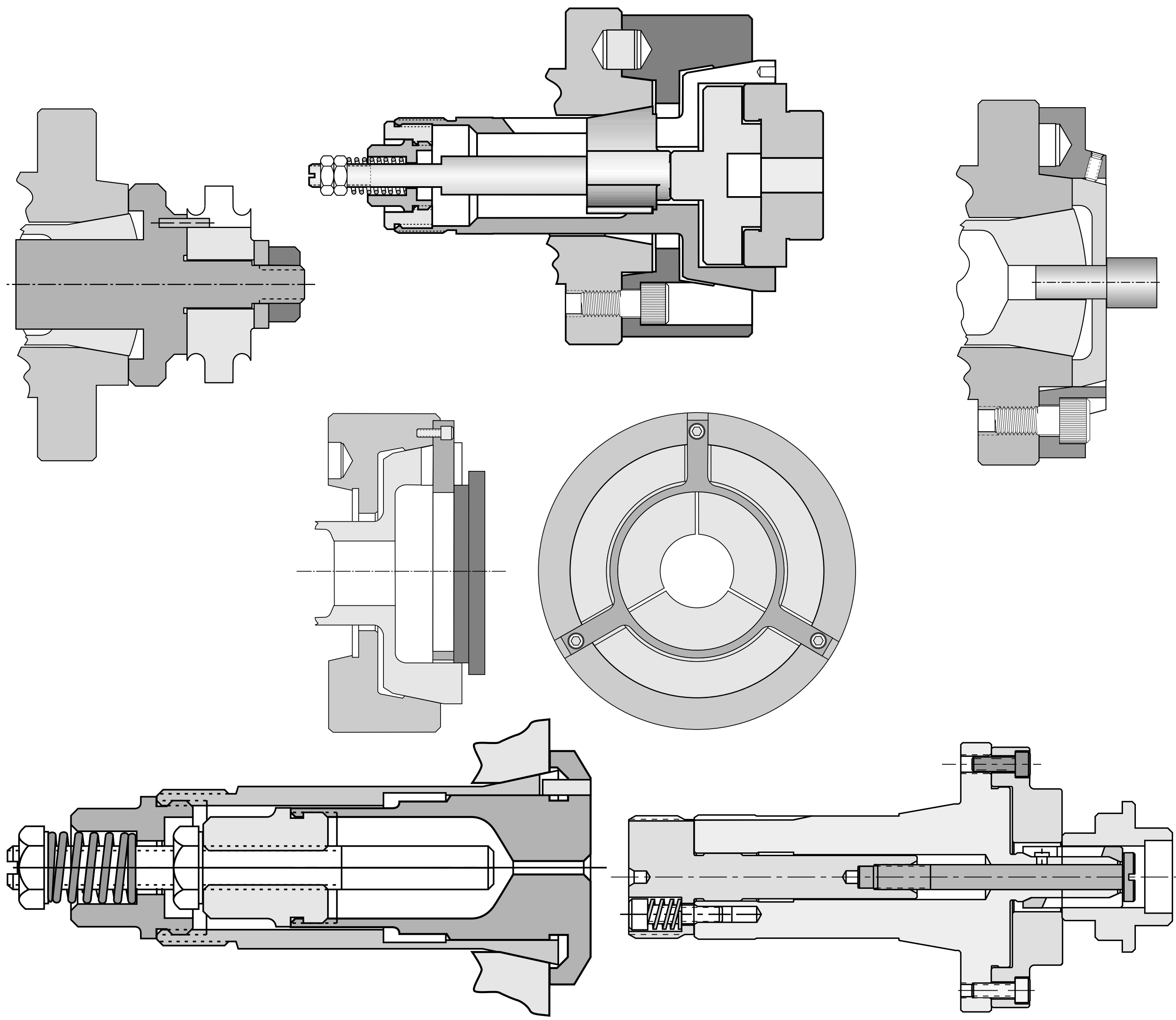
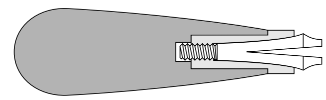
Precision Length Control

Draw-In Collets and Step Chucks



In The Beginning

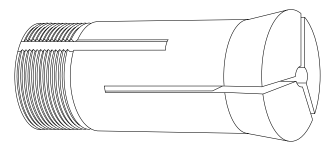
the first collet was patented by Herick Aiken around 1839. It was used in a hand held device to hold a needle. The collet was eventually used on lathes and milling machines. Henry Hardinge developed the production method for making "True-hole" collets around the turn of the century (1906). Today there are basically two style collets – the draw-in-to-close and the push-to-close.



Herrick Aiken Collet
December 27, 1839

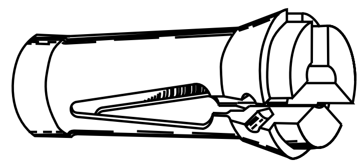
The Draw-in Collet

is best suited for parts where the diameters have to be machined concentric to the chucking diameter. The draw-in collet is not very accurate for holding lengths in relationship to the part shoulder, which locates against the collet, face, step, or internal stop. Because of its ability to hold parts concentric, the draw-in collet is generally used for precision machining.



The Push-to-Close Collet

is not very accurate for holding parts concentric, but is fairly accurate at holding lengths. The collet does not move when the collet is closed. The collet is shouldered and a sleeve moves forward, pushing against the collet head angle to close.



The Purpose

of this publication is to help you learn about precision length control. Throughout the years, devices have been developed to help reduce (and sometimes eliminate) the length control problems associated with draw-in collets. We will show you how these devices work and how to apply them to your particular application. Basic length control methods are easy to learn. We will begin with the most fundamental concepts and build on them until you have a thorough knowledge of precision length control for draw-in collets and step chucks.

Hardinge®

has been designing and manufacturing collets and workholding devices for over 100 years. Let us use our technical expertise to help you solve your workholding problems. We can manufacture any of the devices shown in this publication to meet your specific needs. You will find a majority of the items illustrated on our shelves waiting for your order – instant solutions to your specific needs.

Please

read and study the information and illustrations. If you have any questions, give us a call, and we'll be glad to help (800-843-8801).

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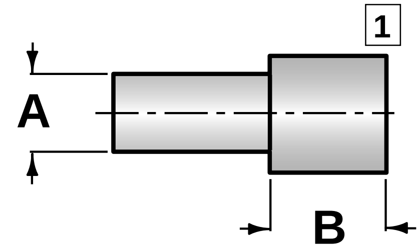
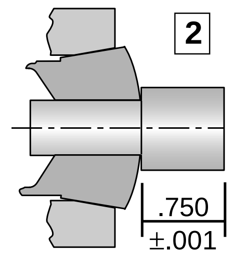
Why Part Length Control?

The draw-in lathe collet has always been noted for holding parts concentric but is not very accurate for holding part lengths. Anyone who has operated a lathe with draw-in style collets spends considerable time trying to overcome the inherent part length problem. Many times, additional costly operations are required to hold precision lengths. Therefore, much time and money is saved when lengths are controlled during the initial or secondary lathe operation.

Typical Lathe Operation – Face the Part



Let's look at a typical part and the related length control problems. The draw-in collet grips on the chucking diameter "A" which varies ±.002" (figure 1). The only machining operation required is to face the part while holding the "B" length dimension to ±.001" (figure 2). We insert the setup part in the collet and face it to exactly .7500" from the shoulder "B".



