to be sure you're not over-engineering the part and asking for surface finish processing that exceeds your requirements and budget. For example, if having a slight groove in a rod will not affect the performance of the part, then examining it at 100x magnification may be excessive. But if you are producing a ball bearing that will be used within a critical airplane part, a high magnification level may be necessary to ensure functionality and meet safety requirements.

What is SEM — and can I use it to inspect my parts?
An SEM examines a sample by scanning it with a focused beam of electrons, which reflect off the topography of a sample to produce 3D, high-resolution images of the object and/or surface, with astonishing detail and no confusing light source shadow effects.

However, for everyday applications, an SEM is extremely expensive, complex, and difficult to use. In addition, because it is so fundamentally different from ordinary methods of microscopy, an SEM does not provide a basis of comparison with what can be seen by the eye using the more typical optical microscope method. Therefore, asking for SEM-level "free of defects" is, at least for the present time, not practical.

What are the capabilities of the typical microscopes used for inspecting parts?
Common optical microscopes can measure anywhere from 5x to 50x, and there are other, more advanced options. For instance, Metal Cutting Corporation has an optical microscope that is capable of magnification to 200x, and our video inspection equipment can display an even greater level of detail.

Ensuring Dimensional Accuracy

Is metric versus standard (inch) measurement still an issue?
Yes. Moving back and forth between metric and standard (or inch) measurements still causes accuracy problems, due to the use of incomparable units, human error (such as misplacement of a decimal point or adding a zero in the wrong place), rounding, and inaccurate conversion. It has important implications in everything from aerospace applications to medical devices and automotive welding machines. While in most situations a poor fit may not have life-changing repercussions, in other instances, part failure may be catastrophic.

Technology does provide more reliable conversion tools and help to reduce the risk of human error. Computer numeric controls (CNC) on machines allow conversions to be calculated internally for all of the values within a machine's control. On the shop floor, staff often use a handheld digital micrometer with a display that allows users to toggle between metric units and inches with the press of a button. However, standard to metric conversions (and back again) are still not trouble-free, if for no other reason than equipment itself needs to make rounding decision based on display size.

Do most machine use the same units?
No. Most machines are calibrated in the unit that makes the most sense for the particular machine's primary use. For example, a tool used in carpentry may be calibrated in standard inches and its fractions, which are appropriate for woodworking; however, inch fractions would be ten to one hundred times larger than the measurements needed in a tool used to make medical devices.

Can parts based on metric units work with those based on standard measurements, and vice versa?
In a global supply chain, you might be using parts from many subcontractors, some domestic and some in countries where the metric system is prevalent. Those parts may have to connect and interact with other each other. That not only means converting dimensions between standard and metric, but also taking part tolerances into account. Parts made at the top of the tolerance range measured in a metric system may not fit with another component at the bottom of the tolerance range as measured in a standard system.

Why does rounding off figures create accuracy issues?
Rounding can lead to conversions that are outside the accepted range of tolerances. Therefore, it is important to take care in deciding how many decimal places to extend a conversion. For example, you might say 0.01 mm converts to 0.04"; however, that calculation rounds the figure of 0.0393700787 to only the second decimal place. In a world requiring tolerances to at least the third or fourth decimal place, 0.04" may not be accurate enough.

In addition, the effect of rounding is compounded among multiple interacting parts, as well as across dimensions and tolerances. However, these variations can be overcome by ensuring that any rounding is performed methodically and consistently so that all dimensions will be within (or tighter than) the accepted tolerances.

Does using calibrated measuring devices ensure accuracy?
It is a given that customers, material suppliers, and parts manufacturers all use NIST traceable, calibrated devices to take measurements. However, that does not guarantee that everyone measuring the same part will get the same results. That is because within each device, there is a tolerance, indicating accuracy within plus or minus X amount. What's more, the tool used to calibrate that device — for example, a pin — also has its own tolerance. The tool used to calibrate the pin has its own tolerance, and so on.

