



What Is Needed to Make Parts on a CNC Lathe?

Making Parts on a CNC Lathe

We are writing this article so that our customers will better understand what is involved in making a part on a CNC lathe, and also to answer customer inquiries like the one that follows.

Some of our customers are under the impression that you can load a picture of a part into our machine and it will make the part for you. This is not the case with any CNC machine. Below is an example of one of our customer's inquiries.

Customer email:

Hello

I own 2 of your CNC lathes, but they actually don't work for me.

I need a system that can be operated easily by taking lines or designs from Adobe Illustrator DXF files and work on two or three passes (rough and finish) to make something like this:



FIGURE 1—Customer-supplied example.



FIGURE 2—Customer-supplied example.

Sherline email response:

Hello Sherline Customer,

To make sure that there is no misunderstanding, your problem is not our machine. What you are asking for is software that will convert a DXF file to G-code program for the shapes below to run on our lathe, correct?

Can you send me some of the DXF files that you would like to convert to G-code?

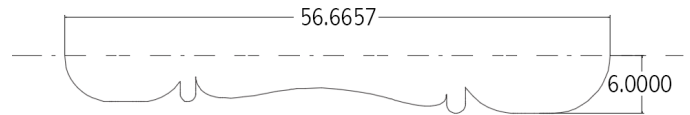


FIGURE 3—DXF File: (sample part from Customer.DXF)

Sherline follow-up email:

1. The first problem with the DXF file is that it is not to scale (accurately dimensioned). It is a free hand sketch. The size of the part when we opened it is roughly 12" diameter by 56" long.

A. All parts must be accurately drawn to the correct dimensions regardless of the file type. A G-code program will be generated for the "exact" part dimensions and shapes in the DXF file.

There are several CAD (computer aided drafting) and CAD-like programs which can generate DXF and other files. First you need to purchase or download one of these CAD programs and learn how to draw dimensionally accurate parts. Even if you are using Illustrator to draw a part. It needs to be drawn to scale and to the correct dimensions.

NOTE: Most CAD programs come as CAD/CAM programs (computer aided drafting / computer aided machining)

B. If I scale this DXF file down to 1/10 the original size, the new part will be approximately 1.18" diameter by 6.0" long. This is now a part size that could be made on our lathe. You will need to measure your part to see what the actual diameters and length are.

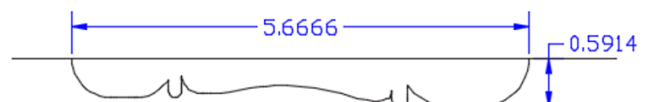


FIGURE 4

2. The next problem is the actual shape of the part. This is regardless of whether it is the part in the DXF file or a part like the green part below that you wish to duplicate.



FIGURE 5

- A. The reason this is a problem is that insert cutters come in different shapes. These shapes are the industrial standard shapes of turning and grooving inserts. You can also hand grind high speed steel turning cutters or form tools, but they also need to be a shape that can cut an area of the part entirely or without cutting some of the finished surfaces that you don't want removed.
- B. Some standard insert shapes are 35, 55, and 80-degrees for turning tools. For grooving tools, our cutters come in .031, .062 (square end) and we have .031 and .062 (radius end)



FIGURE 6—RH 55-degree carbide tool holder (P/N 2256).



FIGURE 7—RH 80-degree carbide tool holder (P/N 2253).



FIGURE 8—Grooving carbide tool holder (P/N 2267, Inserts not included).

- C. You can also hand grind “Form Tools” out of High Speed Steel cutter blanks that will cut some or all of the odd shapes that the insert cutters above cannot cut.
- D. Below is a copy of the hand drawn DXF file with standard insert cutters above it. This shows the shape and orientation of these cutters so you can see how certain shaped inserts could be used to cut the profile shape of your parts, whereas other cutter shapes will either not work at all, or can only be used to cut certain areas of the part.