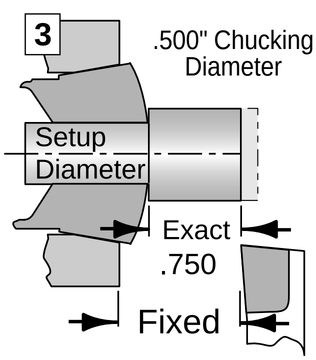
After making four pieces, we check our fifth piece and find the shoulder length is .006" less than our setup piece, and is below the print specifications (figure 2). Being concerned, we check the shoulder length of the other parts. The fourth is +.003" over, the third is -.001" under (which is okay), the second is - .002" under, and the first one is fine. The chucking diameters "A" were all within the ±.002" print specification.

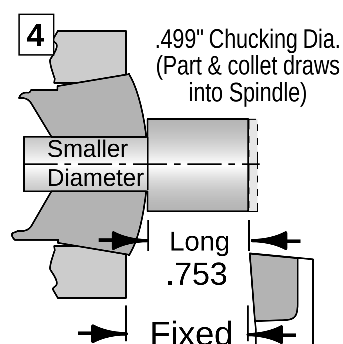
Why Did The Length Vary?

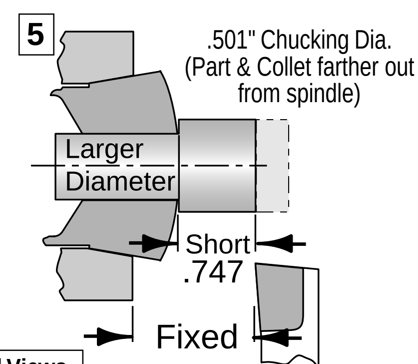
First let's look at the collet. It has a 10° head angle. If the .500" chucking diameter (figure 3) is reduced by .001" to .499", the collet will pull back into the spindle an additional .003" before firmly gripping the part (figure 4). If the chucking diameter of the part is .501", the part will **not** be drawn into the spindle as far as the .500" diameter part. It will actually be .003" further out than the setup piece (figure 5).

There are two fixed items in this setup; one is the spindle and the other is the facing tool. When the chucking diameter is .001" smaller, the part is pulled .003" further into the spindle. When faced, the finished part will be .003" longer than the setup piece (figures 3 and 4). The facing tool does not move; only the collet with the part moves. The reverse is also true; if the chucking diameter is .001", larger, the part will be .003" further out than the setup piece. After facing, it will be .003" shorter (figure 5).

In Summary, always remember the 1:3 Rule of Thumb for a 10° Closing Angle**:** For every .001" variation on the chucking diameter of a workpiece, the finished length will vary .003" in relationship to the spindle face.







Exaggerated Views

Chucking Diameter Tolerance Relationship to Expected Length Variations

Diameter Tolerance	.0001"	.00033"	.0005"	.001"	.002"	.004"	005"
Length Variation	.0003"	.001"	.0015"	.003"	.006"	.012"	.015"

Note: Each style collet has a maximum chucking diameter variation it can grip before a different size collet is required. HQC® *Quick-Change* collets can handle a much greater chucking diameter variation than solid and master collets.

Methods That Do Not Hold Precision Lengths

Is a solid collet stop the answer? No! The stop will make certain that each part locates in exactly the same place, in relationship to the collet. What happens to the collet when the chucking diameter is .001" smaller than the set up piece? It pulls back into the spindle .003". The stop is attached to the collet, therefore, it and the part, go with the collet (figures 6 and 7).

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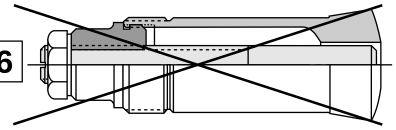

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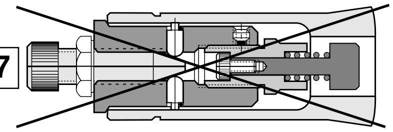

How about a step collet? The step is in the collet; the collet moves whenever the chucking diameter is not exactly the same as the setup piece, therefore, it will not work either (figure 8).

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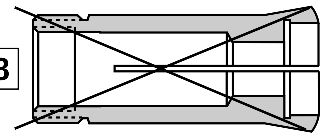

Will a draw tube stop work? No! The draw tube stop is attached to the inside of the tube with compression rings or expanded "O" rings. The draw tube pulls the collet back into the spindle. If the second part is smaller or larger than the setup piece, the draw tubes position will vary. Length control is impossible (figure 9).

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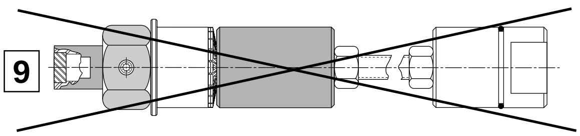
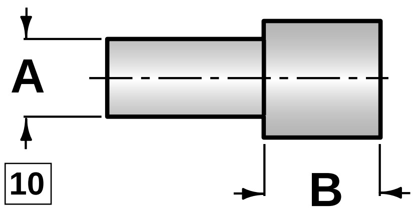


"Mic" and Stack- The Hard Way to Hold Part Lengths



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While walking through a shop, we saw a lathe operator with several stacks of parts arranged on his work cart. We asked what the stacks were for. "Length control" was his answer.

He explained that the workpiece had a .500" chucking diameter "A" (figure 10) and it varied a total of -.003". The shoulder-to-face length tolerance "B" was -.002". Using the "1:3 Rule-of-Thumb", it was determined that the variation on the chucking diameter would result in a length variation of .009", which was unacceptable.

Part Groups Needed to Hold Lengths					
1st	2nd	3rd	4th	5th	6th
.5000" .4995"	.4995" .4990"	.4990" .4985"	.4985" .4980"	.4980" .4975"	.4975" .4970"

To hold the print lengths on this job, the operator must "mic" the chucking diameter of each piece before machining and group all those with the same dimension together. A -.0005" variation on the chucking diameter would give a .0015" length variation. This would allow for a .0005" cushion within the .002" finish part length tolerance (see above chart). After measuring all the parts there would be a total of 6 stacks.

The initial setup was done using the part with the largest chucking diameter from the first group. The facing tool was set to the low side of the print dimension's tolerance. In this way, the part with the smallest chucking diameter would have had a length that would fall within the print tolerance. After finishing with the first group, the operator went on to the next group, gripped the part with the largest chucking diameter and reset the facing tool the same way that was done on the first group, etc. Six setups had to be made. Note: If the chucking diameter had varied ±.003" twelve (12) setups would have been necessary.

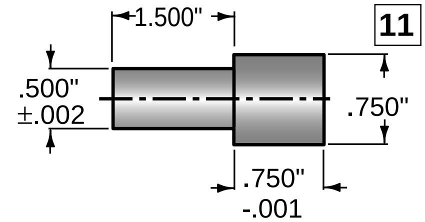
Does this method work? Yes, but it is not very productive and, unfortunately it is very common practice throughout the machining industry.

What are the Alternatives? Hold a tighter tolerance on the chucking diameter during the first operation machining. This could allow the second operation finish length tolerance to be held. The cost of holding the first operation could increase the production cost considerably (see chart on previous page as a guide when holding chucking diameters).

