

PypeServer with EdgeConnect machines

1 Machine configuration

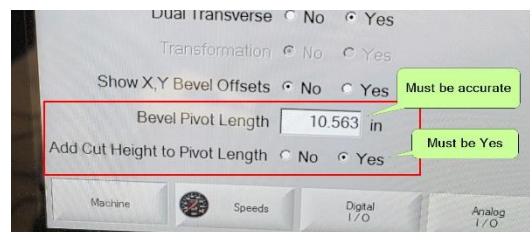
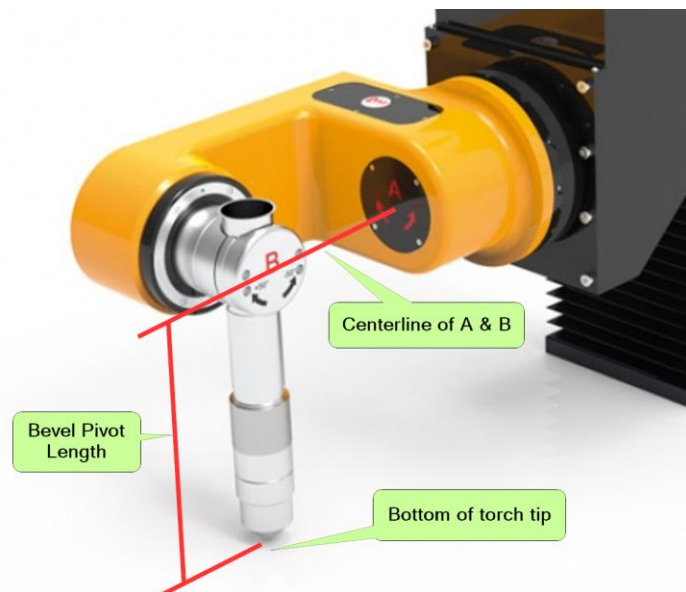
When configuring your machine, some preparatory steps are required in order to get meaningful test results.

1.1 Getting axial directions correct

This is done in conjunction with PypeServer in an online meeting where the operator performs various test cuts with PypeServer, and PypeServer support changes configurations per test results. For these tests it's best to use smaller pipe in the 3-6" range that, as mentioned above, does not creep along or rise up off the roller bed. Only a few feet of pipe will be used, but for stability the pipe should be long enough to touch several bed-rollers.

1.2 Machine Pivot Height

If you plan to bevel (tilt the torch), then you will need to set your Bevel Pivot Height as accurately as possible. PypeServer can help you with this. Note that not all heads have A and B on the same plane. If they are not on the same plane, the height is to the B centerline.



1.3 Getting the G96 Constant set right (Roller-bed machines only)

If your machine rolls the pipe using a chuck, this is not applicable.

The G96 Constant is typically provided by the machine manufacturer. This constant tells the machine how many steps it must perform for a given distance of roll. If it is off, then holes will not be round, endcuts will either cut too far or not far enough, etc.

One way to set the G96 Constant is to program a roll for one full rotation of the roller wheels, which are 16" in diameter. This can be achieved using this program:

```
G20 (Inches)
G91 (Incremental steps)
FA200 (Acceleration setting)
G93 X0 (Pivot Ht Comp from Torch Settings)
(Step increment is 0.050 Inches)
M37 T1 (Station)
G96 Y2.7929 (G96 rollerbed constant)
G01 A0. F20. (Torch Straight up -)
M50 (Torch height control off)
M28 (Bevel following disabled)
G01 A0. F20.
F80
G01 Y-50.26548 (one full rotation of the roller bed wheels)
M19 (Cancel all stations)
M02 (End of Program)
```

Steps in using this program:

1. Mark a wheel where it can be indexed against some frame piece
2. Run the program (which rotates the wheels one exact full rotation)
3. In the NC file, if the wheel:
 - a. under-rotated: increase the G96 value
 - b. over-rotated: decrease the G96 value

Repeat steps 2 and 3 until the bed wheels are rotating exactly 360.

2 Pipe Quality

For cuts to be accurate and for the machine to cut without issues, the following factors are important.

2.1 Pipe must not be bent

Also, for all machines, make sure that the pipe is straight such that the pipe is not rising up off the rollers when rotating. In some cases bent pipe can be cut in production, but it will skew many test results at the when configuring and testing.

If the pipe is rising up off the wheels, the torch will touch the pipe and the cut will potentially fail.



2.1.1 Specific note on Using Torch Height Sensing

This is under the Bent Pipe topic because this is the primary reason to use Torch Height Sensing. Through testing, we've found that using Torch Height control does not work well when beveling. The machine cannot maintain a steady arc voltage measurement and the torch height changes too much to make a useable cut. For zero-bevel cuts (torch straight up and down the entire cut), torch height sensing can work if the Arc Voltage is set correctly. The settings in XPR are seldom realistic. We've found that through trial-and-error users find a useable Arc Voltage to keep the torch from going to high and faulting, or going to low and hitting the pipe.

Applicable Settings and GCodes:

2.2 Testing for pipe creep

For machines that do not have a chuck and roll the pipe with wheels on pipe bed, it's recommended to roll the pipe around numerous times to check that the pipe is staying in the same position and not creeping up or down the roller-bed. This can also happen in some cases with a chucked pipe. Note that pipes will sometimes creep even if they appear straight.

