



## The 'Diameter Mode Dilemma'

"Diameter Mode Dilemma" is a term used to refer to the loss of resolution on a lathe cross slide, or X axis. This 'phenomena' is particular only to a lathe cross slide, and does not occur on the carriage axis (Z), or for that matter, any axis of a milling machine or any other mechanical machine. Why then, does this only occur on the cross slide of a lathe? This is because the cross slide is unique, in that it removes material from both sides of a workpiece at a rate of 1:2, meaning that for every 1 unit of cross slide advance, 2 units of material are removed from the workpiece. In other words, if the cross slide is moved .004" into the workpiece, .008" of material is actually removed from the part. This forms the first part of the dilemma: do you measure the cross slide movement, or how much material is being removed from the part? Let's take a look at some of the factors affecting the 'Diameter Mode Dilemma'...

### Scale resolution

Scale resolution affects the displays ability to measure cross slide movement. The current "industry standard" scale is the 5 micron (5µm) scale. The smallest movement a 5 micron scale can detect is .0002". Therefore, a 5 micron scale "counts" in two ten-thousandths increments, ie when you move your machine it will count .0002", .0004", .0006" etc. But remember, the cross slide removes twice the amount of material than the cross slide moves. So while your cross slide is moving .0002", .0004", .0006" you're really removing .0004", .0008", and .0012" of material from your part.

Cross Slide Movement	Part Reduction
.0002"	.0004"
.0004"	.0008"
.0006"	.0012"

What it boils down to, is the smallest measurable increment you can reduce your part is .0004", which would be the resultant travel when a cross slide scale moves .0002".

### Radius vs. Diameter

A digital readout can be programmed to display cross slide movement in either "radius" or "diameter" mode. From the factory, the default setting is to always show scale movement in "radius" mode. Radius mode counts in a direct 1:1 ratio – in other words, if a scale moves .004", the display will read a .004" change. Radius mode is always used for milling machines, wirecut, EDM machines, etc. But the exception is the cross slide on a lathe.

Setting "radius" mode displays **movement of the cross slide**.

Setting "diameter" mode displays the amount of material being removed from a part or **part reduction**.

Therefore, most lathe operators prefer setting the cross slide scale to display in diameter mode. That's because it's more important to see how much material is being removed from the part, than it is to see how much the cross slide is moving (remember, the carriage scale is still set to read in radius mode because the carriage cuts at a 1:1 ratio like most all other machines do).

Now assume we're using a standard 5 micron scale (.0002" resolution), and leaving the display to it's factory default setting (radius mode). Next, we move the cross slide the smallest increment the scale is capable of reading (.0002"). Under these circumstances, here's what the display would indicate:

"Radius" Mode 5 Micron (5µm) 0.0002" Resolution Scale		
Actual Cross Slide Movement	Display Reads	Part Reduction
.0002"	.0002"	.0004"

Notice that .0004" of material is being removed from the part, but the display only indicates a change of .0002". You can probably imagine how easy it would be to remove more material than you desired using this method. That's why most operators prefer to work in 'diameter' mode instead of 'radius' mode.

Let's take a look at an example where the display has been programmed to read in "diameter" Mode:

"Diameter" Mode 5 Micron (5µm) 0.0002" Resolution Scale		
Actual Cross Slide Movement	Display Reads	Part Reduction
.0002"	.0004"	.0004"

Note the display reads exactly how much material has been removed from the part, not cross slide movement. If you consider this for a moment, it makes sense. Cross slide movement is immaterial – what's truly important is what's happening to the part. That's why most operators prefer to work in 'diameter' mode.

However, note also that the smallest measurable change of part size is now .0004", or four ten-thousandths. Although the scale can sense a change of movement of .0002", .0002" of cross slide movement removes .0004" of material from the part, effectively reducing the scales resolution in half. Let's expand the chart a bit:

"Diameter" Mode 5 Micron (5µm) 0.0002" Resolution Scale			
Actual Cross Slide Movement	Display Reads	Part Reduction	Effective Resolution
.0002"	.0004"	.0004"	.0004"
.0004"	.0008"	.0008"	
.0006"	.0012"	.0012"	
.0008"	.0016"	.0016"	
.0010"	.0020"	.0020"	

Note that your effective resolution has now been reduced to four ten-thousandths – in other words, you could not remove exactly .0006" of material – you would have to choose between either .0004" or .0008".

It's important to note that whether you choose to display the cross slide movement in either "radius" or "diameter" mode is immaterial. Either way, with a .0002" movement on the cross slide, you still remove .0004" of material. That's just the nature, or characteristic, of how lathes work.

### Beating the Diameter Mode Dilemma

The only way to 'beat' the diameter mode dilemma is to use higher resolution scales. As stated before, the minimum increment a 5 micron (5µm) scale is capable of registering, or reporting, is .0002". But upgrading to a 1 micron (1µm) scale increases your resolution to 50 millionths or 0.00005". When programmed to read in diameter mode, they display in .0001" increments, as noted below:

"Diameter" Mode 1 Micron (1µm) 0.00005" Resolution Scale			
Actual Cross Slide Movement	Display Reads	Part Reduction	Effective Resolution
.00005"	.0001"	.0001"	.0001"
.00010"	.0002"	.0002"	
.00015"	.0003"	.0003"	
.00020"	.0004"	.0004"	
.00025"	.0005"	.0005"	

So you can see that upgrading to 1 micron (1µm) scales effectively gives you 4 times better resolution! And for only \$50 more, the DRO PROS 1µm SlimLine cross slide scales really show their value! So what does DRO PROS recommend? We recommend 5µm scales for the carriage, and 1µm SlimLine scales for the cross slide. In this configuration, effective resolution is .0002" on the carriage and .0001" on the cross slide. For just a \$50 upgrade, you get 4 times the resolution - definitely worth the upgrade in our opinion!

Best of luck, but most of all, enjoy your new DRO kit! - **DRO PROS**