Are there better methods? Yes. They're on the following pages.

Methods That Hold Precision Lengths

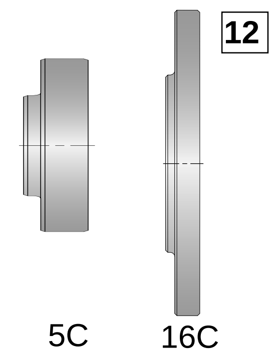
There are several methods for part length control, each having its advantages as well as disadvantages. Throughout the remainder of this publication various methods of length control will be presented. We will start with the simplest methods, fixture plates, and move on to the more complex methods. Once these methods are understood, precision length control will no longer be a problem.



The Part is similar to the one we started with. It has a .500" (±.002") chucking diameter that is 1.5" long with a .750" diameter hub which is .750" long. The only machining that takes place is facing the part to hold the length from the back shoulder to the face; .750" (-.001") (figure 11).

Choices: Let's take a look at the possible choices we have. The "Mic and Stack" will require 12 separate stacks. The chucking diameters of the parts in each stack can only vary a maximum of .00033" if we are to hold the .001" length tolerance. We will also have to perform 12 separate setups. This is doable but time consuming and impractical. Let's investigate the use of a fixture plate.

Precise Length Control Using Fixture Plates

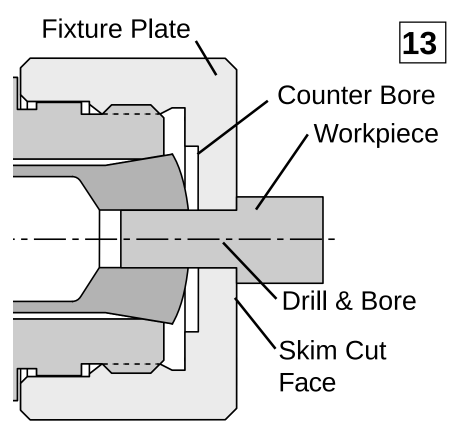


Fixture Plates

Most people think of a fixture plate as a base for fixturing irregular shaped parts which cannot be held with a collet, step chuck, or a jaw chuck. Here is another use — a backing plate for a workpiece that has a shoulder and a long chucking diameter.

How to Make a Backing Plate

- Remove the flange from the fixture plate. Then hold the outside diameter of the fixture plate in a step chuck and counterbore the back face enough to clear the face of the collet when it is opened and closed (figure 13).
- Remove the step chuck and closer.
- Mount the collet and adjust it for the chucking diameter.
- Remove the workpiece.
- Mount the counterbored fixture plate to the spindle of the machine (the 5C Plates are threaded or taper locked, the 16C, 20C, 25C Plates are bolted onto the spindle).
- Rough drill and then finish bore and chamfer the hole. The bore should be .005" to .010" larger than the largest chucking diameter of the workpiece.
- Lightly face the fixture plate to make sure it is perpendicular to the center-line of the spindle.



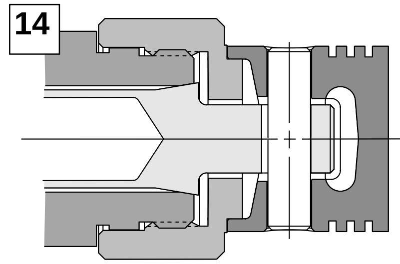
How to Use a Backing Plate

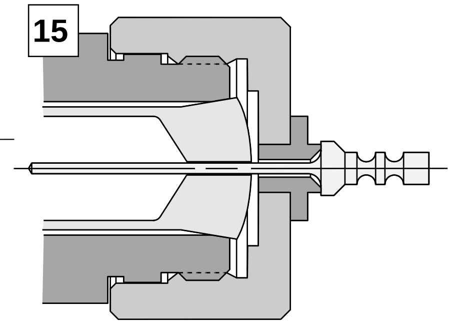
- Load the part through the fixture plate into the collet.
- Close the Collet. As the collet closes, the part is drawn back against the face of the fixture plate with a tremendous amount of force.

Advantages: This is one of the best methods for holding lengths. Any part that has a shoulder and a long chucking diameter can use this method to help eliminate chatter, improve surface finish and extend tool life. The tremendous force exerted when pulling the part back against the plate stabilizes the part. A part held in a collet does not have this advantage.

Disadvantages: There is one major drawback with a fixture plate – the cost. Fixture plates are expensive. A different one is required for each size part, even when the chucking diameter is only 1/64" larger, and they will not work for parts without long shanks.

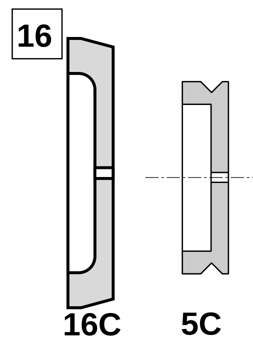
Summary: The spindle of our lathe is fixed; only the collet moves in and out as the chucking diameter of the workpiece varies. For precise length control, the workpiece must locate against some portion of the spindle face or spindle seat, or against something that locates against these surfaces. (figures 14 & 15)





Precise Length Control Using Stop Plates

The fixture plate is the most basic method of length control. It is the basis for all other length control devices. Let's take a look at the Stop Plate**.** It overcomes the high cost factor of the fixture plate with very little loss in efficiency.

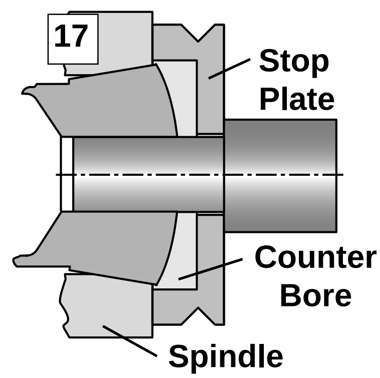


The Stop Plate is nothing more than a glorified hardened and ground washer (figure 16 for commercial stop plates).

How To Make a Stop Plate

- Counterbore the washer on one side large enough for the collet to open and close without touching the back of the plate (figure 17).
- Grind the two faces of the plate parallel to each other.
- Bore the stop plate .005" to .010" larger than the part's chucking diameter.

How To Use a Stop Plate



- Clean both sides of the plate and the face of the spindle.
- Push the part through the backing plate.
- Place the shank of the part in the collet and push the whole assembly back firmly against the face of the spindle.
- Close the collet. This action pulls the part and the stop plate firmly against the face of the spindle.

Advantages

- Inexpensive – Commercial stop plates are available in sets of 3 with 1/8" bores. They take up very little space for storage. A basic set can be made in 1/16" increments up to the maximum collet capacity.
- Maximum stability – This is due to tremendous pressure exerted against the parts shoulder when the collet closes. This helps eliminate tool chatter and allows machining of small, long diameter parts, with shoulders, that normally cannot be successfully machined by holding them in a standard collet.

Disadvantages

- Chips & dirt – Although this process is excellent for short run jobs (5 to 25 pieces), they are very time consuming when machining large quantities. If chips are not thoroughly cleaned from both faces of the plate and the face of the spindle, perpendicularity cannot be held accurately. Even lengths can vary, depending upon chip size which gets between the spindle and plate.