2.3 Pipe Bed must be level on all wheels

Pipes will also creep and other irregular pipe movement may occur if the pipe bed wheels are not level down the length of the bed. If only one or two wheel sets are off, this will produce varying cut results depending on the length and location of the pipe.

2.4 Pipe OD accuracy

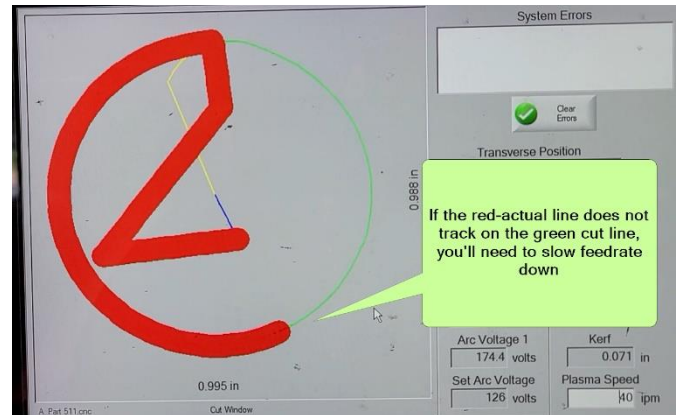
On roller-bed type machines, for end-cuts to finish correctly and holes to be round, it is essential to input the actual pipe outer diameter. Entering the wrong diameter by even a little, such as 1/16" will result in distance inaccuracy of $1/16 * \pi$, or ~0.2" when cutting around the pipe. If measuring across the pipe, measure in multiple locations in case the pipe is not round.

Recommended: One way to get an accurate outer diameter for a pipe is to take a thin piece of string (like dental floss) and wrap it 3 times around the pipe, then divide the measured string length by $3 * \pi$.

3 General Cutting Recommendations

3.1 Feedrates

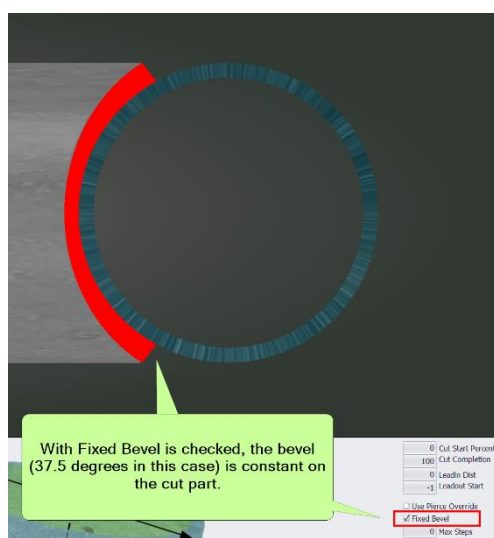
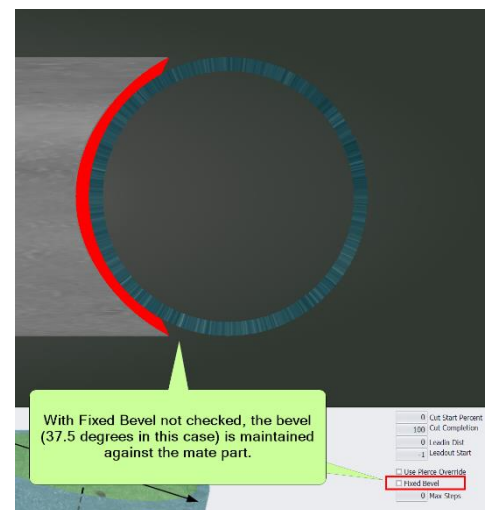
For straight cuts, most machines run well at the recommended feedrates. When beveling, and with any cut that involves rapid motions, feedrates often (on some machines) must be slowed down so that the EdgeConnect Controller can keep the torch on the cut path. (This does not appear to be a machine servo power limitation.) You can visually see if your feedrates are too fast by watching the cut in Phoenix to see if the actual cut path (in red) is following the planned cut path (in green). If the feedrate is too fast, the deviation is typically visible both on-screen and on the actual part.



3.2 Use Fixed Bevel

By default, PypeServer cuts maintain (within machine limits) a bevel against the mating part. For example, a saddle with a 30 degree bevel will vary in its actual cut bevel so as to maintain a 30 bevel against the part it is saddling on to. From a GCode perspective, this means that the torch angle must continuously/dynamically change to preserve that mate bevel.

This dynamic beveling is not well supported by EdgeConnect controllers. Cuts that dynamically change the bevel in GCode during the cut will typically be jagged.



By checking the “Fixed Bevel” checkbox for a cut, the cut bevel will be maintained against the part being cut. This eliminates changes to the bevel in GCode, which results in a smoother cut.

A “Fixed Bevel” saddle will have the same bevel on the cut pipe, all the way around the pipe.

4 Torch Height Sensing

Most EdgeConnect controlled machines support Torch Height Sensing (THS) to determine proper torch height. THS can be used for the beginning of a cut (touching off) and while making the cut.

There are pros and cons to using and not using THS.

4.1 Using Torch Height Sensing to touch off

THS is always included in GCode for touching off ("M07 HS"), but you can disable THS completely (for most torches) by disconnecting the ground/sensing wire to the torch tip. There may be other ways to disable THS in EdgeConnect settings.

