

# Reduction of Cycle Time and Increase of Production in Honing Machine by Buffing Tool

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**ABSTRACT:** Honing is an abrasive machining process that produces a precision surface on a metal workpiece by scrubbing an abrasive stone against it along a controlled path. Honing is primarily used to improve the geometric form of a surface, but may also improve the surface texture. Honing is a cutting process where multi-edge tools coated with particles with continuous surface contact between the tool and workpiece are used to optimise the dimension form and surface of pre-machined work pieces. Between tool and workpiece there is change in direction of longitudinal movement takes place. The finished surfaces are characterised by cross hatch pattern on the surface. In a honing machine, boring tool or honing stick is used to bore an internal bore in the material. It is a timed operation and also rate of production is very less. Timing of honing is defined by quick cutting of the peaks of the pre-machined bore surface. Due to this operation material wastages are considerable high. So that for reducing processing time and increase a production. We introducing buffing tool in honing machine. It have multiple point cutting edges and it boring a material in a stock. Here machining time is considerably less when compare with other operation. The cost of an operation also reduced. Strength of the material may be increased. This rapidly achieves a smoothing of surface in material.

## I. INTRODUCTION

### 1.1 HONING PROCESS:

Honing is a low velocity abrading process in which stock is removed from metallic or non-metallic surfaces by bonded abrasive sticks. It is a finishing operation employed not only to produce high finish but also to correct out-of-roundness, taper and axial distortion in work piece. In honing, since a simultaneous rotating and reciprocating motion is given to the stick, the surface produced will have a characteristic cross-hatch lay pattern. Honing is an abrasive machining process that produces a precision surface on a metal work piece by scrubbing an abrasive stone against it along a controlled path. Honing is primarily used to improve the geometric form of a surface, but may also improve the surface texture.

Depending on size and shape of work pieces honing can be performed by following two methods.

Typical applications are the finishing of Cylinder for internal combustion engines, Yokes for steering column, air bearing spindles and gears. Finish boring or internal grinding may do the job, but spindle deflection, variation in hardness of the material.

Machining a hole to within less than 0.001 in. in diameter and maintaining true roundness and straightness with finishes less than 20( $\mu$ ) in. is one of the more difficult jobs in manufacturing. It can remove as little as 0.0001 in. of stock or as much as 0.125 in. of stock. However, usually only 0.002 into 0.020 in stock is left on the diameter for honing.

### 1.2 BUFFING:

"Buffing" is the process used to shine metal, wood, or composites using a cloth wheel impregnated with cutting compounds or rouges. The cloth buff "holds" or "carries" the compound, while the compound does the cutting. The industry refers to "polishing" as the process, which uses abrasive belt finishing.

# International Journal of Innovative Research in Science, Engineering and Technology

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Buffing generally requires two operations, a cut buff and a finish buff. Even the cut buff, which is the coarsest buffing operation, is too fine for removal of pits, coarse abrasive polishing lines, or deep scratches. This is why surface preparation prior to buffing is critical to a high luster, final finish.

Excellent pre-buff surface preparation starts with using the finest abrasive belt that production will allow. It is from this point that removal of the original scratch line needs to be accomplished to achieve the final buff finish.

The original "scratch" or polish is followed by one or two additional polishing steps. Cross polishing the abrasive lines if possible and buff off of approximately 400 grit or finer abrasive on metals.

The cut buff will remove the final polishing lines, but may not be as bright as required. The finishing buff will produce the luster.

## The two basic buffing processes in manufacturing are:

**Tangential buffing** is the traditional hand buffing process which also can be automated. The part surface is positioned 90 degrees to the buff. The buff width is generally designed to be sized to the part. Tangential buffing creates high heat because of the higher required buff pressure applied to the workpiece.

The tangential buffing process works well with parts that can be easily repositioned and uses buffs that range from 12" to 18" diameter running at 1700 rpm. The process is just ok for contouring, it works well for harder metals (steel and stainless) and harder ceramic composites.

The process is a good choice for robotic automated processes.

## Mush buffing

The process uses large diameter buffs up to 24" and run at approximately 800 rpm. The slow speed allows the buff to conform or mush around the part, running cooler resulting in less damage of the part or buff. The automated buff lengths are up to 16 to 18 feet. Compound penetrations down into the buffs are important. Mush buffing is a good cost effective process for softer metals (Aluminium, Brass, Copper, Zinc) and softer composites.