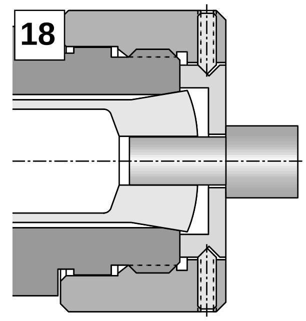
- Lost production time – The operator handles two pieces all the time. The part must be assembled in the stop plate and then in the collet. The fixture plate method does not have this problem because it is one solid piece mounted to the spindle. Simply clean the face of the fixture plate and insert the part.

- **Is there cure for this problem?** Yes, a Spindle Mount.

Precise Length Control Using Spindle-Mounted Stop Plates

The spindle mount is used to hold stop plates firmly against the spindle face. Stop plates can be quickly removed, replaced and centered in minutes. One spindle mount is used for an infinite number of stop plates with different size bores.

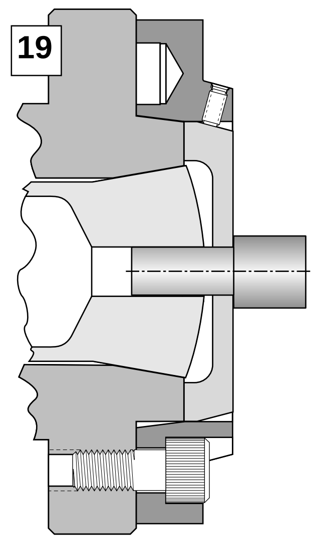
The **Spindle Mount** for the stop plates is threaded, or taper-locked on the 5C spindle; it is bolted on the 16C spindle (A2-5).



5C Spindle Mount

How To Assemble the Stop Plate to the mount (figures 18 and 19).

- Clean all surfaces.
- Slide the part through the plate into the collet. Push and hold them against the face of spindle.
- Close the collet.
- Adjust the four taper point screws on the 5C mount centering the plate around the part. Use the flat point screws on the 16C mount to center the plate (the set screws push the plate against the face of the spindle).
- Open the collet and pull the part out 1/4" or more and finely adjust plate to center.



16C Spindle Mount

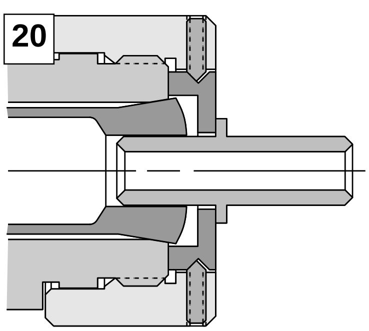
How To Use the Spindle-Mounted Stop Plate

- Clean face of stop plate and the shoulder of the part.
- Open the collet.
- Load the part through the stop plate and push the part firmly against the plate.
- Close the collet.

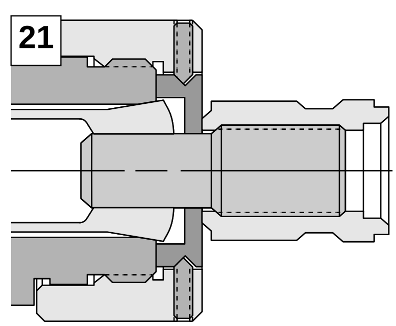
Advantages: We now have all the advantages of the fixture plate at an extremely low cost. Chips cannot get between the face of the backing plate and the face of the spindle. You're ready for precise length control and high production work.

Disadvantages: The parts must have long chucking diameters.

Summary: We have located the stop plate against the face of the spindle and the shoulder of the part against its face of the plate. The spindle doesn't move; only the collet moves. We have again achieved precise length control.

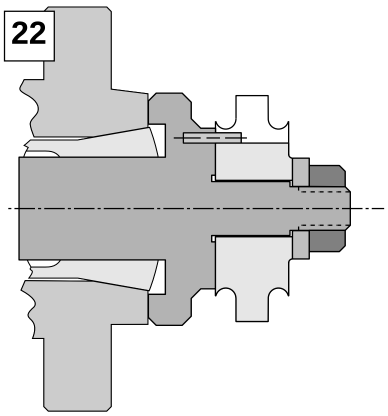


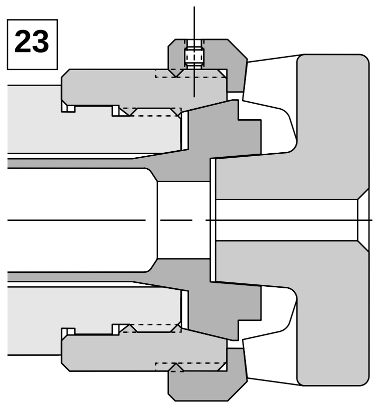
Here are some other examples to stimulate your imagination.

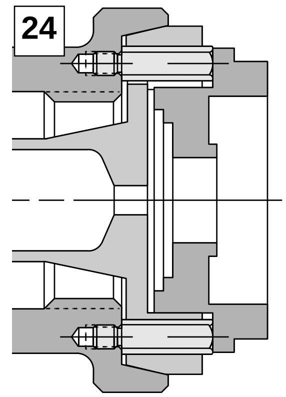


Touch-The-Spindle and Pin-Style Step Chucks

Precise length control requires the part to locate directly against the spindle or against a device which locates against the spindle. With a little imagination you will see other ways to accomplish this task. Any device which locates against the spindle must have its part locating surface "trued up" with a light facing cut. Make certain not to machine the face of the actual spindle. Here are some other examples of touching the spindle to hold lengths:

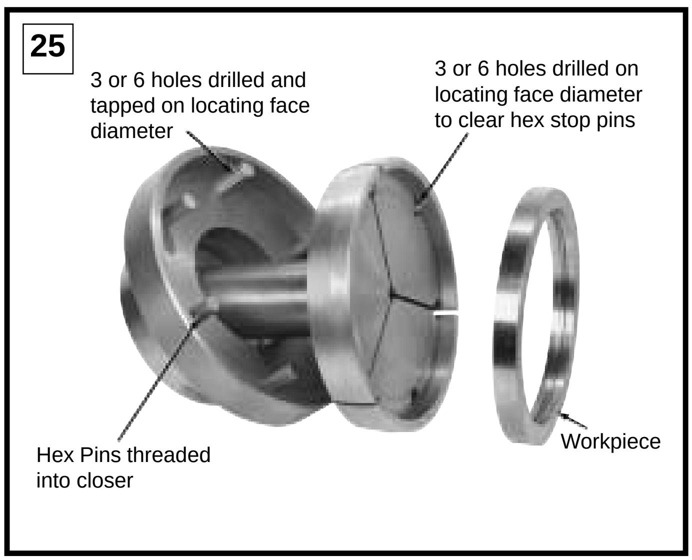






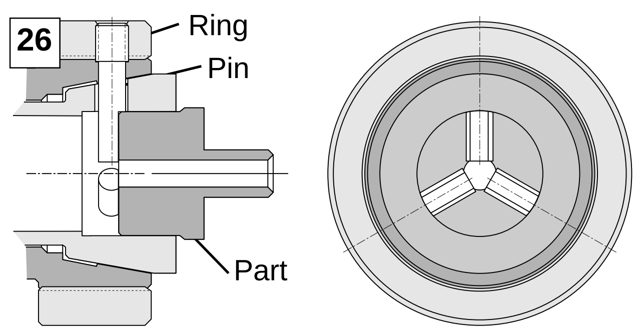
Pin Step Chucks are an excellent method of length control. The illustration in figure 24 shows the concept very well.

