

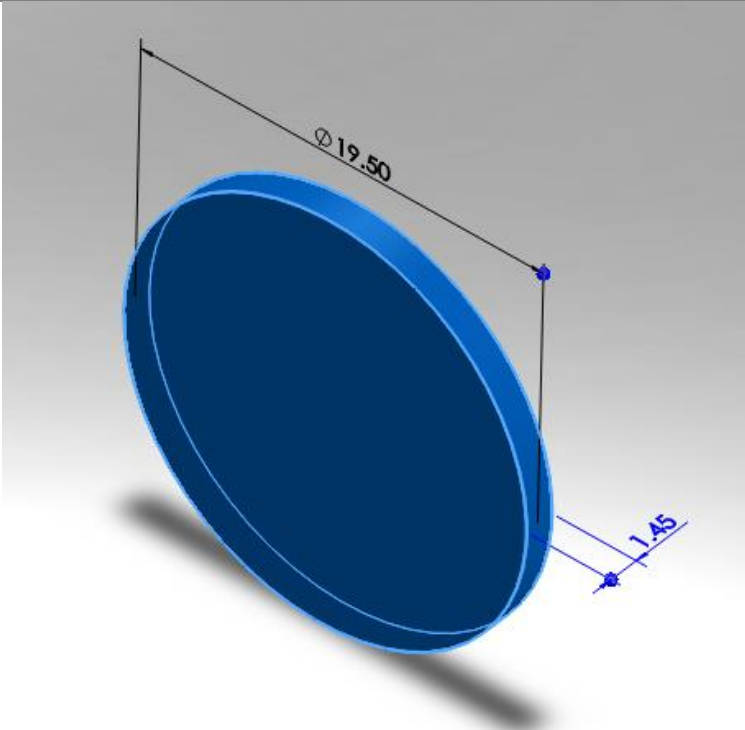
Report: Project Deliverable 2

1 Aim

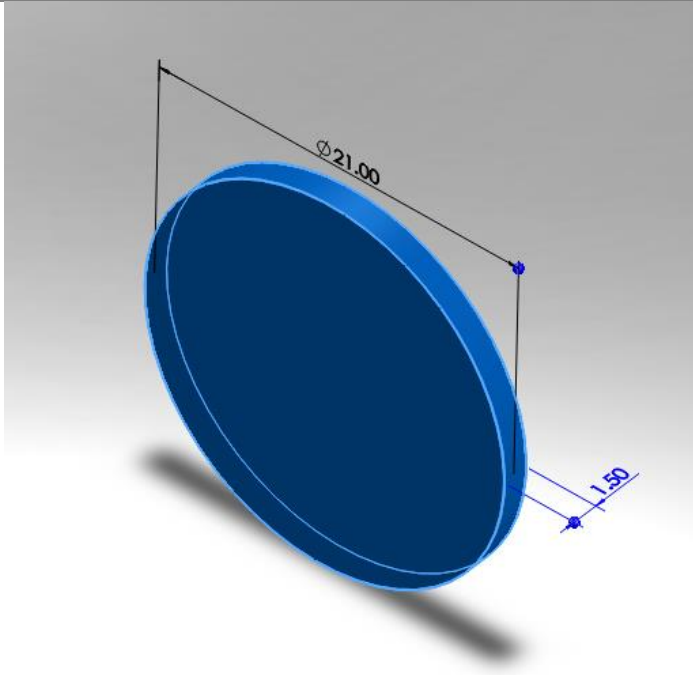
The purpose of this paper is to discuss in detail the manufacturing methods required to make Kuwaiti coins. The coins selected for manufacturing are 5, 10, 20, 50 and 100 fills.

2 Product design

The product design is prepared using SolidWorks, 2020. The details of the provided in the following table. Diameter and thickness of all coins are shown with the CAD model pictures. In D1 report, we found that stainless steel is best material for coin production. In properties section of table we mentioned the other design properties of coin.

COIN	CAD model	Properties
5 fills		<p>Frame shape: Circular</p> <p>Size: Diameter- 19.50 mm & thickness- 1.45 mm.</p> <p>Tolerances: 2%</p> <p>Surface roughness: 44.60 micrometer.</p> <p>Material: Stainless steel</p>