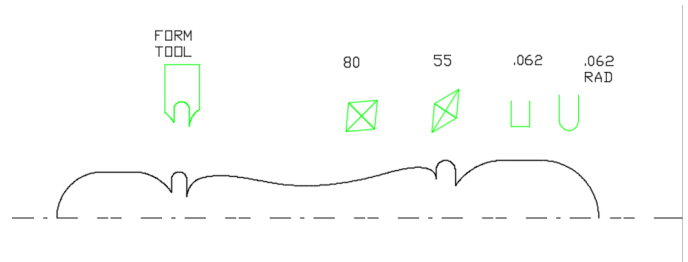


FIGURE 9

- E. None of these standard-shaped inserts will be able to cut your entire part shape because of the geometry of the inserts and the shape of your part. The 55-degree inserts would be able to cut most of your part. If you look at the drawing below, you will see the surfaces that the 55-degree insert can cut in “green.” The inserts in “red” show the areas that cannot be cut because the backside of the insert will be cutting away what should be a finished surface on the part. To cut the areas of the red insert, a form tool may work or a modified groove tool (.031 W/ Radius).

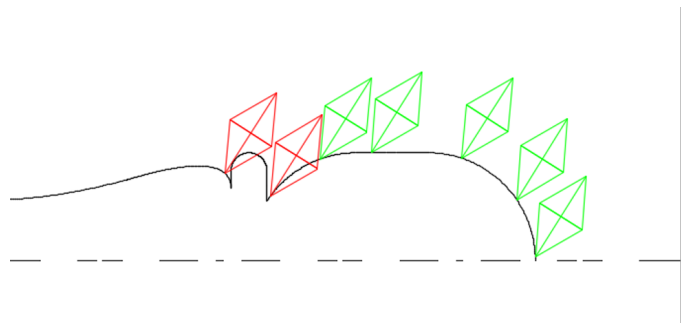


FIGURE 10

3. In order to generate a G-code program for your part, the next thing that you need is a CAM program (computer aided machining). You load your DXF file into the Cam program to generate a G-code program to machine your part.

For this part, I am using BobCad, which is a CAD/CAM program. A CAD/CAM program allows you to draw your part and generate a G-code program for your part.

- A. In a CAD/CAM program, you choose the shape and size insert cutter that you are going to use. For most parts, it will take more than just one insert to finish a part. Some inserts (and insert shapes) are used for roughing. Others can be used for finishing, or both rough and finishing. Other cutters will be used to machine the surfaces that the rough and finish inserts were not capable of cutting due to cutter interference with finished part surfaces (as described above).
- B. In the CAM program, you choose all of the feeds, speed, depth of cut, and number of cutting passes each tool takes. You also choose how much material will be left after the roughing cuts for the finish cutter to machine.
- C. The CAM program will take your insert geometry, the part shape, and the cutting parameters that you gave it. Then it will generate a G-code program to cut your part shape without removing any finished part surfaces. In the picture below, the green lines represent the tool cutter path for the roughing cutter which is a 55-degree insert tool.

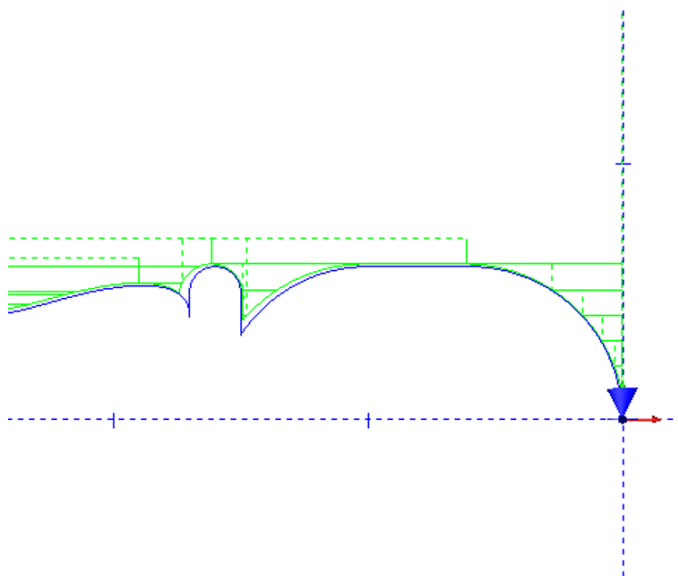


FIGURE 11

If you look closer at the cutter paths you will see that the program is cutting the exact shape of the part at the front of the part. However, it is cutting away from the backside of the part radius in order to keep the backside of the insert cutter from machining away the finished part surface (see Figure 12).