- Drill holes in the step chuck on the diameter of the locating surface on the part.
- Mount the closer on the spindle of the machine which is going to run the part.
- Mount the step chuck in the closer (key of spindle aligned to keyway of step chuck).
- Center-punch the closer through the holes in the step chuck.
- Remove step chuck and closer.
- Drill and tap the closer.
- Threaded hex pins are made and assembled.
- Mount the closer and step chuck.
- Insert pins into the face of the step chuck and close the step chuck on round pins.
- Lightly face the hex pins to make them perpendicular to the spindle centerline.
- Remove round pins from the step chuck.
- Load the part and close the step chuck.
- Machine the part.



Side-Pin Step Chuck: The pins are brought in from the side of the closer. This method requires more mass on the closer (figure 26).

- Make a heavy-walled ring and thread or press it on the closer.
- Drill and tap locating pin holes through the side of the closer assembly.
- Drill large clearance holes in the step chuck for pin clearance (as shown) or widen slots to clear the pins.
- Assemble the pins and face to make them perpendicular to the spindle centerline.



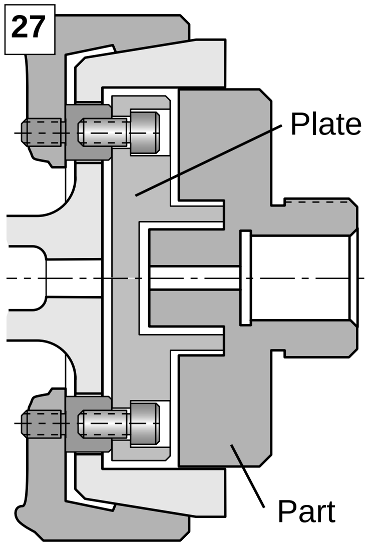
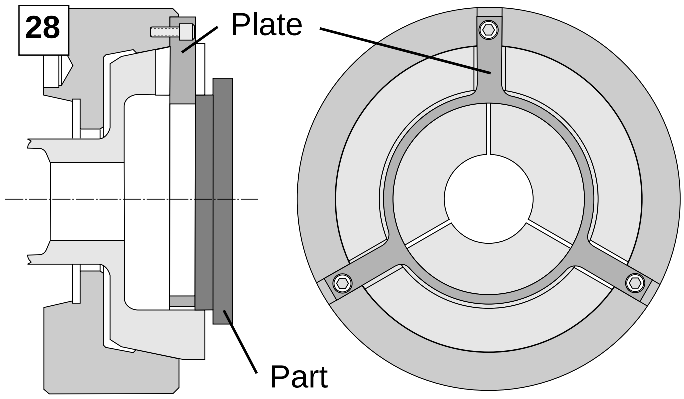


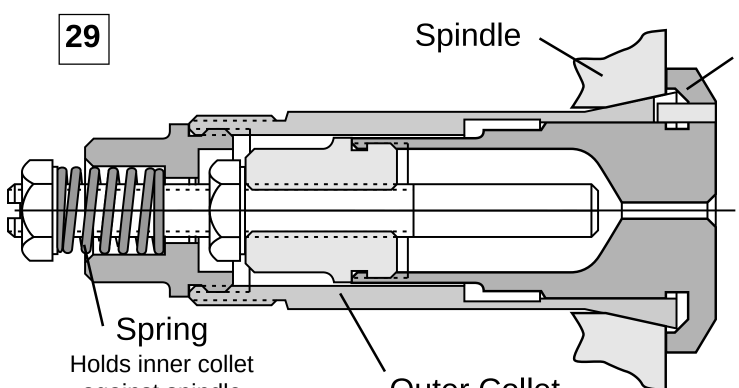
Plate-Style Pin Step Chucks: These are made with plates bolted to large pins. The plate is then machined to the configuration of the locating surface of the part (figure 27).

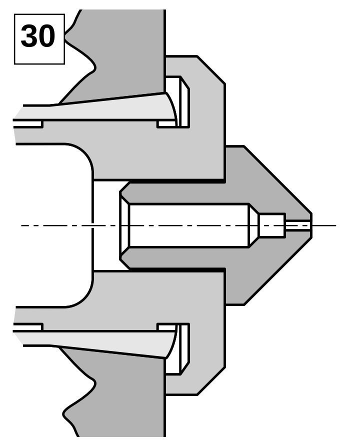
External Spider-Style Step Chucks: (figure 28)

This method has slots on the face of the closer. The spider plate is made from heavy sheet metal and bolted to the face of the slots of the closer.



Dead-Length® Collets and Step Chucks





The Dead-Length® Collet, patented by Hardinge®, brings everything that we have discussed together into one uniquely designed, high production, precision length control device.

How the Dead-Length Collet Works: (figures 29 and 30)

- The inner collet locates against the spindle face.
- The outer collet is pulled back by the collet closer. This action closes the outer collet down on the inner collet, gripping the part. This action also draws the inner collet firmly back against the face of the spindle.
- The stop in the inner collet, along with the adapter in the outer collet, and the spring and nut hold the whole assembly together. When the collet closer moves forward to open the collet, the spring holds the face of the inner collet against the spindle face.
- The spring adjustment is critical. If the spring is compressed too tightly, the whole assembly will be pushed forward when opening the collet, thus moving the face of the inner collet away from the spindle face, allowing chips to fall in the gap.

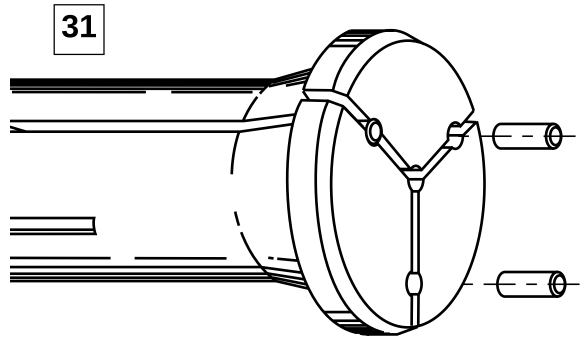
  NOTE: If there are problems holding lengths, this is the first thing to check. Back off the spring nut one turn and check again for inner collet push out.

Emergency Inner Collets come standard with the Dead-Length® collet assembly. These soft inner collets are used for short run production jobs.

How Emergency Inner Collets Are Used

- Pins are inserted in the appropriate holes in the face of the collet for machining.
- The collet closer is then adjusted like a normal emergency collet.
- The bore is machined to the exact size of the chucking diameter of the workpiece (high side of its tolerance).
- After machining remove the assembly from the spindle.
- Take the pins out and debur the inner collet.
- Reassemble and mount the assembly back in the spindle.

31



Hardened and Ground Inner Collets are also available. These eliminate the time needed to bore out the collet. The collet is hardened and will last for years under normal machining conditions. The emergency collet is intended for short run jobs, or when there is no hardened and ground collet on hand.