10
fills



Frame shape: Circular

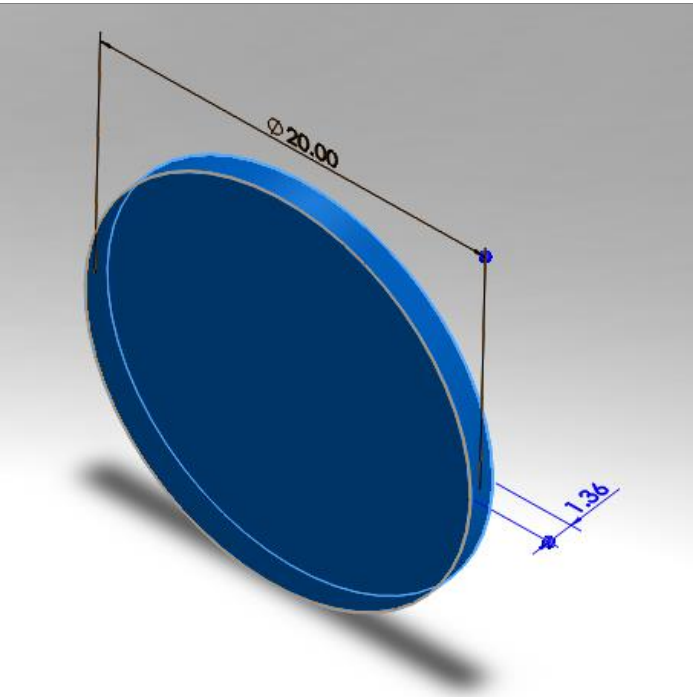
Size:
Diameter- 21.00 mm &
thickness- 1.50 mm.

Tolerances: 2.5%

Surface roughness:
50.00 micrometer.

Material: Stainless steel

20
fills



Frame shape: Circular

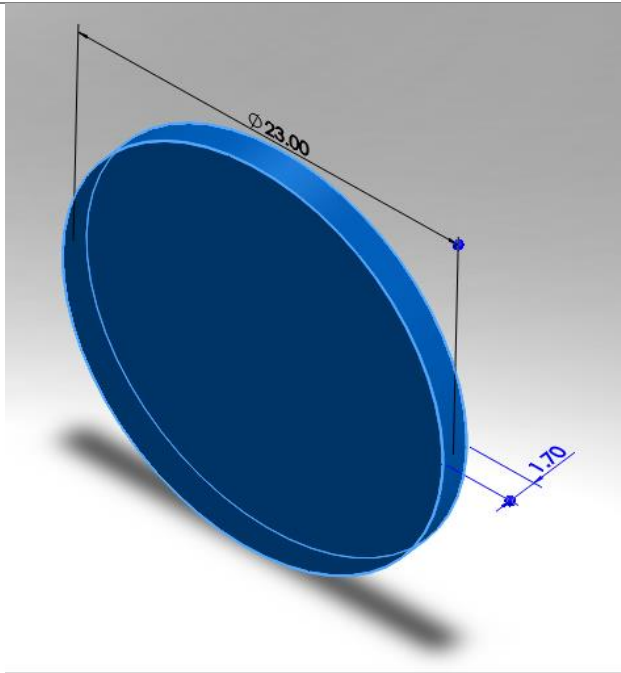
Size:
Diameter- 20.00 mm &
thickness- 1.36 mm.

Tolerances: 2.5%

Surface roughness:
40.00 micrometer.

Material: Stainless steel

50
fills



Frame shape: Circular

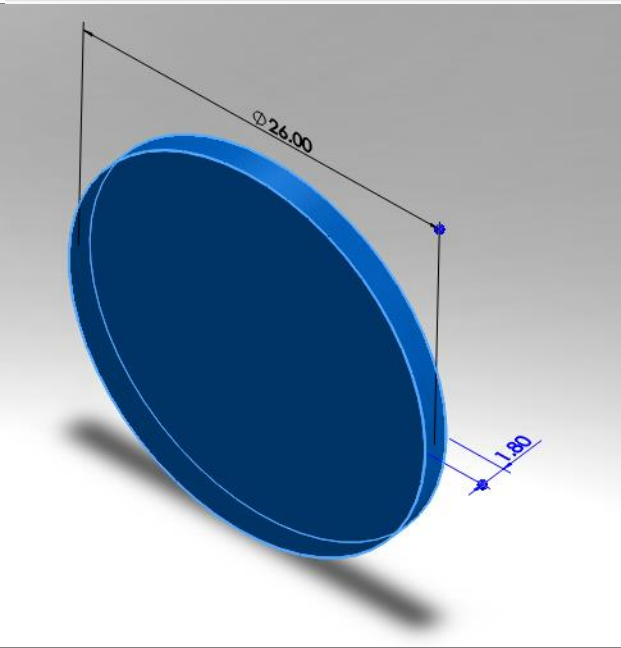
Size:
Diameter- 23.00 mm &
thickness- 1.70 mm.

Tolerances: 1.5%

Surface roughness:
30.00 micrometer.

Material: Stainless steel

100
fills



Frame shape: Circular

Size:
Diameter- 26.00 mm &
thickness- 1.80 mm.

