ITCD 301-001 Tool and equipment design: Fall 2010

Homework # 4, **Due date - November 29’Th, Monday, 2010, before 11.55 PM EST**

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The following questions may be adapted from Fundamental of Tool Design, 5th edition, SME. Make sure to **provide references** from where you are supporting the answers. Try to get the answers from the journal article rather than Google search.

1. What are the problems of insufficient clearance in die-cutting operations? How do you overcome them? (10 points)

Tight clearances will result in holes having a high ratio of shear or burnish to fracture, and less taper at the the expense of accelerated tooling wear. The fracture, which starts from each side, may not meet evenly. One or more sharp projections may result. Double breakage sometimes occurs when too little clearance is used. Essential indicators for the diemaker are secondary shiny areas on the inside of the hole and/or slug and a rough, torn fracture. The fracture which travels from both sides of the stock may not be meeting evenly and will leave a ragged edge. The die may burnish the torn peaks of the fracture. The solution to double breakage problems usually requires increasing the punch to die clearance. Within reasonable limits, increasing the amount of clearance between the punch and die will decrease the required cutting force. Lowering the cutting force will usually increase the number of parts produced before the tool requires sharpening.

2. Which method is used to produce medallions? Explain the method in a short paragraph and then draw a sketch. Explain bending, forming and embossing. (10 points)

Flat coining is the method that is used to produce medallions. These can vary from stainless steels to sterling silver and gold alloys. Very high forces are required to bring up all of the detail in some medallion work. Forces of 325 ksi or higher are achieved.

* Bending is used to increase the rigidity of shaped parts in pressworking operations. The part to be bent is supported on each side of the bend and force is applied to a forming punch in the center. The load produces compressive stresses in the material on the inside of the bend as it is forced into compression. Tensile stress or stretching occurs on the outside of the bend. To produce a bend in a finished part, the yield point of the material must be exceeded. If the bending force applied does not exceed the yield strength of the material, the beam will return to its original shape on removal of the load. If the stress exceeds the material-yield strength, the beam will retain a permanent set or bend when the load is removed. The goal of the process is to bend the material the correct amount. Springback will opccur until residual stresses in the bend are equal to the stiffness of the material.
* Forming dies are tools that form or bend the blank along a curved instead of a straight axis. There is little stretching or compressing of the material. The internal movement or plastic flow of the material is localized and has little or no effect on the total thickness or area of material. A forming die may be designed in many ways and produce the same results. The tool that is the cheapest and has the simplest design may not always be the best because it may not produce the stamping to the drawing specifications.
* Embossing is when a shallow surface detail is formed by displacing metal between two opposing mated tool surfaces. One surface has the depression and the other has the projection. The metal is stretched slightly rather than being compressed. The most common purpose that embossing is used for is the stiffening of the bottom of a pan or container. The embossing is designed to follow the outside profile of the part. Embossments are often ribs or crosses stamped in the metal to help make a section of a blank stronger by stiffening. An embossing die can be a male and female set of lettering dies or a profile of one of various shapes.

3. What are Gaging principles? What bilateral tolerance would be applied to a master gage used to set a working gage measuring a dimension with a tolerance of +/- 0.002 in.? (10 points)

* Class XX gages are precision smoothed (lapped) to the very closest tolerances practicable. They are used primarily as master gages and for final close tolerance inspection.
* Class X gages are precision lapped to close tolerances. They are used for some types of master gage work and as close tolerance inspection and working gages.
* Class Y gages are precision lapped to slightly larger tolerances than Class X gages. They are used as inspection and working gages.
* Class Z gages are precision lapped. They are used as working gages where part tolerances are large and the number of pieces to be gaged is small.

4. Explain the various attributes that are measured on a drilled hole. What is optical measurement? Explain with a sketch. (10 points)

* Flatness: Various methods of checking flatness are available. Method selection depends on the accuracy required, size of the part, and time available to make the check. Flatness cannot be easily checked by functional methods.
* Straightness: Can be checked by various methods, depending on the accuracy required and part size. One common method is through the use of a straight-edge.
* Circularity: Should be checked with a precision rotating spindle, rotating table, or circular tracing instrument. Measurement is made by centering the part on the table, establishing an axis, and placing a stylus in contact with the surface of the cross section.
* Cylindricity: Checked with the same equipment that is used to check roundness, except that roundness readings must be taken at a number of sections along the entire length of the part and placed in a way to establish a common axis from which a tolerance zone can be established and measurements made to determine whether they fall within the tolerance zone specified.
* Angularity: Most short run parts are checked for angularity with the standard surface plate methods. Sine plates or simple staging fixtures are used to place the datum surface of the concerned feature in proper alignment with the surface plate.
* Runout: All features of the part must be measured separately to ensure that they are within the specified size limits and the boundary of a perfect form at MMC.
* Position: When position tolerance is applied on an MMC basis it allows functional gaging to be used.
* Parallelism: Checked by placing the datum of the part on a surface plate and searching for any out of parallel conditions with a height stand and indicator.
* Optical measurement is a measurement technique that relies on the use of optical sensors to collect measurements. Several different types of systems are available, including fully automated ones, as well as systems that allow for more manual control for precision measurements. High end systems can be quite costly and are found in labs and materials testing facilities where exact measurements are critically important. Information found on wisegeeks.com.

5. What are compound dies and progressive dies? Explain deep drawing of cups and extrusion process. (10 points)

The compound die allows you to cut both the internal and external aspects of a part in one press stroke, producing the finished part in a single station. The progressive die simultaneously performs multiple moderations on a piece of sheet metal. The die drawing (stamping) process feeds a strip of metal through several stamping stations, each of which performs one or more operations to create a completed part with each stroke of the press. Information found on diebuilders.com.

The cup drawing process starts with a flat round blank. The blank is subjected to radial tension and circumferential compression. The metal thickens as it flows toward the draw radius. Deep drawing is unique because of the deformation state of metal restrained by the blankholder.

With extrusion the operations are generally performed in hydraulic or mechanical presses. The press applies sufficient pressure to cause plastic flow of the workpiece material and form the metal to a desired shape. A metal slug is placed in a stationary die cavity into which a punch is driven by the press action. The metal is extruded upward and around the punch, downward through an orifice, or in any direction to fill the cavity between the punch and die. The finished part shape is determined by the shape of the punch and die.