Other Style Dead-Length® Collets and Step Chucks

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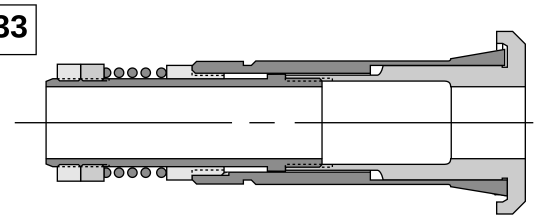
33



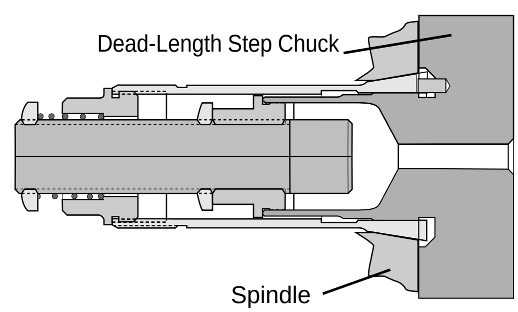
16C Dead-Length Thru-Collet

The Dead-Length Thru-Collet is used for bar stock and has the same precise length control capabilities. The Thru-Collet feature does reduce the maximum diameter stock which can be held with the collet. Bar stock is fed thru the open collet to the revolving stop. The inner collet does not draw back when the collet closes, therefore, the length is held very accurately even when the stock diameter varies (figures 32 and 33).

34

Dead-Length Inner Step Chuck Assembly

35



16C Dead-Length Step Chuck

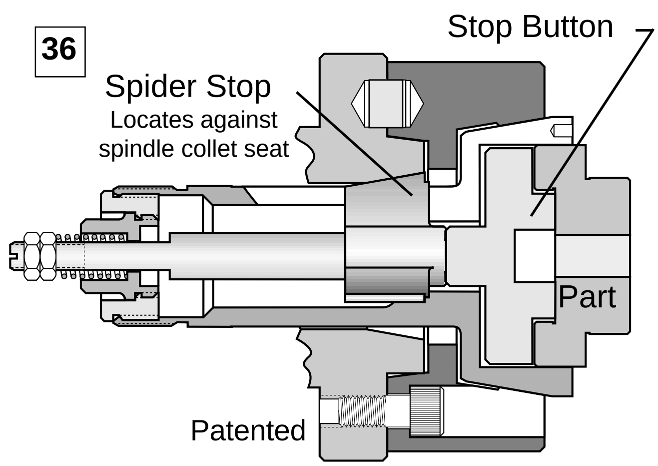
The Dead-Length Step Chuck is nearly identical to the Dead-Length collet except that it has a large diameter head for gripping parts up to 2-3/4" and to a depth of 1/2". This device is for light machining operations only (figures 34 and 35). For heavier duty machining, a step chuck must be contained with a step chuck closer. The Dead-Length *Spider-Stop* step chuck should be used for those applications.

The 16C Dead-Length® *Spider-Stop* Step Chuck uses a heavy-duty finned stop that locates against the collet seat in the spindle. The spider is internally threaded to receive the stop button. The stop button is machined to conform to the part and its locating surface (figure 36).

This device is excellent for standard and heavy-duty machining. There are two models, one for up to 3" diameter work and the other for up to 4" diameter work.

If you have a need for holding larger diameter workpieces, Hardinge® has a special collet department which can meet your requirements.

36



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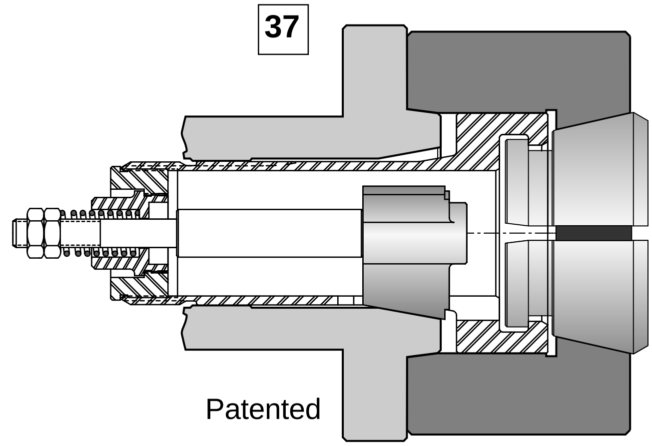


16C HQC®-42 Quick-Change Collet Dead-Length® Spider-Stop Assembly also uses the collet seat in the spindle to locate the length control device. The *Spider-Stop* is internally threaded, 1/2"-20 TPI, but a stop button is not supplied.

Advantages of Dead-Length Systems

- Commercially available — off-the-shelf delivery.
- Precise length control up to the capacity of the collet or step chuck.
- Inexpensive emergency collets.
- Hardened and ground inner collets.
- Available for the Hardinge HQC® *Quick-Change* Collet Systems.
- Spider-Stop systems capable of heavy stock removal.

Disadvantages

- None.

Summary: The Dead-Length collets and step chucks all use either the face of the spindle or the collet seat to guarantee precision length control. Because they are commercially available there is no lost production due to development in your own facility. The appropriate components are hardened and ground to assure maximum life of the product which may not be possible in your own facility.

We have come a long way in our understanding of length control and should be familiar with the following methods, as well as their advantages and disadvantages. The chart below summarizes what has been covered.