If THS is used, the machine will lower down to the part until it detects a given Arc Voltage. Arc Voltage is set in the Torch Properties in PypeServer.

Pros:

- The torch doesn't actually touch the pipe.
- If the pipe is bent and is rising up off the wheels at the touch off point, the torch will remain above the pipe. This can be better than a physical touch off because with a physical touch off the pipe will flex back up and the torch will fault because it is too close to the pipe—hitting the pipe at the start, or during the cut when beveling. If the pipe is bent, then THS should be on for the remainder of the cut so that the torch will follow the variable pipe height. See section [Using THS for Cuts](#) for more information.

Cons:

- The Arc Voltage may need to vary between metal types to get a proper height. Arc Voltage is also sensitive to proper grounding and pipe surface continuity at the touch off point. E.g. if there is rust on the pipe at the ground or the torch tip, then torch height will be adversely affected.

Not using Torch Height Sensing to touch

IF THS is not used, then the machine will simply lower the torch until it detects physical contact with the part.

Pros:

- Arc Voltage is not a factor. The machine is simpler to use and often more reliable.

Cons:

- A bent pipe might be pushed down and then spring back up after touching off, resulting in a torch contact fault when starting, or when beveling during the actual cut.

4.2 Using THS for Cuts

Using THS for the actual cut is typically needed in these situations:

- Cutting holes with the pipe fixed. It is typically required for smaller pipe. See section [Cutting Holes with the Pipe Fixed](#)
- Cutting bent or out of round pipe where the pipe height varies through the cut.

Using THS can produce good results with these conditions:

- The pipe is clean so that Arc Voltage readings are accurate
- The pipe is well grounded

- The torch is not beveling steeply. For steeper bevels (~> 10 degrees?) the torch has a difficult time reading arc voltage (on pipe) and the torch will move in ways that will gouge the part and make the cut uneven. These issues may be solved by carefully tuning the Arc Voltage, having good electrical continuity through the pipe, and perhaps having all other machine factors well-tuned.

4.3 Arc Voltage for THS

As discussed above, Arc Voltage is used to determine torch height. Arc Voltage settings vary by pipe composition, electrical continuity through the pipe, consumable condition, and other lesser factors.

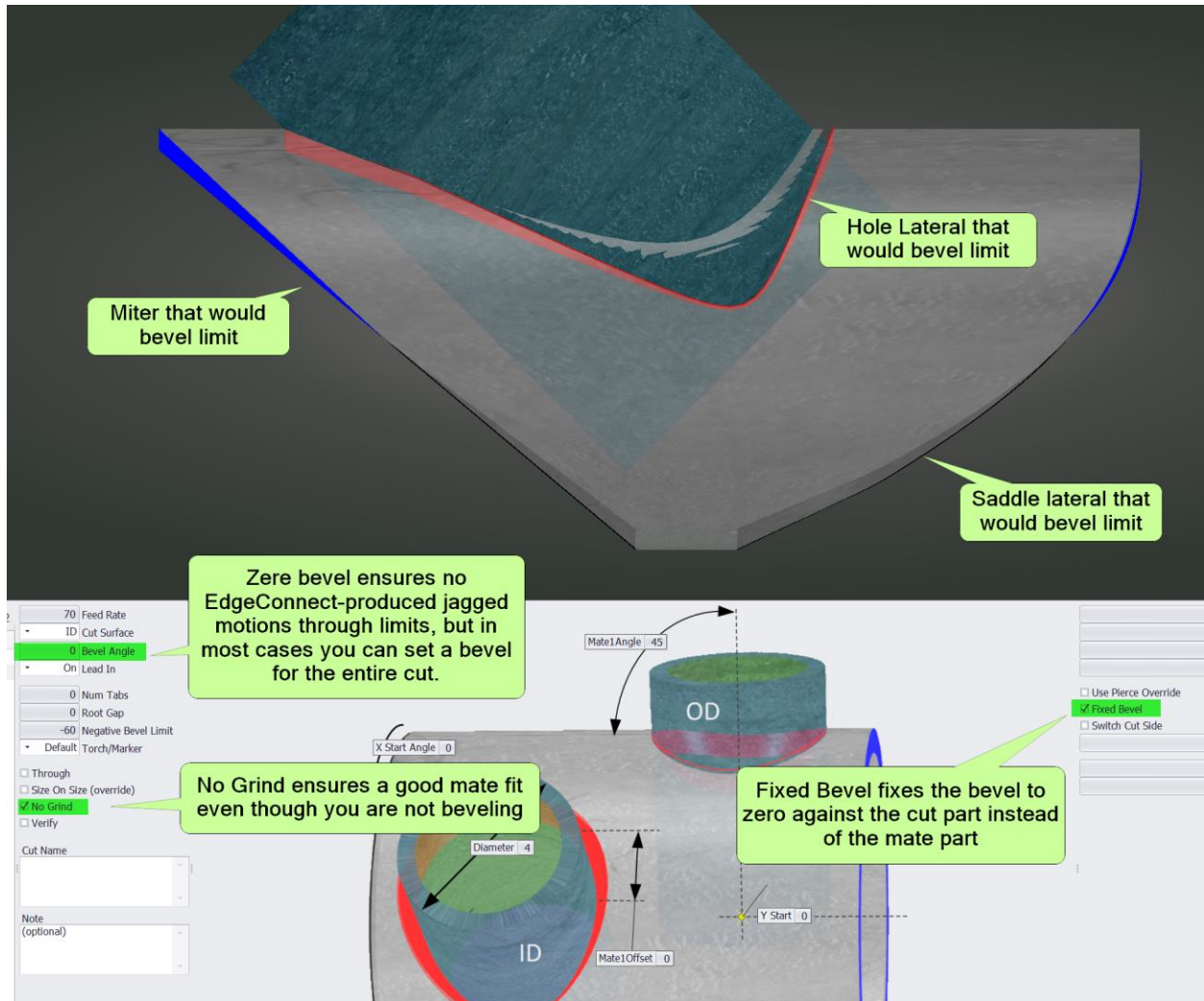
It is recommended that you familiarize yourself with Arc Voltage as covered in EdgeConnect documentation.