The tools used for conversions also bring rounding into the equation. Most CNC machines are calibrated in one unit and convert — and round — to the other. For example, a popular modern digital micrometer is engineered, operates, and calculates readout dimensions in metric units. However, when users toggle a button to switch from metric to standard, they are not getting an entirely new calculation. Rather, they are getting a conversion to standard, including the rounding factor or error that is necessary for the decimal places provided in the readout.

Fortunately, a reliable vendor takes tool tolerances into account when determining how to achieve dimensions that are within your specifications.

How should I inspect a part's inside diameter (ID)?
Agreeing on the tool to be used for verifying ID, particularly with small diameter tubing, can mean the difference between meeting your specs and incurring the cost of additional work. Traditionally, the inside diameter of small tubing or cylinders is measured using pin gages, a simply designed, failsafe method of inspecting a part for conformity and quickly determining whether it is functionally in compliance. For more exacting needs or small diameter tubing IDs (e.g., 0.002" to 0.004") that cannot be measured with standard pin gages, optical measurement offers a more sophisticated option for calculating the diameter of a cylinder or tube.

As always, it is important to consider the part's end functionality. For example, will the tube need to carry gas or liquid? If so, optical measurement may be the most reliable way to ensure that the tube's diameter is sufficient to allow gas or liquid to flow. However, if the tube length is short (say, under 1"), a pin gage may be perfectly acceptable, telling you tube's ID is too small; what's more, a pin gage is less expensive than optical measurement.

Are there drawbacks to using a pin gage to inspect ID?
For most small diameter tubing sizes with an ID from 0.005" to 0.200", pin gages yield acceptable results that can be correlated. However, pin gages are not designed to provide a measurement value for individual characteristics of the part's diameter. Additionally, a pin gage can only measure one limit of tolerance (not both plus and minus). Like all calibrated measuring devices, pin gages also come with their own tolerances, which can lead to stacking.

With very small IDs (e.g., less than 0.004"), it is challenging to insert a delicate pin gage into a tube without bending the tube or causing damage to the pin gage. Pin gages themselves are subject to wear and need to be monitored for damage. Results can vary from user to user and not consistently meet the pass-fail criteria. In addition, for inspecting a very long cylinder, a pin gage is impractical.

What is optical measurement and how is it used to inspect ID?
The optical measurement method can be simple, such as using a light to visually check a tube for blockage or to measure a point just inside the end of a tube. But generally, optical measurement uses a sensor to measure various points around the circumference and inside a tube, and then runs the numbers through an algorithm to determine if the average ID is within tolerance. Optical measurement is more precise than pin gages and can be used to measure circles, arcs, and more complex shapes. It is great for making sure liquid will flow through long, small diameter tubing.

Are there drawbacks to using optical measurement to inspect ID?
Using an optical system is more costly than using pin gages. Moreover, optics can look only so far into a tube and cannot resolve deep into the Z-axis. Although optical measurement may provide assurance that a tube's average diameter is within specifications, it will not tell you if the ID is consistent throughout the tube, and issues such as a protrusion in the tube might just be averaged in. The optical method also may not be accurate enough if another part needs to fit into the tube, requiring the ID to be double-checked with a pin gage or other go/no go method to verify fit. In addition, optical measurement can be affected by the surface finish and cleanliness of the part, as well as the repeatability of part placement in relationship to the optic sensor.

How can help to ensure I get accurate measurements and parts that meet inspection requirements?
There are 7 simple "rules" that can help to ensure that calibrated measuring yields accurate and consistent results — especially with very close tolerances, where a slight discrepancy in measurement can mean the difference between in spec and out of spec.

1. Make sure you and your supplier or manufacturer are using the same type of device to do the measuring.

2. Make sure you and your supplier/manufacturer are using measuring devices that are correctly cross-calibrated.

3. If possible, provide your manufacturer with the measuring gage or other device you plan to use to verify the dimensions of your parts.