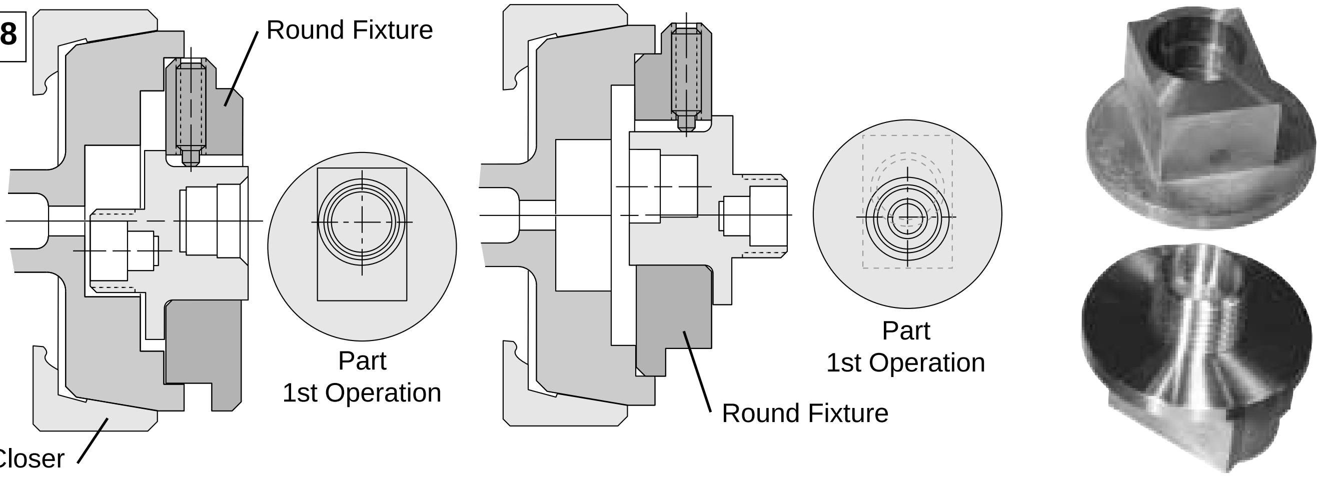
Method	Advantage	Disadvantage
"Mic" & Stack	Doable	Extremely time consuming Inaccurate - Not considered precise
Fixture Plate	Precise length control Excellent for long run jobs Available for the 5C & 16C spindles	Part must have a long chucking diameter with a locating shoulder - Fixture plates are expensive
Stop Plates	Precise length control Inexpensive Stabilizes the part Reduces chatter - Improves finish	Part must have long chucking diameter with a locating shoulder - Time Consuming Subject to chips and dirt behind plate Not practical for long run jobs
Spindle Mounted Stop Plates	Precise length control Reasonably priced Excellent for short and long runs Plates quickly changed for new job Quick part loading Reduces chatter - Improves finish Available for the 5C & 16C Spindle	Parts must have long chucking diameter with a locating shoulder
Touch-the-Spindle - Pin Step Chucks -	Precise length control Quick part loading	Requires custom made devices to locate against the spindle
Dead-Length® Collet	Precise length control Inexpensive inner collet Quick setup Available for the 5C & 16C spindle	None
Dead-Length® *Thru-Collet*	Precise length control for bar stock Inexpensive inner collet Quick setup Available for the 5C, 16C & 20C spindles	Reduces maximum stock capacity of the inner collet
Dead-Length Step Chuck	Precise length control - nexpensive inner step chuck - Available for 5C, 16C & 20C spindles	Light machining only 2-3/4" maximum diameter part
Dead-Length *Spider-Stop* Step Chuck	Precise length control Heavy duty machining Quick part loading	4" Maximum diameter work In stock for the 16C Spindle Can be special ordered for others
HQC® *Quick-Change* Dead-Length *Spider*-Stop Assembly	Precise length control for HQC® Quick part loading	Must be installed before HQC spindle mount - In stock for 16C and A2-5 Spindles - Can be special ordered for others

There Are Other Ways!

There are other methods which do not use the fixed spindle for length control. One method is used for parts which are difficult to hold and are usually mounted to a face plate or held with a very elaborate fixture. We call this method **"Off-the-Spindle"** or **"Round Fixturing"**.

Off-the-Spindle Fixturing — Round Fixturing

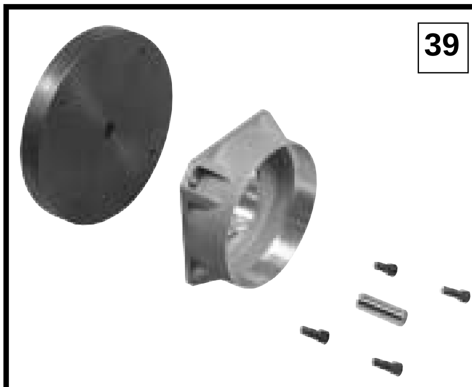
38



Off-the-Spindle fixturing evolved from the need to hold precise lengths when machining cast and irregular-shaped parts on machines with draw-in collet style spindles.

The standard practice when machining castings or irregular-shaped parts is to make a special face plate to hold the part. The parts are usually piloted on a stud or located against two surfaces. The part is then bolted or clamped to the fixture plate. After the machining is completed, the part must be unclamped from the fixture. The fixture is cleaned and the new part positioned and clamped into place (figure 39). This unloading/loading process takes time, and during that time the machine tool is not cutting chips. It is totally non-productive.

39



Face Plate, Part, Loading Pin

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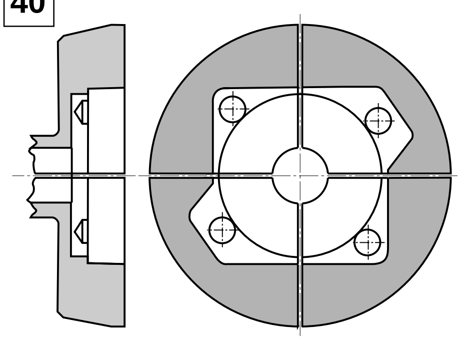
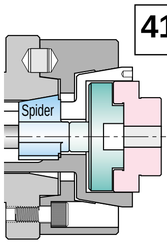


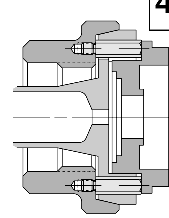
A special step chuck contoured to the shape of the part is one approach to solving this problem (figure 40). When the step chuck closes it grips the part at two, three and sometimes four places. This eliminates most of the nonproductive time on the machine (time required to clamp and unclamp the parts). The disadvantage of this method is length control. The parts usually vary considerably between the chucking surfaces and the 1:3 ratio still holds true.—for every .001" variation in the diameter, the part will vary .003" in length.

41



Spider-Stop technology or **"Touch-the-Spindle"** technology (figures 41 and 42 and pages 7 and 8) is another way step chucks can be made. Many times these work very well, especially with precision cast parts or parts which have been precision machined during previous operations.

42

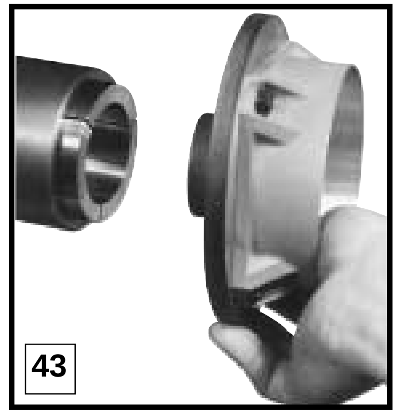


The accurate gripping range of step chucks fall within a certain tolerance range. When this range is exceeded, the parts will not be held firmly enough and the process becomes impractical. Most castings and molded parts fall within this category. The *Spider-Stop* and contoured technology may not be practical for your cast or irregular-shaped parts.

This is where the Off-the-Spindle/Round Fixturing technique comes into play. The two main elements in this method are (figures 43 and 44):

- A hardened and ground extra-depth step chuck with a chucking bore to the exact size of the chucking hub. The locating surface, which may be the bottom of the counterbore, or the face of the step chuck, should be perpendicular to the bore within .0002" or less.

- The chucking hub diameter, or the OD of the round fixture, is exactly the same size as the bore in the step chuck, -.0002" or less. The locating surface is perpendicular to the chucking diameter within .0002" or less. For .0003" length control the chucking diameters between round fixtures cannot vary more than .0001".



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Two or more round fixtures are required. The part is placed on the round fixture and clamped in place by the most efficient method dictated by the configuration of the part. It is very important that the round fixture be precision balanced. The round fixture with the part is positioned in the step chuck and firmly held in place while the step chuck is closed.

During the machining of the first part, the second round fixture is unloaded, cleaned and reloaded. For maximum efficiency the fixture loading must take less time than the machining and gaging operations. If it takes 2 minutes to machine the part, it has to take less than that to inspect the part, empty and reload the round fixture.

