Manufacturing Process Sheet

CSU EMEC - Screwdriver

CSU EMEC Contact Information: (970) 491-3366 CSU Engineering Building 400 Isotope Dr. Fort Collins, CO, USA 80521	

Name(s): Erin Keown
Team: MECH200B L01
Date Requested: 03/22/2022
Target Due Date: 04/05/2022

Part Name: Screwdriver
Part Number: 3
Quantity Required: 1
Drawing Number: 3
Material: Aluminum and Steel

Process Families Needed to Complete Part:

Turning	Knurling	Forging	Grinding
Tempering	Sanding	Polishing	

Tools Needed for Machining Operations:
CNC Lathe
Lathe
Acetylene Torch
Drop Forge
Sandpaper (120 to 3000 grit) and Letter Punchers
Grinder
Polishing and buffing wheel, with jeweler's rouge
Rockwell Hardness Tester

Obtain a screwdriver blank then complete the following:

Turning on the Lathe:

1. Since the part is not completely flat on the end with the aluminum handle, you must turn down the end, removing as little material as possible at a time, until it is completely squared off.
2. Insert the blank into the chuck, clamping the steel end down tightly.
3. After setting up the lathe tool in its holder, touch off the tool with the end of the screwdriver handle, and set z = 0.
4. Set the lathe to run at a speed and feed appropriate for the aluminum handle. I chose approx. 300 RPM and a feed of around 0.0022in/sec.
5. In 0.002in increments, slowly face the end of the part until it is square. Only take off as much as is necessary to square it off. Use soluble oil.
6. With the now faced part still in the lathe, attach a center drill to the lathe tailstock quill.
7. Center drill the end of the handle until the thinner tip of the center drill is all the way in. Use soluble oil.
8. Remove the part from the lathe and wipe it down to remove excess chips and oil.

CNC Lathe Operation:

1. Place the screwdriver into the CNC lathe chuck and tighten it as tight as you can. Ensure that the start of the handle is 1⅜ in away from the jaws of the chuck. This can be done using a parallel placed between the start of the handle and the jaws of the chuck.
2. DO NOT LEAVE THE CHUCK KEY IN THE CHUCK. Make sure it is removed!!
3. Move the tailstock to the piece (make sure it has a live center in it) so that the end of the center is in the hole made by the center drill.
    a. Make sure the live center is tight against the part so that all of the part spins at the same time.
    b. Tighten the tailstock and quill down as tight as possible.
4. Make sure the tool turret can turn without bumping the piece.
5. Run program 06249 (or whichever one it is for the part).
6. Hit “cycle start”. Pause the machine each time the tool changes (including at the start), and re-alight the coolant to pour right on the tip of the lathe tool.
7. When the program finishes, take the tool out. Wipe off excess coolant. Keep the nub on the end of the screwdriver, this will be removed later.

Knurling:

1. Place the steel part of the screwdriver into the laws of the lathe chuck, and tighten.
2. Align the knurling tool in the tool holder. Support the piece from both ends by using a live center in the tailstock of the chuck. Tighten the tailstock and quill down.

    a. The tool must be PERFECTLY SQUARE to the screwdriver handle, and PERFECTLY CENTERED on the screwdriver handle. Otherwise, the knurling will not come out correctly.
    b. Use a machinist's square for this portion, and check that when the handle spins, both wheels of the knurling tool turn at the same time, with the same speed and pressure.
3. When you are satisfied with the set up, place the knurling tool on the end of the handle where the first knurling marks will be.
4. Using a speed of Low: (127 - 80), and a feed of 5-7 thou, (LCS8W), push the knurling tool between 30-40thou into the part (using the x direction increments of the lathe as a guide), and start the lathe in the forward direction.
    a. Supply cutting oil with a brush (don't catch the brush in the knurling tool) throughout the knurling process.
5. If the knurling isn't deep enough, let the cutter run to the other end of the handle, push it in further, and put the lathe in reverse. *Do not take the cutter off the part until you are satisfied with the depth of the knurl.*
6. Remove the part and clean it of chips using compressed air. Use a cloth to remove excess cutting oil.
7. Punch initials into the bottom of the screwdriver using letter punchers and a hammer. When clamping the part into a clamp, protect the knurling with soft jaws and a cloth.

Forging the steel tip of the screwdriver:

1. Perform this process with the company of a TA or professor. Do not attempt to do it alone.
2. Wrap the handle of the screwdriver in a cloth and secure it in the tongs.
3. Turn on the oxygen and acetylene gas, open the oxygen all the way, acetylene only ¼ of a turn.
4. Open the acetylene valve of the torch and light it, increasing the gas until the soot burns off.
5. Add the oxygen by opening the valve on the torch and increase it until the hot blue cones only burn about ¼ inch in length.
6. If the drop forge hasn't been used yet, make sure everyone is standing clear and open it by connecting the air hose to it and turning on the compressed air.
    a. You will need to preheat it before forging as well. Remove the torch from the stand and carefully touch the ends of the flame to the forge mold, brushing it back and forth for 30s on the top and bottom of the mold. Repeat this for 2 minutes total, then return the torch to the stand (clamp it tightly).
7. Heat the first inch of the drill rod (screwdriver tip) to a bright orange, keeping it perpendicular to the flame, and about halfway into the flame.

8. Place the hot tool tip in the forge press and use the pedal to drop forge it twice. If the tool sticks to the mold, only press it once.
9. Repeat steps 7 and 8, no more than 6-8 hits total.
    a. Put the tool further into the mold each time you press it.
10. When you are done forging, turn off the acetylene first, then the oxygen, and slowly release all the air from the drop forge. Make sure the area around the forge is clear before you do this.
    a. Bleed the lines of the gasses after turning the tanks off completely.
11. Allow the part to cool before continuing.

Grinding:

1. Grind the end of the tool down to the specifications required in the tool drawing. Make sure to remove all of the excess material left by the drop forge process.

Thermal Conditioning (Hardening and Tempering):

1. Harden the screwdriver point. Follow the processes for lighting the torch (detailed above in the forging instructions), and heat the end of the screwdriver to bright orange (test it for 1450-1500℉). Quench it in oil.
2. Clean the point by using abrasive paper and/or a wire wheel.
3. Temper the point by heating it about 1.5” back from the point. Carefully watch for a deep-straw/bronze color to migrate towards the point (520℉). When the desired color reaches the point, quench the tip in water.
4. Test for hardness using a Rockwell hardness tester.

Finishing Processes:

1. Sand down the tip of the screwdriver with sandpaper to around 1000-1500 grit.
2. Polish using a buffing/polishing wheel and jeweler’s rouge.