Tolerances: 1.5 %

Surface roughness:
30.00 micrometer.

Material: Stainless steel

3 Manufacturing of coin: Process 1

3.1 Description of manufacturing process

The manufacturing process of the coin is shown in the following flow chart. (Figure 1)

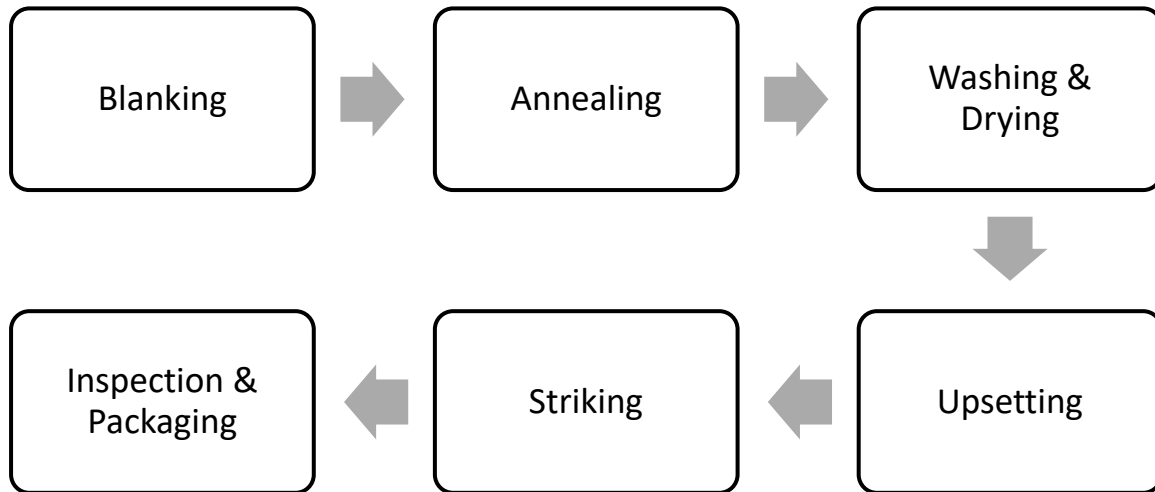


Figure 1 Manufacturing of coin: Process 1

The first type of manufacturing process involves the blanking, annealing, washing and drying, upsetting, striking and inspection and packaging. The all steps are discussed in the following points.

- The raw material for manufacturing is sheet of desired material and thickness. The blanking operation involves the punching operation of desired shape of coin from sheet.
- To preparation for striking, blanked coins are annealed. The physical qualities of the metal are changed during annealing, making it softer and allowing it to be moulded without breaking. The pattern will be better preserved on the annealed blanks during striking.
- To restore the colour of the coins, they are washed. Cleaning and anti-tarnish chemicals are used in the cleaning solution.
- To "upset" the border of a coins to create a higher rim, the upsetting process is used. The blanks are fed into a channel slightly smaller than their diameter by the upsetting mill. The metal is pushed up around the edge, forming a rim. The edge protects the finished coin from wear while also allowing it to be stacked.
- The coins are taken to the coin presses, where the design is struck and printed on coin.
- After inspection coins are packed.

3.2 Cost analysis of first type of manufacturing process

The detailed cost analysis of the manufacturing process is shown in the following table. The cost are divide into operating cost and material cost. The operating cost for each coins are approximately same. However, material cost will vary with sizes of different coins. In this analysis, we are discussing about the manufacturing process cost hence material cost is not considered.

Table 1 Cost analysis of first type of manufacturing process

Process name	Operating cost (per coin) in Kuwaiti dinar	Other cost (if any)	Comments
Blanking	0.001	Machine maintenance	-
Annealing	0.005	Maintenance of burner etc.	-
Washing & Drying	0.0005	Washing instruments	-
Upsetting	0.008	Machine maintenance	-
Striking	0.003	Machine maintenance	-
Inspection & Packaging	0.002	-	-
Total cost	0.0195 (in Kuwaiti dinar)		

4 Manufacturing of coin: Process 2

4.1 Description of manufacturing process

The manufacturing process of the coin is shown in the following flow chart (Figure 2). This manufacturing process of coins is based on the casting. Casting is traditionally old method for production of coins.