5 Endcuts

5.1 Bevel Limiting expectations and recommendations

For Saddles, if you set a negative bevel limit, the torch will typically jerk in transitions between the limit and the normal cut. This is caused because minor variations in path direction are not handled smoothly by EdgeConnect controllers.

Steep miters and tilted saddles (like laterals) will naturally bevel limit at the maximum torch bevel. This will cause some rough spots in the cut. One solution to smoother cuts of this type is to set the bevel to zero, check the “Fixed Bevel” box, and also check the “No Grind” feature. This will give you no-bevel cuts, but they will fit nicely with the mating parts. There will however be undercuts in places. You can also set the bevel to something other than zero that is acceptable around the cut.



6 Holes

6.1 Cutting Holes with the Pipe Fixed

For machines with linear motion across the pipe, hole cuts can be configured to fix the pipe rotation while cutting. This usually results in higher quality hole cuts. This feature works for circular, rectangular and elliptical holes.

6.1.1 Settings for Fixed Pipe Cuts

PypeServer determines if the pipe can be fixed for a hole cut by these two Torch Property parameters:

Fixed Pipe Hole Max Percent Of Pipe Dia	0.5
Lock Pipe Rotation On Holes	True

Lock Pipe Rotation On Holes turns the feature on or off.

Fixed Pipe Hole Max Percent of Pipe Diameter provides the maximum hole size for locking/fixing the pipe and is calculated as Hole Diameter/Pipe Outer Diameter. E.g. with this set to .05, then for a 4" OD pipe, any hole 2" or smaller would be fixed. The pipe will rotate for holes larger than 2".

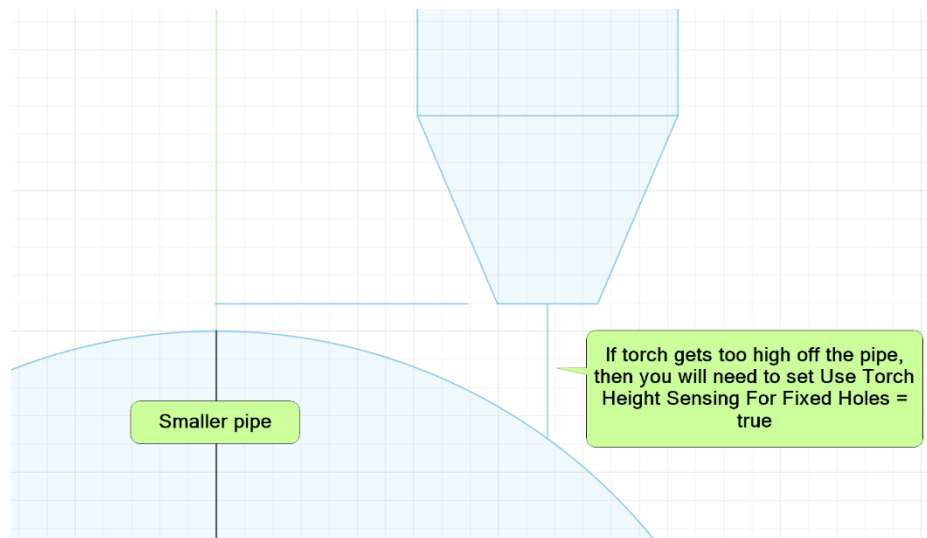
Using Torch Height Sensing for Fixed Holes

If you are cutting smaller pipe, the holes will wrap around the pipe such that the torch must follow the pipe height down Z to maintain a reasonable cut height.

For these holes, set **Use Torch Height Sensing for Fixed Holes** to true.

