

Cost Reduction in File Manufacturing by using Special Purpose Resistance Heating: A Case Study

Sameer S. Gajmal¹, Prof. Santosh Rane², Prof. Sudhir.G Bhatwadekar³

¹Assistant Professor, Department of Mechanical Engineering, Gharda Institute of Technology, Lavel

²Associate Professor, Department of Mechanical Engineering, SPCE, Mumbai

³Associate Professor, Department of Production Engineering, K.I. T.'s college of Engineering, Kolhapur.

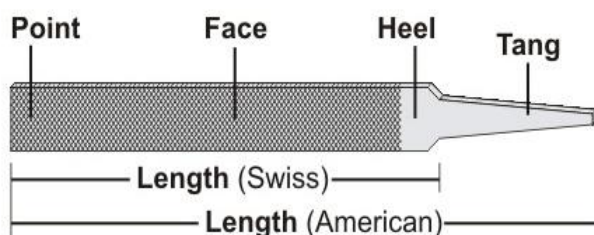
Abstract: File manufacturing industry is having a tremendous scope in the market. There is a large variety of files which are manufactured in mass production. Out of 11 nos. of operations, one of the operation is tang forging operation. The raw material is heated and is made undergo through open die forging process. In the present paper a case study of an small scale industry is discussed. For the tang forging operation the source used for heating the raw material was Gas heating. Special Purpose Resistance Heating Furnace was replaced instead of Gas heating. It was found that the cost of tang forging operation was reduced to almost 80%. Also it was found that the operator was put into a comfortable and safe work environment due to replacement of Gas Fired Furnace by Resistance heating Furnace.

Keywords: File, Gas Heating, Resistance Heating.

I. INTRODUCTION

A file is a metalworking, woodworking and plastic working tool used to cut fine amounts of material from a work piece. It most commonly refers to the hand tool style, which takes the form of a steel bar with a case hardened surface and a series of sharp, parallel teeth. The file is one of the most basic and essential tools found in the any type of industry. The proper file can rough out a shape rapidly or refine and smooth the finest of details. Having a good selection of files will enhance your creative potential. While files seem so common, they are actually quite amazing tools. The first files were made completely by hand with each tooth formed by striking a chisel at the proper angle and interval. The first successful file cutting machines came into use in the mid eighteenth century. This, along with improvements in the refining of iron ore into steel and better heat treating processes, led to the development of the modern files.

Figure 1. Basic Parts of a File



II. TYPES OF FILES

A. Depending on the Type of Cut:

1. Extra Rough Cut and Rough Cut Files

Both these types of files are used for the initial filing where the amount of material removed is quite a lot while precision is not a concern since it is normally carried out at the beginning of a filing operation.

2. Middle Cut, Bastard Cut and Second Cut Files

These types of files are used for intermediate operations after the heavy material removal is complete and before finishing the final smoothening out operation.

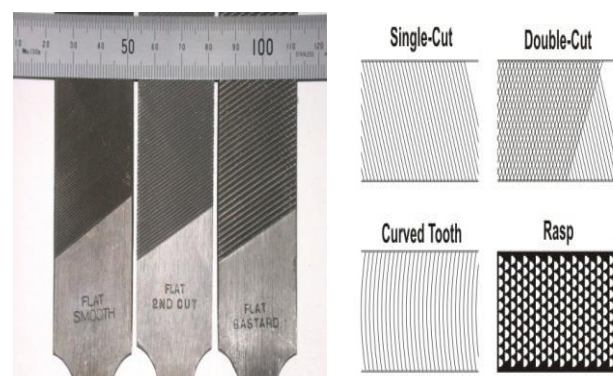
3. Smooth Cut and Dead Smooth Cut Files

These files are used for finishing the filing operation by smoothening out the irregularities which are left by the previous two operations.

In the above file classification is must be noted that the various types of cuts are made possible with the variation of teeth density of the file. A rough cut file and other coarse files have relatively less number of teeth per inch while the smoother files have the maximum number of teeth. The cut of the file refers to how fine its teeth are. They are defined as (from roughest to smoothest): rough, middle, bastard, second cut, smooth, and dead smooth. A single-cut file has one set of parallel teeth while a cross-cut or double-cut file has a second set of cuts forming diamond teeth.

Some of the important files types are listed as follows

Figure 2: Types of Files Depending upon cut



B. Types Of Files Depending On The Shape Of The Shank:

1. *Flat Files:* As the name itself suggests, these files have flat shank shape which have teeth on both sides and are mostly used for level filing work involving straight surfaces.