4. Have a pre-production discussion with your vendor and provide detailed instructions on how measurements should be done, including the method and device to be used, to how many decimal places you will measure, whether the last decimal place is rounded, and if so, how.

5. Make sure all your measurement requirements are included in your drawing.

6. Identify for your vendor the truly critical dimensions and how they will be measured, so you will be on the same page from day one.

7. Where practical for your inspection needs, use a functional test such a simple go/no go test with a pin or screw gage.

What should I do if my measurements and my vendor's measurement don't agree?
When there is a discrepancy between a manufacturer's measurement results and what you get when you inspect the finished parts, the issue can often be resolved simply by re-measuring. If the source of the discrepancy still cannot be identified, a formal correlation study can be performed, using the best practices of Gage R&R methodologies. If the correlation study does not reveal a measurement device problem or method error, the manufacturer may need to cut the parts at a closer tolerance than specified in order to achieve the required results.

Putting It All Together in an Effective Request for Quote

Filling out an RFQ is like doing an Internet search: The more criteria you put in, the more refined and accurate your results (and your cutting quote) can be. From the characteristics of the part itself and the quantity needed, to the tolerances, materials, and inspection methods — all of these things affect how a part will be produced and at what cost.

While a well-constructed RFQ should help you gather the necessary information and steer you seamlessly through the process, these FAQs provide added guidance in completing a thorough RFQ.

What should I include in a RFQ's part description?
The part description is one of the most crucial sections of the cutting quote, and the more details there are, the better the quote will be. At Metal Cutting, our RFQ form asks for all applicable specifications and tolerances — diameter OD, tube ID, wall thickness, length, radius, parallelism, perpendicularity, surface finish, and anything else that matters.

We are still in the pre-production stage, so why are tolerances so important to include in an RFQ?
Tolerances determine the type of machine and tools to be used, which in turn, drive part cost. In addition, because making a tolerance tighter by just one decimal place can increase the cost by a factor of two or three, providing your tolerances can alert a vendor to potential over-engineering with tighter than necessary tolerances. On the flip side, a loose tolerance can also raise a red flag. In either case, an alert vendor can come back to you to be sure the tolerances you are asking for are appropriate and necessary for your end application and budget.

How does surface finish affect a quote?
A requested surface finish may pose production challenges and require additional processes that have an impact on cost. Therefore, it is often helpful for a vendor to know why a particular finish is being requested. Is it a functional finish that is required in order for the part fit smoothly with some other part? Is it a part that must be cosmetically pleasing? Is a particular finish needed to eliminate glare and reflection under bright lights (for example, in an operating room)? Or is it a case of over-engineering, where a less costly finish may be satisfactory?

How specific do I need to be in an RFQ?
Whenever you provide a description of a part's traits, it is important to be as specific as possible. For instance, rather

than saying "some burr allowed," provide a measurement for the maximum burr allowed. If you have a profiled part with diameter steps, provide the minimum and maximum inside corner breaks allowed. Likewise, if some surface defects will not affect functionality or visual appeal, give a measurement for how deep the lines may be.

Why do I need to include a drawing in the RFQ?
Hand-in-hand with the part description, providing a drawing of the part, with all of its dimensions and tolerances labeled, is a critical step in achieving the optimal quote. Particularly when you are dealing with a new vendor, for new part orders, and for revisions, a drawing is an invaluable tool. If you are looking for a new source for an existing part, providing a sample of the part is extremely helpful.

How does the material source impact a quote?
If your vendor has to provide the raw material for your parts, that will increase the vendor's costs and your quoted price. If you provide your own raw material, that puts you in control of the source and how much you want to spend.

Can a vendor tell me which material is best for my parts?
A vendor can make a recommendation but cannot guarantee the results for your specific application. That is why it is vital for you to do your legwork and find out what material will work best for your part. As the customer, you are in the best position to define your goals and select the material with the right chemistry for your application. If you are a third-party buyer or a purchasing agent, you can go back to the engineer for more details and help in picking the right material and source.