Use Torch Height Sensing

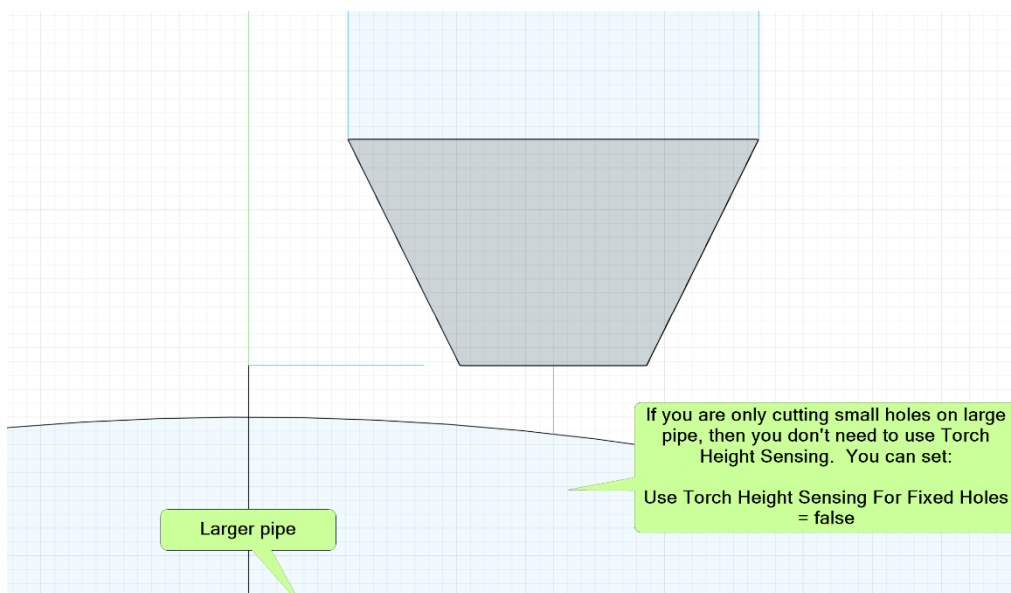
Use Torch Height Sensing For Fixed Holes



Note: You do not need to set "Use Torch Height Sensing" to true, as that is for all other cuts.

Larger pipe and small holes

If you are only cutting small holes on large pipe, then you can leave Torch Height Sensing off.

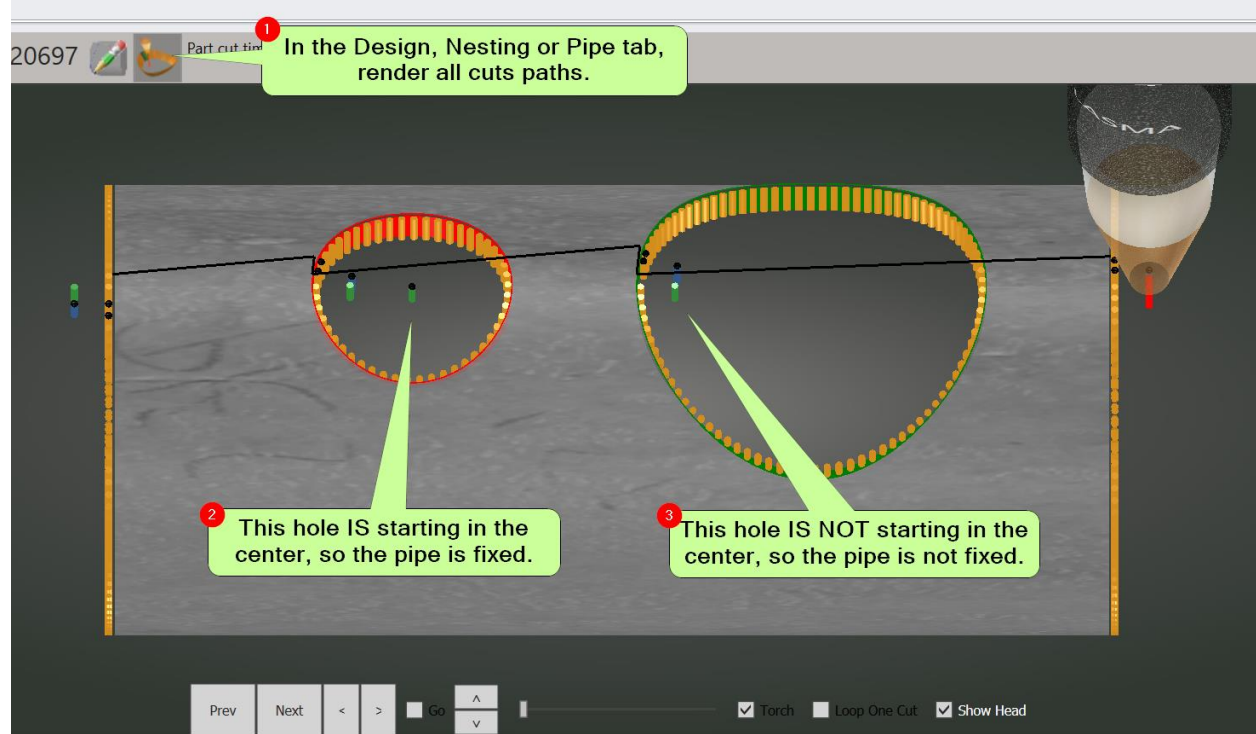


NOTE: If you are cutting offset holes, even on large pipe, you may need to use THS. However, if for the hole you check the "Fix Bevel" box, the hole should cut well without THS (again, for large pipe).

6.1.2 Seeing what holes are fixed in the PypeServer viewer.

To see if a hole is fixed, you can render the cut path. If the first step is at the center of the hole, then the pipe will be fixed for that hole cut. If the first step is at a normal leadin location, then the pipe will be rotating for that cut.

If you want to see all the holes at once, then render all cuts for your part or nesting, as shown below:



6.2 Offset and Tilted Holes

Offset and tilted holes can also use the fixed pipe feature. The pipe will be fixed at the center of the hole. If you check the “Fixed Bevel” checkbox the holes should cut nicely.

6.3 No Grind for holes

No-grind is only supported for ID-fit holes, which includes Size-on-size holes. This is because No-Grind for OD holes results in the same cut as same as ID holes with No-Grind. The hole dimension is set to the ID, but the hole is the same.