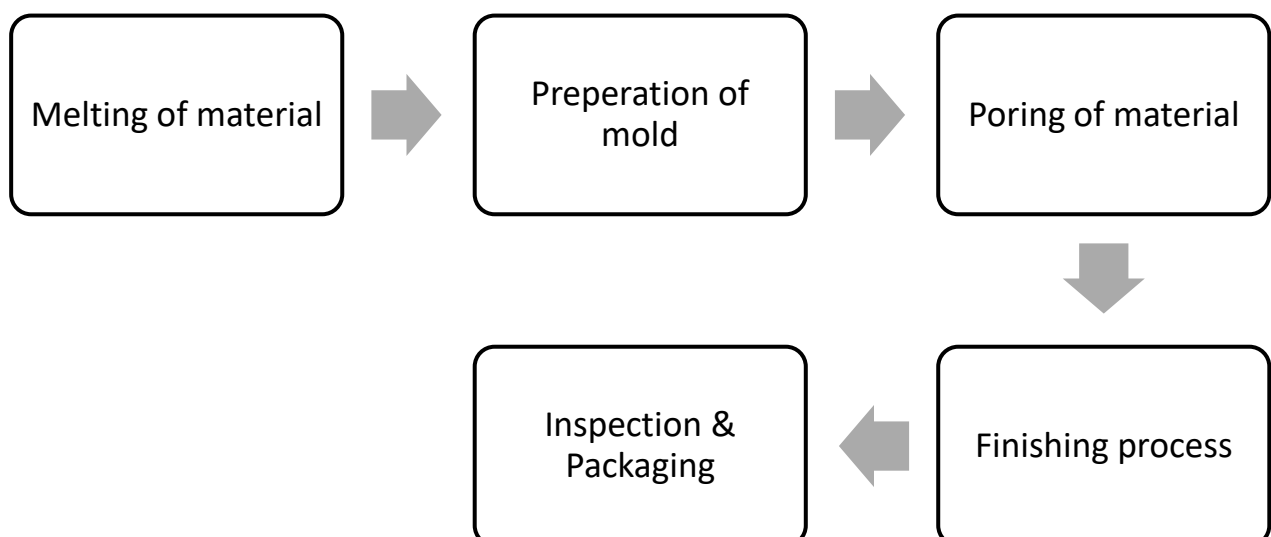


Figure 2 Manufacturing of coin: Process 2

The second type of manufacturing process involves the casting process. The all steps are discussed in the following points.

- In the first step of process, the raw material is converted into molten form using the furnace. This is first step of process.
- In second step, a mold is prepared for the coin. The mold shape and size is decided according to coin shape and size.
- The molten metal is poured into the mold.
- After waiting for some time (solidification time), the mold is opened and casted coins are obtained.
- The finishing operation is performed to removes defects of casting.
- After inspection coins are packed.

4.2 Cost analysis of second type of manufacturing process

The detailed cost analysis of the manufacturing process is shown in the following table- 2. The cost are divide into operating cost and material cost. The operating cost for each coins are approximately same. However, material cost will vary with sizes of different coins. In this analysis, we are discussing about the manufacturing process cost hence material cost is not considered.

Table 2 Cost analysis of second type of manufacturing process

Process name	Operating cost (per coin) in Kuwaiti dinar	Other cost (if any)	Comments
Melting of material	0.008	Furnace maintenance	-
Mold preparation	0.01	-	Labour intensive process
Poring of material	0.005	-	Labour intensive process
Finishing process	0.005	Machine maintenance	-
Inspection & Packaging	0.002	-	-
Total cost	0.03 (in Kuwaiti dinar)		

5 Comparative analysis of both process

A comparative analysis of both process are discussed in the following table.

Table 3 Comparative analysis of both process

Factors	Process 1	Process 2
Raw material cost	Raw material cost is high because this need in flat metal sheet form.	Raw material cost is low because any shape of metal can be used. The alloys can also be formed from base metal.
Machine cost (Initial cost)	High	Low
Operating cost (Labour and other)	Low	Very high
Production rate	Very high	Low
Possibility of defects	Low	High
Accuracy in size and weight	High	Low

Table 3 presents a detailed comparative analysis of the both process. The process 1 shows the high merits because of high accuracy with very high production rate and low operating cost. However it need high capital investment and prepared flat raw material sheet.

6 Conclusion

In this report, we presented the two different types of manufacturing process for the production of coins. The process based on blanking, annealing, washing and drying, upsetting, striking and inspection and packaging steps are selected because of high accuracy with very high production rate and low operating cost.

7 Reference

- [www1.oanda.com](https://www1.oanda.com/currency/iso-currency-codes/KWD). (n.d.). KWD | Kuwaiti Dinar | OANDA. [online] Available at: <https://www1.oanda.com/currency/iso-currency-codes/KWD>.
- The Spruce Crafts. (n.d.). How Are Coins Made? [online] Available at: <https://www.thesprucecrafts.com/how-are-coins-made-4589253>.
- [www.usmint.gov](https://www.usmint.gov/learn/production-process/coin-production). (n.d.). Coin Production | U.S. Mint. [online] Available at: <https://www.usmint.gov/learn/production-process/coin-production>.