How important is quantity in an RFQ?
Quantity matters because it affects pricing, delivery time, and minimum charges. Yet, sometimes it is left blank on an RFQ because a buyer does not know what the quantity should be or is hoping to place a minimum order. The difficulty is, many factors affect what comprises a "minimum order." For instance, a vendor's minimum processing fee (or lot charge) could cover anything from 10 parts to 1,000 parts, depending on the complexity of the cutting process required. If the vendor must provide the raw material for the part, that will also affect the minimum lot charge.

The size of your production run and ultimately how many parts you need, and how often, all make a difference in total cost and whether it makes sense to place a minimum order. For example, if it takes an hour to set up a job and you run 20 pieces a month for a year, then you would pay for twelve hours of setup. However, if you run 240 pieces at one time but take delivery over a year, you would only for for one hour of setup time. Or, if you need 10 parts now for a prototype but know you will need more parts down the road, it may be more cost-effective to place a blanket order for 10,000 parts and have them ready for re-order later as needed.

How does the deadline impact cost?
Frequently, customers say they need an order "yesterday," and it is true that orders must often, by necessity, be filled at a rapid pace. But since faster means more costly, it is worth thinking about whether an order really needs to be expedited. If a project is not really ASAP and you know that the parts will eventually be used, it may be more cost-effective to have an ongoing, long-term, blanket order in place. That way, a set quantity of parts can always be on hand and ready for re-order as needed.

Do I have to give a target price? I don't want to tip my hand and end up with a higher price than I might otherwise be quoted.
Having a target price can help your vendor narrow down the options and determine what is feasible for your application and your budget. If you tell us you want a part as cheap as possible, we have to ask: Are you really looking for a cheap part, where a rough, angled cut that has burrs and is out of tolerance is sufficient? Or do you want a more precisely cut part, with sharp edges and tight tolerances? A realistic target price that considers your quantity and end use will help us better understand what you really need. It may also tell us if we are the right vendor for you, and help us to advise you if a different process might be better suited for making the parts and/or quantities you require.

Why does a vendor need to know the end use of the parts I want to order?
In theory, an RFQ is just a series of facts that a vendor can use to produce exactly the part you need, without regard to the end use of that part. However, there are times when not knowing the end use has serious implications. For example, if you need a stainless steel part for use in a medical implant, your RFQ must specify that end use so your vendor knows to use medical grade material. Having an understanding of your the intent may also help your vendor recommend the process that best accommodates your end use and your budget.

Conclusion

An RFQ is an invaluable tool for providing all the information a vendor needs to deliver an optimal quote. By including as much pertinent information as possible in an RFQ, you can help to ensure you get the part you want and a cost estimate that is as accurate as possible.

When providing specifications, remember that choosing the proper tolerances helps to ensure product quality, ease of manufacturing, and time to market. It is critical to take the end use into consideration when determining which tolerances are most critical and will, in turn, drive the production and cost of your parts. By thinking about the material choices and how they relate to the requirements of your end use early in the manufacturing process — for instance, as you are doing your drawings or completing an RFQ — you can avoid problems down the road and help to ensure that your parts will pass inspection and meet your needs.

By investing some time and care in accuracy — such as the conversions between different measuring systems — you can help to maintain quality and control cost. By working up front with your supplier or parts manufacturer to define how the dimensions of your parts should be measured and agree on the calibrated device and measurement procedure to be used, you can greatly improve the odds that your parts will be in spec.

As your partner in this process, good vendors will use an RFQ to extract from you the criteria that will allow them to deliver the part that you want and need, based on an quote that is an accurate reflection of the work required and the cost. By keeping the lines of communication open and making sure you and your vendor are both well informed, you can work together to make parts sourcing a simple and effective process.