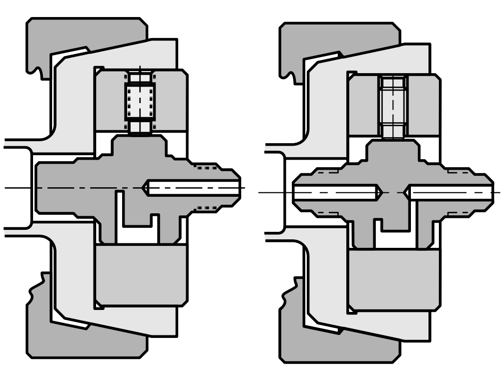
The Off-the-Spindle/Round Fixturing technique is extremely efficient. If the chucking diameters on the round fixtures are within .0002" of each other, we can expect to hold lengths within .0006". If your length tolerance on the parts is .001", the job is going to be easy.

Pin/Plate Step Chuck technology combined with round fixturing will ensure precision length control. The pins or plate would locate against the round fixture. Any variation in the chucking hub diameter would not affect the length tolerance. It would be "dead on".

Summary: The key to maximum productivity is to keep the machine cutting metal. Round fixturing techniques ensure maximum cutting time in the machine. Higher precision length control can be guaranteed when round fixturing and pin/plate step chuck technology are combined.

Here are several round fixturing examples (figures 45-48). Look them over and let your imagination soar. Look over figure 38 on the previous page for an eccentric application of a molded part.

45



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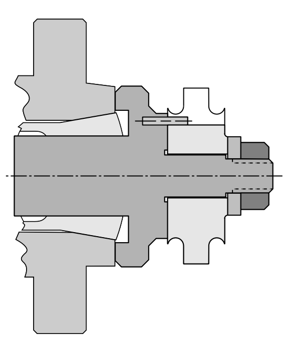

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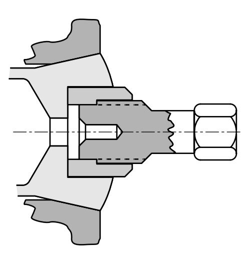

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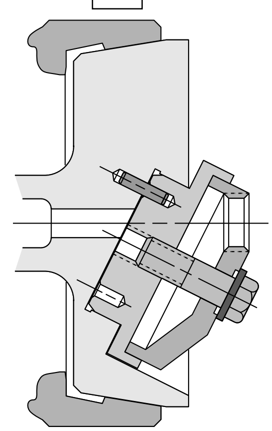
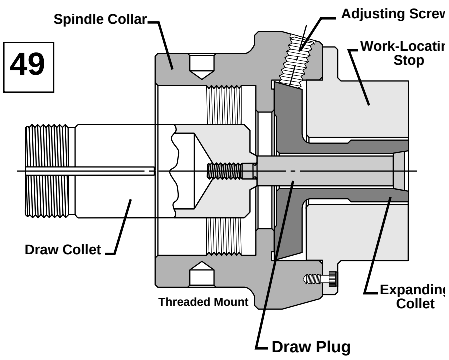


Precision Length Control using Expanding Collets

Expanding collet assemblies have always been one method for holding precision lengths on lathes that have draw-in collet capabilities. If there is a good hole in the part it can be held with an expanding collet.

Early expanding collet systems were either spindle mounted (figure 49), which were the most precise, or the collet style (figure 50). One version of the collet style uses master pads made from soft steel or aluminum which can be removed and easily replaced.

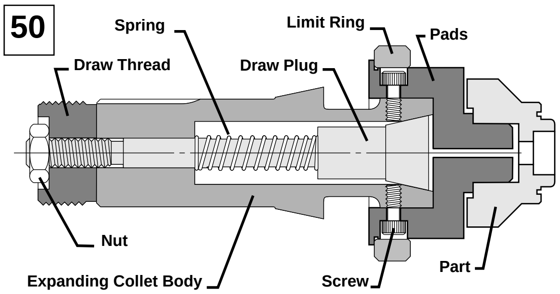
49



How Expanding Collets Work (figures 49 and 50)

- The expanding collets were initially located against a spindle collar mount.
- The closing device, a tapered draw plug, is attached to a headless draw collet.
- When the draw collet is pulled by the collet closer, the expanding collet opens up, gripping the bore of the part.

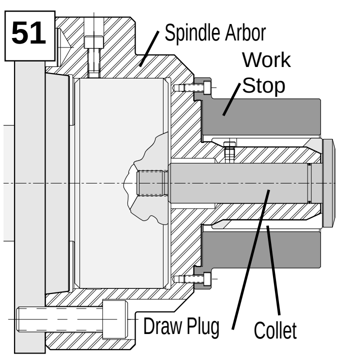
50



The collet never moves, therefore, the part never moves. If the part locates against the face of the collet, or if the collet is stepped and the part locates against the step, precision length control is assured. When the part cannot be located against the face of the collet, or a collet step, a work locating stop is used. Work locating stops are attached to the spindle mount to help locate each new part in the same length position as the previous part. These expanding collet systems are able to hold length tolerance in the low ten thousandths of an inch.

Newer style expanding collet systems such as the Hardinge® Sure-Grip® Expanding Collet System, use multi-split double-angle collets, which have a total expansion range of 1/64" from their nominal size. This style expanding collet system has a double-angle arbor which is part of the spindle mount or part of a solid collet which locates in the spindle's collet seat. The collet slides on the arbor, locating on a key.

51



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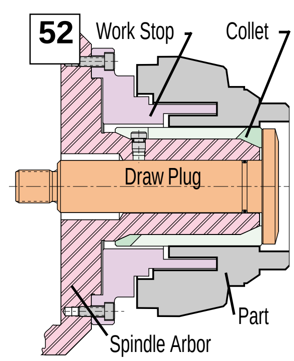
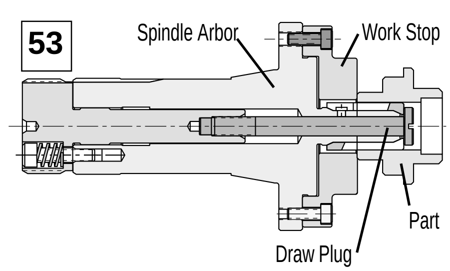


How Sure-Grip Expanding Collets Work (figures 51-53)

- The back face of the draw plug pulls the collet back causing the collet to ride up on the two angles of the arbor which open the leaves of the collet parallel to each other.
- The collet and the part move back until the collet has firmly gripped the bore of the workpiece. If the chucking diameter (the bore of the part) varies, the position from one part to the next part will vary longitudinally. **NOTE:** Locating the part against the face of the collet, or a step on the collet, will **not** cure this length control problem.
- Because of the longitudinal movement of the collet a work stop is required to guarantee precise length control. Work stops are used on the spindle mounted expanding collet system as well as the collet style systems.

53



Conclusion: Our objective was to give you a basic understanding of precision length control for machines which use draw-in collets. There are literally hundreds of ways to make precision length control devices, but they all boil down to the basics shown in this publication. If you have any questions about the information in this book, please give us a call and we will be happy to help you.

If you don't have the facilities or expertise and have a workholding situation that needs a solution, please give us a call. We have hundreds of workholding systems sitting on the shelf waiting to be instantly shipped to you. Our Special Collet Department and Engineering Department are devoted to designing and manufacturing custom devices to meet your most stringent requirements. Let our one hundred plus years of experience in the design and manufacturing of collets work for you.

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