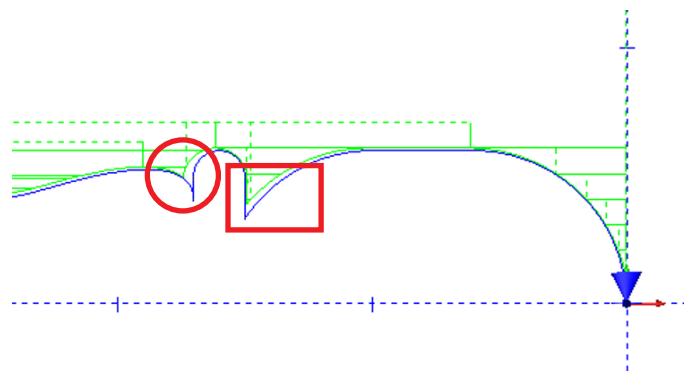


FIGURE 12—The red shapes show the differences between the cutter path and the actual finished part surface that the insert cutter can not cut.

Conclusion

Anyone can learn how to use one of our machine and make parts in a relatively short period of time. The area that will take the most time is learning how to use the CAD/CAM software.

There are no simple programs, software, or machines that you can load a DXF file into and have it make your part for you. They haven't invented the "Star Trek Replicator" yet.

You will need to purchase CAD/CAM software and learn how to draw dimensionally accurate parts. Then learn how to use the CAM part of the software to generate cutter paths and a G-code program to cut your parts

Then choose the correct tools (insert cutters), the correct tool cutting order, and the correct feeds and speed in order to machine your parts.

Start with simple shapes and small parts (such as chess pieces). Then move up to larger parts and more complex shapes. There is a G-code example of a chess piece at the end of this document.

In addition to this you are also learning the machinist trade. Larger parts like your green part in the picture or your DXF part will either need to be supported at both ends (chuck holding on one end and a live center on the other end). This means that you may also need to have extra material at either end of the part to hold onto. The other option might be to mount your part on a mandrel (a machining fixture or shaft that the part blank is mounted on and secured to). You can see an example of a mandrel on our "Pen Making Demonstration" video ([Pen Making Demo Part 3 - YouTube](#)).



FIGURE 13—Turning pen parts on a Sherline CNC lathe.

Software

There is free CAD/CAM software that you can download and there is software that you will have to pay for.

Most CAD/CAM software is capable of uploading DXF and other files.

There is a lot of software available for mills and CNC routers. There is less available for lathes.

Below is a list of some of the more popular software that our customers are using:

- BobCad ([CAD/CAM Software Products - BobCAD-CAM](#)). Not free.
- Fusion360 ([Download Fusion 360 for Free | Free Trial | Autodesk](#)). Free for hobbyist or almost free (for now).
- Check out other CAD/CAM options on our [CNC Links and Resources](#) web page.
- I had my tech person look into free software specifically for for lathes. What he found was E-CAM. See below.
- Below is a program I made with e-cam and the 402300.DXF file.

This program can upload DXF, IGES, STEP, and STL files.

This software comes with a 15 day demo version, and the software is free to use on the weekends.

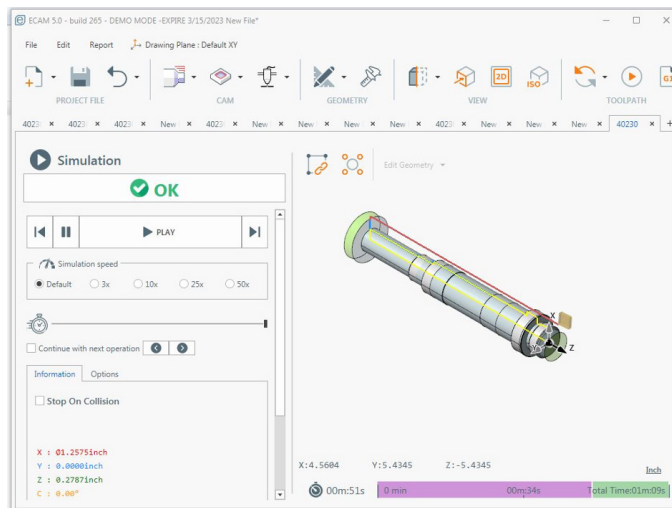


FIGURE 14—A sample part made using e-cam software.

Below are the links for down loading the software and link for lathe examples.

e-cam software

<https://www.e-cam.it/#download>

lathe turning example

<https://docs.e-cam.it/article/76-generic-turning>

I suggest downloading e-cam first and loading in some small simple DXF parts like the chess piece below.

Chess Piece

This part is made from 7/16" diameter stock and the distance from the front of the bar stock to the front of the collet or chuck jaws is 1.100". The finished part is .430" diameter for the largest diameter and it is .860" long (see Figure 15).