## 1.3 BUFF TYPES:

CUT BUFFS	FINISH BUFFS
Spiral Sewn	Loose Buffs
Set Up Wheels	Concentric Sewn
Sisals	Airway
Treated Airways	Flannel

Table-1.3 Buff types

**Spiral Sewn** constructed of cloth sheets and sewn in different spacing's of 1/8" 1/4" and 3/8" being the most common. These buffs are 1/4 to 3/8" thick and can be stacked to create a wider buff surface. This is a buff that is produced in cloth, denim or sisal material. The spiral sewn buff is used primarily for manual cut buffing for general cutting ability.

**Set up wheels** are made of spiral sewn wheels that are glued together and balanced to obtain a thicker (commonly up to 4") and stiffer cut buff. These buffs are used for set up wheels using Aluminium oxide for fast and efficient cutting or Turkish emery combined with grease to create a finer polished surface prior to chrome plating on steel bumpers. These wheels will be set up with 2-3 layers of glued abrasives and can be run for 2-6 hrs of production. These wheels are available in cloth or denim with spirals sewn from 1/8" to 3/8". These wheels are very stiff and are the fastest cutting buff available. **Airway Ventilated** buffs are constructed to decrease the heat created by the buff

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Vol. 6, Issue 3, March 2017

process away from the work piece. The air flows thru the buff as it is rotated. This buff is made of various materials (cloth, treated cloth, sisal) and densities (2, 4, 6 and 8 with the buff being firmer as number increases).

The airway is produced in plies (12, 14, 16, 18, and 20) the increased ply increases the material used and affects also the buff's thickness. There are three different mill treatments of cloth, white, white firm, and yellow maze. Each buff manufacturer will have 3-4 standard to specialized colour dip treatments that will also vary in hardness. The Airway buff is the standard buff for production buffing whether it be a manual or automated process. The buff can cut or finish all metals and composites.

**Finger buffs** are a very aggressive cutting buff. The finger buff is stacked together and can conform well to curved surfaces. These buffs are made in cloth, sisal, and a combination of cloth and sisal. The finger buff is used for fast cutting of stainless metals.

### **Finish Buffs:**

The finish buffs are generally made of softer cloth materials so they will not scratch the surface of the work piece. They are also constructed in various ways and are identified by their construction. The finish buff requires less pressure than the cut buff process. Two passes thru the buff is normal and less compound is left on the part after the finish buff.

**Loose** buffs are a very popular manual and automated finish buff. They are sewn once around the arbor hole creating a loose floppy disc of cloth.

The loose buff can be made in various thickness and is referred as number of plies. The more plies the thicker the buff. The thread count is also important on the finish loose buff, the higher the thread count the finer the material creating a finer finish. The loose buff is a good choice for all metals and composite finishing.

**Concentric Sewn** buffs also referred to as a jeweller buffs are a buff that are sewn in round 1/2" to 1" increments. These buffs are firmer than a loose finishing buff, and sometimes are used as a minor cut buff. The buff sewn seams are commonly cut when reached to expose the next softer amount of material. The concentric sewn buff is produced in 1/2" to 1" widths which is also determined by the number of plies. This buff is popular because of its width and extra firmness. It can be used on all metals and composites.

**Airway** buff is widely used as mentioned earlier for finishing. The best finishing airway is a standard mill cloth low 2 density material. If the metal is harder the stiff firm treatment can also finish well. The Airway is also produced in a flannel material for excellent softness. The flannel is the softest cloth material and is used for very soft metals and composites. The cotton is (picked) an operation the mill uses to pull the nap. The Domed flannel is picked or soft on one side and the Canton flannel is picked or soft on both sides.

## II. LITERATURE SURVEY

A study to investigate the effect of cylinder liner honing angle on hydrodynamic lubrication between piston ring and cylinder liner. Honing angles between 25- 75° were investigated to find the effect of honing angle on film thickness. The plateau-honing is an ultra- finishing process as a result of two machining processes:

rough honing with big size abrasive grains and finish honing with very small size abrasive grains to eliminate peaks on the surface of the piece. It is a very complex process depending on many parameters. Hydraulic cylinder is the core of construction machinery remanufacturing. Which main failure mode is scratch on the surface of hydraulic cylinder bore. Causes of failure mode and feasibility of honing process applied on of hydraulic cylinder bore remanufacturing are analysed considering three factors: little machining allowance, overlapping curve and high surface quality. The honing process technology is presented, including selection of honing machine, honing oilstone, honing oil and process parameters of course honing, micro honing and polishing, and honing process for remanufacturing. A case of applying honing process on boom cylinder bore remanufacturing is given and proved to be