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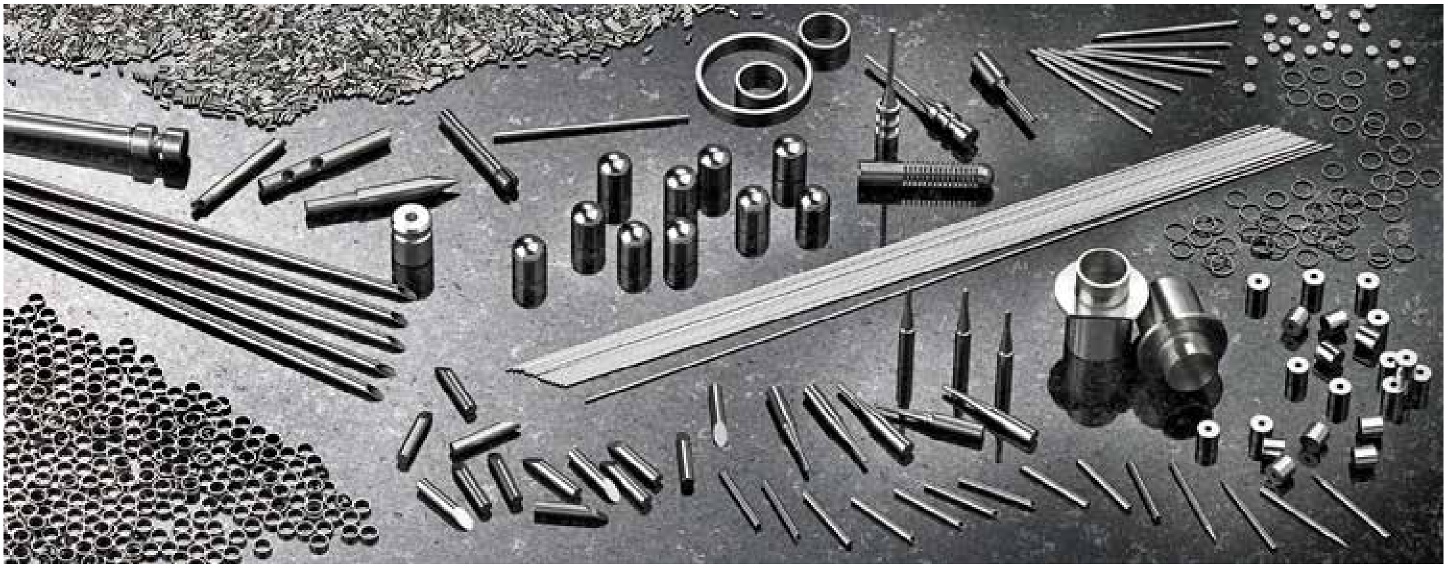

Excellence in precision metal cut off

Metal Cutting Corporation manufactures burr-free tight tolerance parts from all metals. We provide the precision required by medical device, automotive, electronic, biotechnology, semiconductor, aerospace, fiber-optic, electrical and many other diverse industries.

Specializing in precision for over 45 years

We are specialists with over 45 years cutting, grinding, lapping, polishing and machining metal parts. Our experience, inventory and capabilities provide the skills and capacity to meet the needs of technology device manufacturers. Specialty metals, micron tolerances, low or high volumes, complex metrology--all these and more are the requirements we achieve every day for products shipped worldwide.

Burr free cutting is what we're built on

Metal Cutting has been perfecting the science and crafting the art of burr free cutting for over 45 years. All 46 of our proprietary Abrasive and EDM cut-off machines offer unmatched precision and high speed capability with burr-free results. That means you get what you want, when you want it--there is no order too small, and no quantity too large. Cutting is what we're built on; and as the centerpiece of our operation, we work continually to improve our methods to ensure the quality and service our customers depend on.

Questions? Call Metal Cutting today.

We hope you've found this guide to be a handy reference as you determine which 2-axis cutting method is ideal for your application. We invite you to consult with us on your precision cutting needs. We think you'll agree that hearing what we have to say will be one of the best decisions you make in researching precision cutting methods for your industry and application. Call Metal Cutting today at 973-239-1100 or email info@metalcutting.com.

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