6.4 Rectangles and Ellipses

Rectangles and Ellipses are supported the same as circular holes. Tight corners with zero bevels typically work at normal feedrates, but with beveling, you may need to slow your feedrate down for proper path following. See the [Feedrates](#) section for more information on slowing down in corners.

7 Program starting positions

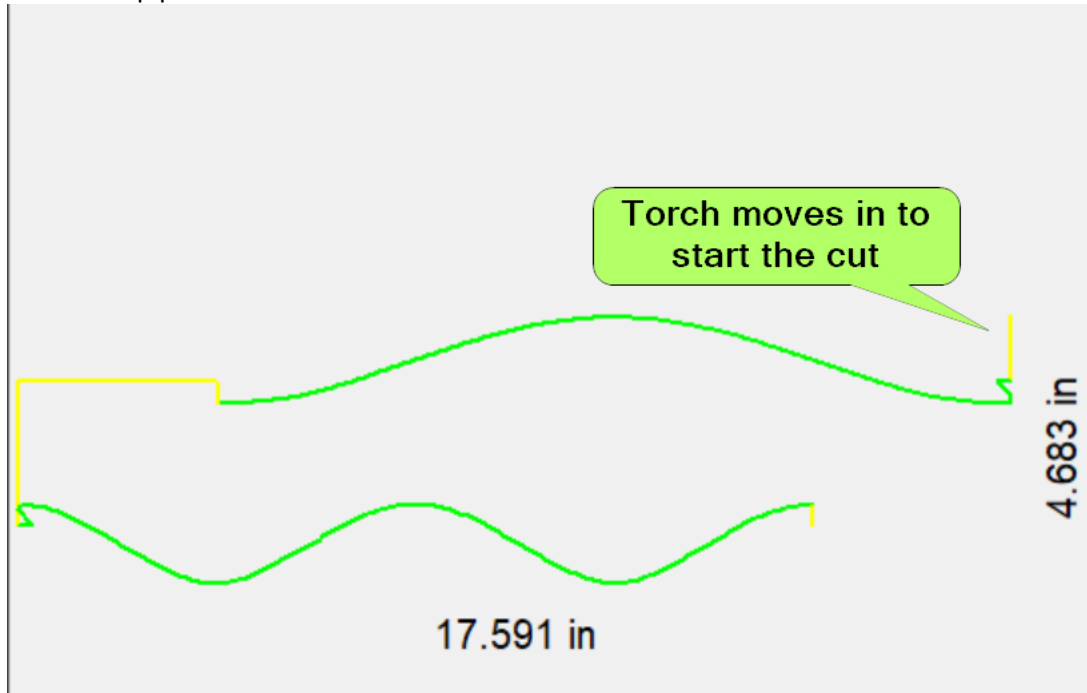
There are four basic starting locations for a program.

7.1 Starting at the start of a leadin (most common)

In this case you are typically starting a cut on the end of the pipe. Just position the torch so it is just on the pipe end.

What if my cut starts farther in on the pipe? Do I need to move my torch in further.

For endcuts, no. It's OK if your endcut starts farther in on the pipe and then moves farther toward the start end of the pipe; the program will move in enough for the start so that your cut will not run off the end of the pipe.



What if all I'm cutting is holes?

For holes with no endcuts, the first hole will be the starting point.

- If the pipe is fixed for the cut, then the start will be at the center of the hole
- If the pipe is not fixed, then the start will be at the leadin start of the hole.

How do I align my hole cuts so they are the right distance from the end of the pipe, but I'm not cutting the end?

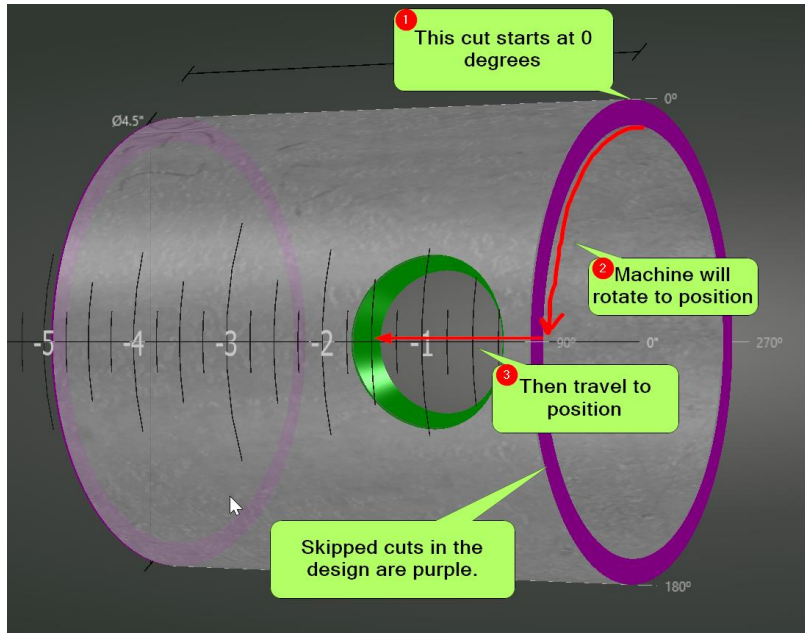
Add an End Marker or a Straight Endcut where the pre-cut endcut is located. Make sure the Skip Cut checkbox is checked. See the next section about starting a cut on a pre-cut pipe end.