Figure No-03: Flat File



2. *Round Files:* The blade or the shank of this type of files is round in shape and the teeth are formed on that round surface. The diameter of the whole shaft is uniform towards one end, while it slightly tapers at the outward end. These files are very useful in filing round shapes such as round holes or enlarging them.

Figure N0-04: Round File



Table No.-01 Various Sizes of Round File

Code No.		04 RD	05 RD	06 RD	08 RD	10 RD	12 RD	14 RD	16 RD	18 RD
Size	Inches	4	5	6	8	10	12	14	16	18
	mm	100	125	150	200	250	300	350	400	450
Thickness	mm	3.8	5	6.3	7.1	9.2	12	16	19	22
					5	5				

3. *Square Files:* These files are very similar in construction to the above mentioned round files with the only difference that the cross-section of the shaft is of square shape which is uniform towards the handle end but gets slightly tapered towards the outside end while maintaining its square shape.

Figure N0-05: Square File



C. Commercial Types Of Files:

I. Saw Files:

1. Mill Regular
2. Mill Blunt – One Round
3. Mill Blunt – Two Round
4. Mill Blunt - Two Square

5. Band Saw
6. Band Saw Blunt
7. Heavy Taper
8. Regular Taper
9. Slim Taper
10. Extra Slim Taper
11. Double Extra Taper
12. Double-Ender
13. Pit Saw
14. Cross Cut
15. Cant Saw
16. Rotary Mower
17. Round Chain Saw
18. Farmers Own
19. Double Edge Saw
20. Feather Edge Saw

II. Machinists' Files

1. Flat
2. Hand
3. Half
4. Square
5. Round
6. Three Square
7. Pillar
8. Warding
9. Knife

III. Rasp Files

1. Flat Rasp
2. Half Round Rasp
3. Round Rasp
4. Cabinet Rasp
5. Horse Rasp - Plain
6. Horse Rasp - Tanged
7. Shoe Rasp
8. File and Rasp Combination

IV. Needle Files:

1. Hand
2. Flat
3. Three Square
4. Square
5. Half Round
6. Round
7. Knife
8. Barrette
9. Crossing
10. Slitting
11. Crochet
12. Hand With Round Edge

V. Diamond Coated Needle Files

1. Hand
2. Flat
3. Three Square
4. Square
5. Half Round
6. Round
7. Knife

III. APPLICATION OF FILES

Files are often used to put the finishing touches on a machined work piece, either to remove burrs or sharp edges or as a final fitting operation. Intricate parts or shapes are often produced entirely by skilled workers using files.

IV. CASE STUDY

In this paper a case study from a small scale industry named Sharda Maa Engineering Located at MIDC Gane-Khadpoli, Taluka- Chiplun District- Ratnagiri is discussed. The component under consideration is Round File 06 inch Size. The Raw material for files is File Steel.

V. LIST OF MANUFACTURING OPERATION IN FILE MANUFACTURING

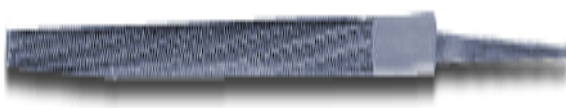
1. Raw Material Cropping
2. Tang Forging
3. Tang Cutting
4. Annealing
5. Grinding
6. Teeth Cutting
7. Inspection
8. Stamping
9. Hardening
10. Scoring
11. Proving & Packing

VI. TANG FORGING OPERATION

Out these operations the Tang Forging Operation of Round File (06 Inch) was taken was study.

The details of the operations before study and modification are as follows:

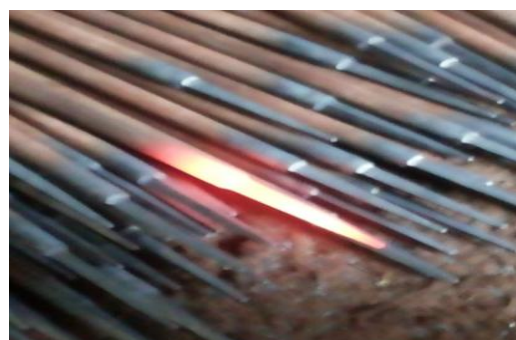
Figure No-06: Tang Forged Round File



Before Study:

- Machine Used for Forging:
Auto Forging Hammer (Hammer of 15 Kg, 25 Kg.)
- Gas Furnace:
Fuel: LPG
Temperature required: 550°C
- Job Holding Tools:
(Pair of tongs, Hand Gloves, etc)

Figure No-07:Tang Forging Set Up with Gas Fired Furnace



After Study:

- Machine Used for Forging:
Auto Forging Hammer (Hammer of 15 Kg, 25 Kg.)
- Resistance Heating Furnace:
Specification: 03 Phase, AC Voltage 440 V,

- Temperature required: 550°C
- Job Holding Tools:
Not required.