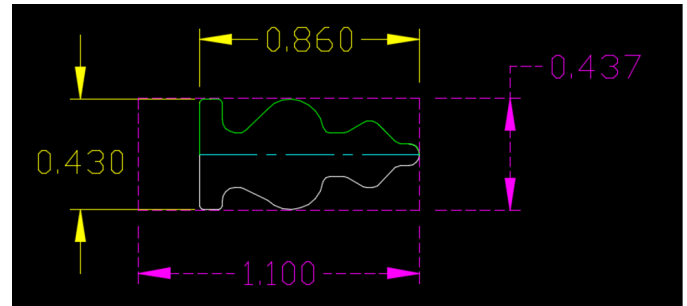


FIGURE 15

1. I created this part using AutoCad and it was saved as a .DWG file. It could have been saved as a .DXF files too. I create my parts using AutoCad because I'm old and this is the program that I know. All CAD/CAM programs have the ability to draw your parts. For lathe parts (and for most mill parts) 2D is all you need for the majority of shapes that you are going to machine.
2. Then I loaded this DWG file into BobCad. Once the file was loaded into BobCad, I positioned my X0, Z0 point with Z0 at the front of the part and X0 on the centerline of the part. I then removed the bottom half of the part because the machine is only cutting the profile of the shape, so only one side of the part is needed.
3. I then used a 55-degree insert to rough turn the part and a .060 groove insert with a .030 nose radius to finish turn the part. The 55-degree tool cut most of the part shape, but it can't cut on the backside of the radius. The .060 groove with the .030 radius can cut the entire shape.

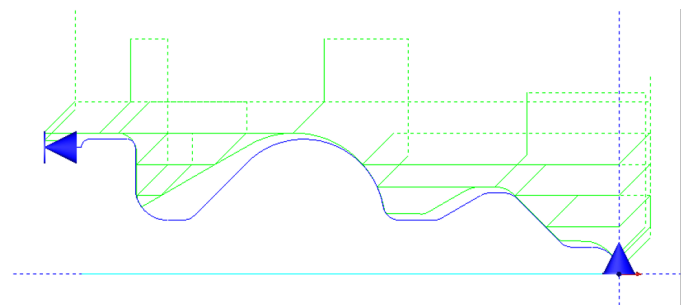


FIGURE 16—Cutter path for rough turn.

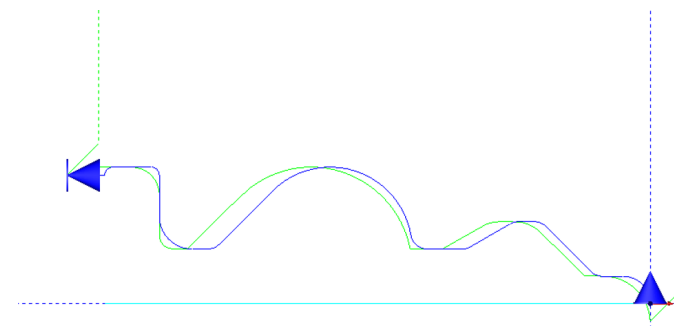


FIGURE 17—Cutter path for finish turn.

Part Program

This part was run on our Accu-Pro Chucker Lathe with the MASSO Touch Control.

I entered the G-code for the hard stop for the automatic bar feeder and I also added the G-code for the cut off tool. The G-code for the rough and finish turning of the part was from the BobCad software.

(PROGRAM FILE CHESS PIECE FOR CHUCKER)

(Machine Setup - THIS PROGRAM USES G)

(TOOL #3 HARD STOP)

G18 G20 G90 G00 G94

T3 M06

G00 Z2.0

G00 X0.00

M05

G0 Z.050

G01 Z-.800 F10.0

M11 (COLLET OPEN)

G01 Z-.890

G01 Z.050

M10

G4 P2000(TIME TO FEED STOCK)

G00 Z1.0

(TOOL #2 55 DEG.RH BACKSIDE ROUGH TURN)

N1 G18 G20 G90 G94

N2 T2 M06

N4 S2500 M03

G0 Z2.0

G0 X.64

G0 Z.05

X.45

G1 X.35 Z0. F5.

Z-.4101

G3 X.4499 Z-.5209 R.1467

G1 Z-.8006

Z-.8007

Z-.92

X.55 Z-.87

G0 Z.05

X.35

G1 X.25 Z0.