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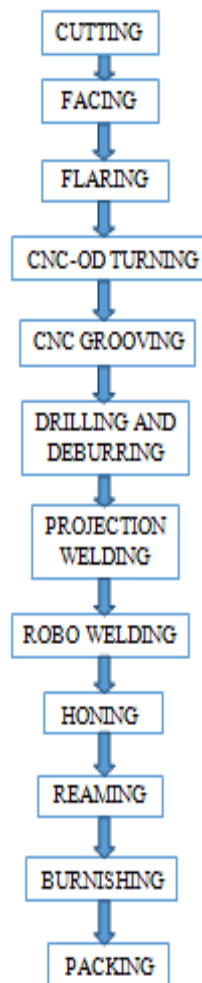
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feasible in practice. The main focus of this work is to reduce potential process variations and reach the six sigma quality level. FPY is an important manufacturing metric for measuring quality and production performance. Honing is an abrasive machining process that produces a precision surface on a workpiece by scrubbing an abrasive stone against it along a controlled path. The problem faced by the organization is that the honing machine is produce large number of defects, thus leading to a FBY of 85%. DMAIC (Define, Measure, Analyse, Improve, Control) based six sigma is used on study to overcome this problem. After data collection, the Cp and Cpk of honing machine found to the 1 and 0.93 respectively. On analysis, the factor contributing to the problem were found to be first spindle dimension and bore, second spindle dimension and bore, prep art bore though and the frequency of the tool change. This speed selection depends upon hardness of crankcase material. S/n ratio larger is better for MRR and S/N ratio smaller is better for surface roughness the result revealed that using MRR gets us stroke pressure increase. From response table and graphs as the rank indicates stroke pressure as great as effect on MRR and the rank indicates the speed pressure has a greatest effect on surface roughness. The objectives of research summarized that feed pressure increases us it is surface roughness decreases.

## III.METHODOLOGY



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### IV. DESIGN CALCULATION

Normal operating cycle time:

Component Details:

Ashok Leyland Steering Hydraulic Cylinder (AL) Diameter = 70 + (0.025 to 0.065) mm

Surface Finish= 0.4 RA

Total Length = 400 mm

Honing Procedure for Roughing: Honing sticks width= 6mm Thickness= 6mm

Length = 75mm

No of sticks = 4 nos

#### Using Stick Grid D151

Machining Size = 69.85mm

Honing Cycle Time = 30.00mins

Honing Size = 70.02 mm

Surface Value= 2.2RA

Honing Finishing:

Honing stick width = 6mm

Thickness = 6mm

Length= 75mm

No of Sticks = 4nos

Honing size = 70.04mm

#### Using Stick Grid D107

Cycle time = 03.00mins

Diameter = 70.02mm

Surface Value = 1.8RA

Honing Fine Finishing: Honing sticks width= 6mm Thickness = 6mm

Length = 75mm

No of sticks = 4 nos

#### Using Sticks Grid D64

Cycle time = 05mins

Surface Finish Value = 0.4RA

Finally:

**Component size = 70.04mm**

**Total Cycle Time= 38.00mins**

Revised and Modified operating cycle time:

Buffing diameter: 38mm

Abrasive material: Silicon carbide, Aluminium oxide

Time to finish one product: 3 minutes

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## V. CONSTRUCTION AND WORKING

### 5.1 COMPONENTS EXPLANATION:

#### A. Spindle Speed:

The spindle speed depends mainly on the diameter of the bore to be honed. The choice of spindle speed is influenced by the following factors:

- 1) Material being honed: - Higher speeds are used for metals that shear easily such as cast iron and non-ferrous metals.
- 2) Hardness: The harder the work piece, the lower is honing speed.
- 3) Surface finish: Rough surfaces that dress the stone mechanically allow higher speeds.
- 4) Number and width of stones in a tool: - Speed should be decreased as the area of abrasive per unit area of bore increases.
- 5) Finish requirement: - Higher speeds usually result in finer finish. Excessive speeds contribute to decreased dimensional accuracy, overheating of the work piece and glazing or dulling of the abrasive.

**B. Reciprocating Speed:** The reciprocating speed, which depends mainly on the length of the honing tool and the depth of the bore, is expressed in meters per minute as the product of number of strokes per minute and twice the stroke length. Since reciprocating speed, rotary speed and cross-hatch angle are related functions, the cross-hatch angle can be controlled by varying the reciprocation speed when rotation is constant. Reciprocation speed has considerable influence on the finish of the job. If the reciprocating speed is high, the dressing action is greater and consequently results in a rougher finish on the job.