7.2 Starting at the edge of the pre-cut pipe end

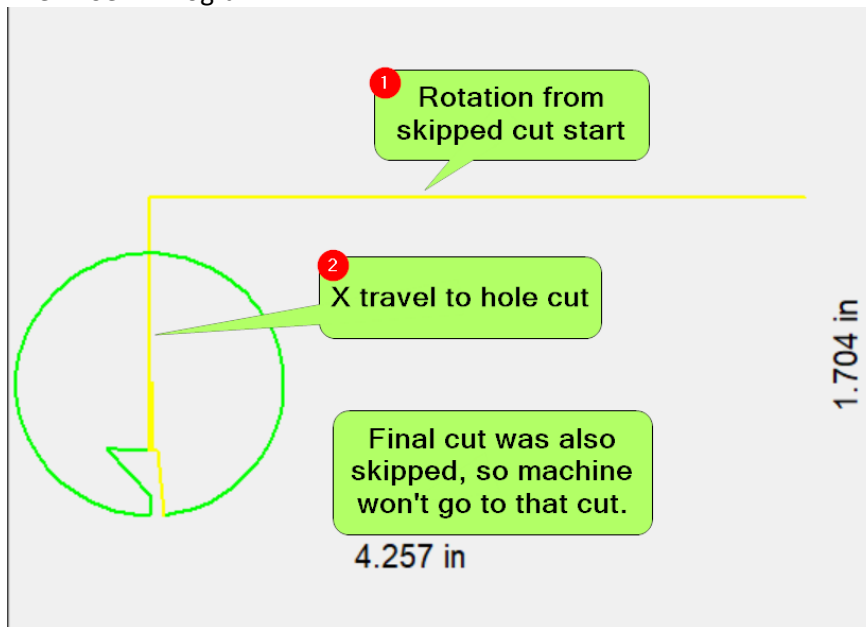
This is for when you want to use the end of the pipe that you're starting the program on. In this case you will move the torch centerline to the edge of the pipe and start the program. Where in PypeServer programming you skip the end-cut is different between loading a single part vs loading a pipe nesting.

7.2.1 Start a Part on a precut endcut.

For a Design Part, where you're only loading a part and not a nesting,



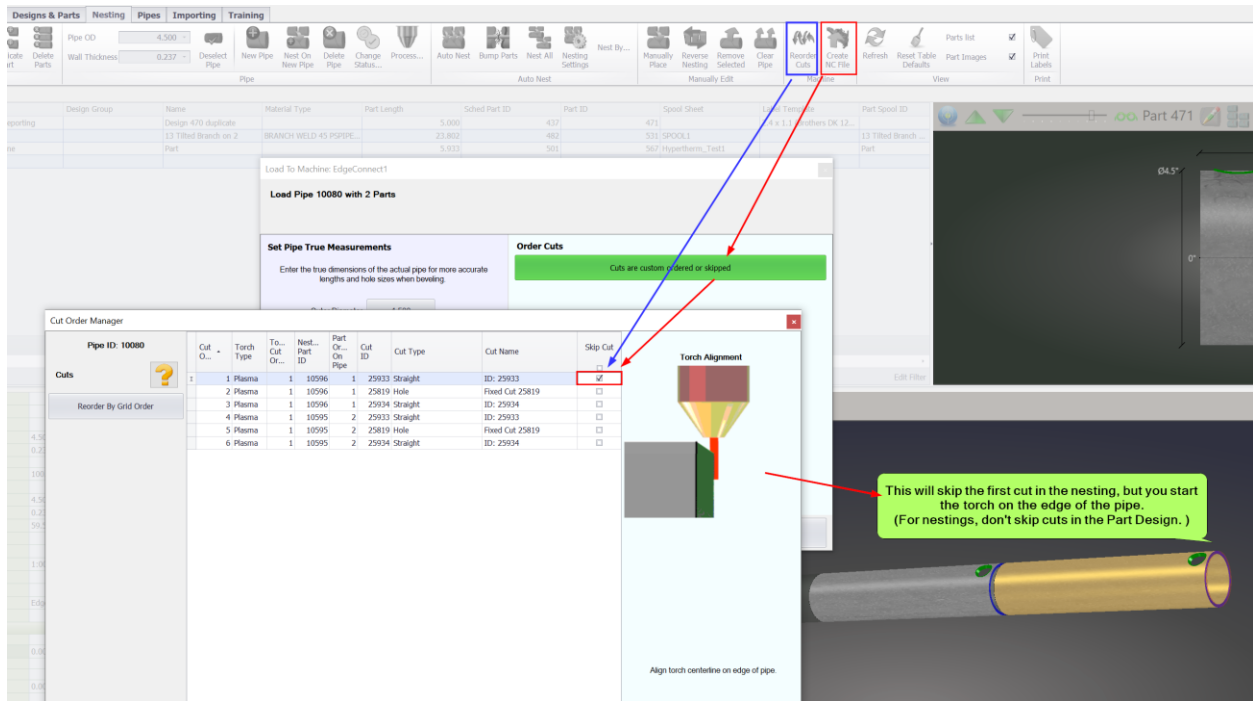
The Phoenix Program:



Note that you can also skip the first cut of a Design part using the "nesting" method below.