Z-.1666

G3 X.278 Z-.1978 R.0431

G1 Z-.3868
G3 X.35 Z-.4101 R.1417
G1 X.45 Z-.3601
G0 Z.05
X.25
G1 X.15 Z0.
Z-.1164
X.1544 Z-.1186
X.25 Z-.1666
X.35 Z-.1166
G0 Z.05
X.15
G1 X.05 Z0.
Z-.0078
G3 X.1042 Z-.0488 R.0612
X.1062 Z-.0896 R.6404
G2 X.1164 Z-.0996 R.0122
G1 X.15 Z-.1164
X.25 Z-.0664
G0 Z.05
X.1146
G1 X.0146 Z0.
G3 X.05 Z-.0078 R.0653
G1 X.15 Z.0422
G0 X.578
Z-.1478
G1 X.378
G1 X.278 Z-.1978
X.2777 Z-.2248
X.2765 Z-.2309
G3 X.2639 Z-.2475 R.0528
G1 X.1976 Z-.3052
G2 X.192 Z-.3185 R.0192
G1 X.1923 Z-.3677
G2 X.2046 Z-.3753 R.0078
G3 X.278 Z-.3868 R.1597
G1 X.378 Z-.3368
G0 X.7499
Z-.4709
G1 X.5499
G1 X.4499 Z-.5209
G3 X.4384 Z-.5603 R.1512
G1 X.423 Z-.581

G3 X.3499 Z-.6459 R1.0142

G1 Z-.7719

X.3934 Z-.772

X.4099 Z-.774

X.4251 Z-.7781

G3 X.4499 Z-.8006 R.0315

G1 X.5499 Z-.7506

G0 Z-.5959

X.4499

G1 X.3499 Z-.6459

X.2499 Z-.7327

Z-.7714

X.2545 Z-.7717

X.3499 Z-.7719

X.4499 Z-.7219

G0 Z-.6827

X.3499

G1 X.2499 Z-.7327

X.2145 Z-.7634

G2 X.2499 Z-.7714 R.0307

G1 X.3499 Z-.7214

G0 X.75

Z-.7807

G1 X.55

G1 X.45 Z-.8307

X.4492 Z-.8667

X.443 Z-.8762

X.4266 Z-.8911

X.424 Z-.8947

Z-.92

X.524 Z-.87

G0 X.8

Z1.

(Machine Setup - 1 Turn Groove Finish)

(TOOL #7 .060 groove .030 RAD)

N1 G18 G20 G90 G94

N2 T7 M06

N4 S2500 M03

N3 G00 Z2.0

Z.1

X.64

G1 Z.05 F2.0

X.0439

G1 X-.0561 Z0. F2.
G3 X.0246 Z-.014 R.0774
X.0517 Z-.0264 R.07
X.0842 Z-.0619 R.0747
X.0863 Z-.1033 R.2898
G1 X.216 Z-.1687
G3 X.2412 Z-.184 R.0825
X.2556 Z-.2022 R.0514
X.2578 Z-.2342 R.2069
X.2485 Z-.26 R.0601
G1 X.1971 Z-.3056
X.1732 Z-.3263
X.172 Z-.3304
Z-.3784
G3 X.4268 Z-.5119 R.1598
X.4052 Z-.5955 R.1553
X.3629 Z-.6318 R.169
G1 X.3119 Z-.6593
X.1729 Z-.7288
X.1728 Z-.753
G2 X.1788 Z-.7638 R.0238
X.217 Z-.7738 R.0218
G1 X.3482 Z-.774
G3 X.4231 Z-.8005 R.045
G1 X.4278 Z-.8088
X.4299 Z-.8149
Z-.837
X.4293 Z-.8808
G3 X.404 Z-.9076 R.0452
G1 Z-.92
X.504 Z-.87
G0 X.8
Z1.
(tOOL #1 .040 WIDE CUT OFF TOOL)
(PART OFF)
T1 M6
G0 Z1.0
(---Start Spindle---)
M3 S1500
G4 P2000
G00 Z2.0
G00 X.8
G00 Z0.0

G00 Z-.900

G01 X.337 F2.0

G0 X .357

G1 X.237

G0 X.257

G1 X.157

G0 X.177

G1 X.057

G0 X.077

G1 X-.02

G0 X.8

Z1.0

G0 X1. Z3.0

M05

M30

Thank you,
Sherline Products Inc.