Figure No-08:Tang Forging Set Up with Special Purpose Resistance Heating Furnace



VII. ABOUT SPECIAL PURPOSE RESISTANCE HEATING FURNACE:

The Furnace used is fully automatic, Water-cooled heavy duty ESR Transformer suitable for different sizes of furnishing rods, with suitable clamping and water cooled heavy duty thyristorised, Latest heat sequence electronic control panel, Electronic control system consists of water-cooled thyristor assembly, necessary sensors for automation and protection & for achieving maximum productivity.

FIRST TIME IN INDIA – special purpose Resistance Heating Machine which is very useful for Engineers’ File manufacturers has been used. This machine is used in place of existing Gas Burners for heating the file ends before forging. The special design used in this machine helps to heat the job faster with considerable less current. Since the Time and Current is less, the electrical energy consumption, which is proportional to the time and square of current, is considerably reduced and hence the operation cost of this machine is negligible compared to gas heating. Apart from the financial benefits, this machine is absolutely Eco friendly compared to gas heating.

Salient Features:

- Low Power Consumption
- Fully Automatic
- Thyristorised Electronic Precision control ensures accuracy
- Absolutely eco-friendly compared to conventional gas heating
- Precise localized heating pattern ensures superior product quality

Table N0.-02: Machine Description:

TECHNICAL SPECIFICATIONS	
TRANSFORMER	
KVA	15 KVA to 30 KVA
COOLING	WATER
INSULATION	CLASS-F
POWER SUPPLY	415 V – 1 Ph

MACHINE SPECIFICATIONS	
OVERALL DIMENSIONS (mm)	400W X 650DX800H
WEIGHT (kg)	150

During the study it was found that the tang forging operation with Gas Fired Furnace was not efficient, also the operator was not comfortable with the hot environment because of the Gas Fired Furnace nearby the workplace. For one shift about 06-07 Kg of LPG was consumed for forging 600- 650 Nos. of files.

Table N0.-03: Cost of Gas Heating

Sr . No.	Particulars	LPG Consumed	Production of Files
1	For One Shift	06-07 Kgs.	600-650 Nos. of Files
2	For Three Shift	18-19 Kgs	1800 Nos. of Files
Cost of LPG required per day			Rs. 1600/- + Transport Charges

After carrying out a deep study, it was suggested to carry out the Tang Forging operation with Special Purpose Resistance Heating Furnace instead of Gas Fired Furnace.

Salient features of resistance Heating Furnace;

- Compact
- Water Cooled Electrode
- Pneumatic Clamping
- Timer for adjusting the heating time period.

Table NO.-04: Cost of Resistance Heating

Sr · N o.	Particulars	Electricity Consumed	Cost of Electricity Consumed
1	For One Shift	10 Units	10 X 8 =Rs.80
2	For Three Shift	30 Units	30 X 8 =Rs.320/-
Cost of Resistance Heating per shift			Rs. 320/- Only

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VIII. RESULTS AND FINDINGS

- By replacing Gas Fired Furnace by Special Purpose Resistance Heating Furnace , the net saving in Tang Forging Operation Cost was Rs.1280/- Per shift.
- Machine Operator got relief from the hot environment which improved his overall efficiency. The file can be handled without using any of the work holding devices, which was required in the previous case of Gas Heating.

Figure No-09: Manual Handling of heated File



- Workplace became safe since Gas Fired Furnace was eliminated.
- Now with Special Purpose Resistance Heating Furnace the component is heated only for the required tang length of 15 mm, excessive heating (along the length) of component is avoided.
- Since the net cost saving in the Tang Forging operation was Rs.33,280/- per month, the capital investment of Rs.1,50,000/- done in procuring the Special Purpose Resistance Heating Furnace was going to be recovered in 4.5 months which was acceptable by the industry.

IX. CONCLUSION

The cost of Tang Forging operation was reduced down to almost 80 % (Initial Cost Rs.1600/- Per shift, Cost After Modification Rs.320/- per shift for the Monthly Production of 1800 Nos. of Round File of 06 Inch Length) which was appreciated by the industry where the study was carried out.