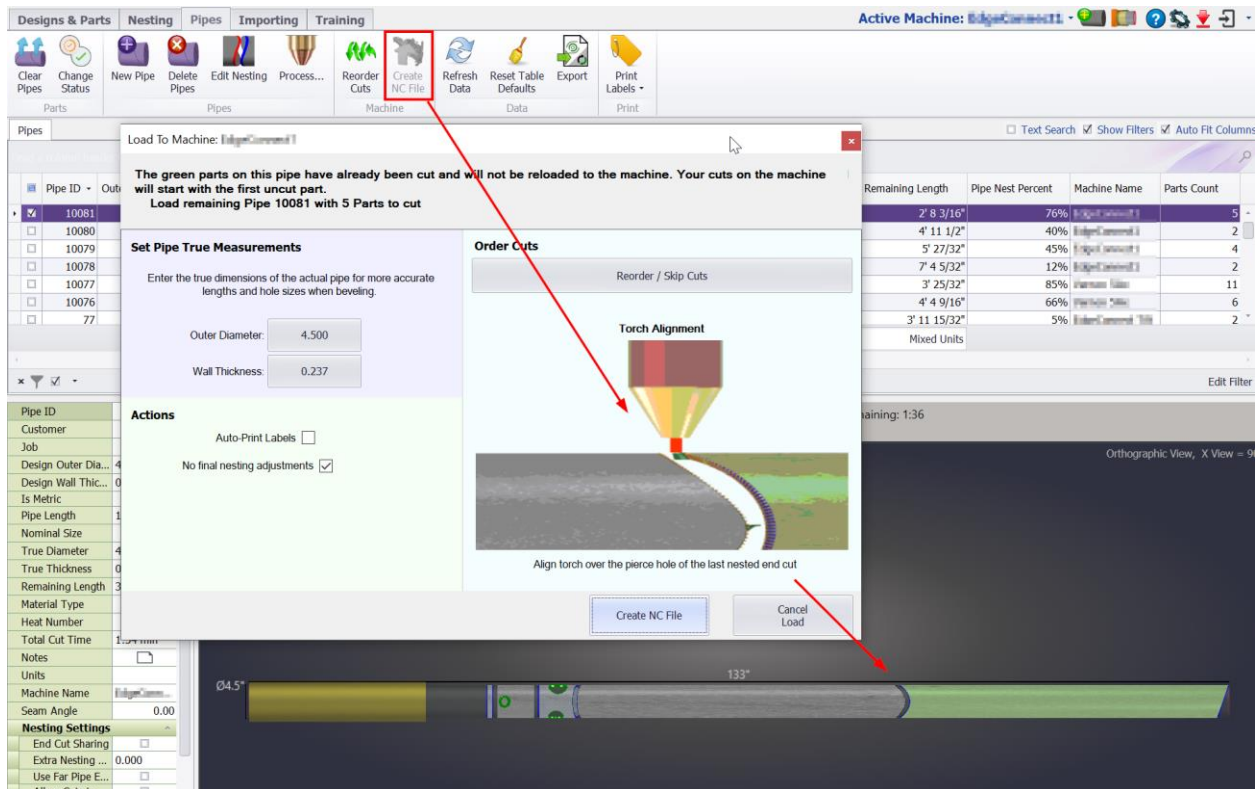
7.2.2 Start a Nesting program on a precut endcut

For nesting programs, you do not skip the cuts in the Part Design. Instead you skip it for the nesting.



7.3 Starting Over the pierce hole of a previous part endcut (Nesting only)

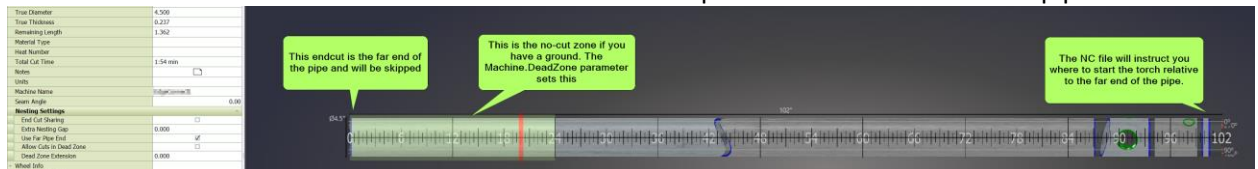
This is for when you have a drop and you put it back onto the machine and in PyperServer you nest new parts onto the existing drop pipe. The cut end of the drop pipe could be a saddle a miter, a straight cut, etc. PyperServer will nest into that endcut shape. In the NC program you will be instructed to place the torch over the pierce hole on the end of the pipe (where the last cut was started). PyperServer will move relative to that position and you won't waste pipe.



7.4 Start at a specific distance down the pipe

This is for when you are using the "Use Pipe Far End" feature, in which the final cut of the NC program is skipped because it is the end of the pipe.

- The end cut must be straight (a straight cut or 90 degree miter).
- The machine must be started with the torch at a specific distance from the far pipe end.



7.4.1 Configuring for "Use Pipe Far End"

For chucked machines that can be homed and support GCode to move in absolute distances from machine zero, you can automate the move to the first cut. See the document Load with the "Last Cut In the Chuck" for how to configure the machine for this.

For machines that do not locate the pipe in an absolute position (like roller-bed machines), and machines with no homing and absolute positioning, the operator must measure the distance from the far end of the pipe to set the starting point for the torch.