**C. Cross-hatch:** Abrasive grains are bonded in the Form of sticks by a vitreous or resin material and sticks are presented to the work. So that their full cutting forces are in contact with the work surfaces. Since a large number of abrasive grains are presented to the work surface simultaneously, substantial material removal takes place. For cylindrical surfaces the abrasive grains are given a combination of two motion-rotation and reciprocation. The resultant motion of the grains is a Crosshatch lay pattern with included angle between 20 and 60.

**D. Honing Pressure:** A wide range of pressure is used to obtain higher rates of material overall and better results. In some of the equipment the hydraulic force for feed-out varied from 10 to 32 kg/cm<sup>2</sup>. However, honing is more often controlled by the rate feed-out than by gauge pressure. Insufficient pressure leads to a low rate of material removal. When the pressure is excessive, a rougher finish will result as the abrasive breaks down very fast. This increases the tooling cost as well as the machine downtime for frequent interchange of the stones. The trial and error method is usually employed for determining the optimum pressure for honing. To start with, a low pressure is used and then gradually using work piece finish as the reference, the pressure can be increased.

**E. Cutting fluid:** A fluid must be used with honing. This has several purposes: to clean the small chips from the stones and the workpiece, to cool the work and the hone and to lubricate the cutting action. A nonical961 type oil is used in this honing process.

**F. Honing stone:** Honing stones sometimes known as honing stick consist of particles of aluminium oxide, silicon carbide and diamond bounded together with play, resinous, corn, carbon etc. The porosity of the structure of the stick, depending on the mixture of grit and bound, methods and pressure used in the forming the sticks, facility cheap clearance, thereby minimizing the generation of heat.

**G. Grit size:** The size of grit may range from 36 to 600, but the size ranging 120 to 320 is most widely used. The selection of particular grit size depends mainly

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on the desired rate of material removal and required finish. Course grit removes metal faster but results in rougher finish.

### H. Abrasive:

1. Selection of the abrasive depends mainly on the composition, hardness of the metal being honed, finish required and the cost
2. Normal aluminium oxides for the steel and silicon carbide for CI and nonferrous materials are used as abrasives.
3. Diamond is used for honing extremely hard and wear resistant materials such as tungsten, carbide or ceramics.

### I. Designation of honing stones:

- 1) The marking system employed for designation of grinding wheels is also applicable for honing stones.
- 2) The marking normally specifies types of abrasive, grit size, hardness and type of bond.

### 5.2 WORKING:

The honing process is used to obtain precise dimension and surfaces in cylindrical shapes with a wide range of diameters the applies to parts such as Hydraulic cylinders, piston, bearing bores, pin holes and to some external cylindrical surfaces.

The Honing process offers advantages of low capital equipment cost, high metal removal rates, and extreme accuracy of 0.001mm (0.00004') in a wide Varsity of materials.



Fig.No.5.2.1 Honing Machine

The abrasive action of the honing tool remove material from the work piece's inside diameter. The tool rotates and expands while the workpiece reciprocates back and forth .To achieves such close tolerances, the workpiece must be allowed to "float" or move in three axes.

This movement is the single most important point in achieving the closer tolerance required in industry today. This of course, reduce one of the three axes of movement, thus reducing the amount of movement or "float"

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These machines hold the work as well as the tool in vertical position. They are available in single and multiple spindle type. The spindle head and hence, tools reciprocate and not the work piece. Suitable fixtures are employed to hold the work piece in position.

Most of the modern machines carry a hydraulic drive for the spindle heads and the tools. Thus machine is best for shorter jobs. In appearance, thus machines resemble the drilling machine. In Honing work, the vertical machine are widely used then the horizontal ones. A Honing tools head used on it.

In vertical honing machine the Ashok Leyland component is fixed between the bar and the jaw, the flexible spindle is placed at the top the bar. The spindle moves in a longitudinal direction due to the spindle motion the internal surfaces are machined. It gives high surface finish to the component.

### 5.5 APPLICATION

Buffing may be used to enhance and restore the looks of certain metal parts or object on cars and other vehicles, handrails, cookware, kitchenware, and architectural metal. In other applications such as pharmaceutical, dairy, and specialty plumbing, pipes are buffed to help prevent corrosion and to eliminate locations where bacteria or mild may reside. Buffing is also used to manufacture light reflectors.

Honing surface have excellent tri biological properties high bearing area ratio, low surface roughness and define cross hatch patten for lubricant retention. Tight bore size and cylindrically control couple with enhanced tri biological characteristics extends the life of bearing.



Fig no: 5.2.2 Abrasive buffing wheel

Buffing wheel for very soft polishing or which can be used to polish into interior corners may have no stitching, the cloth layers being kept in position by the centrifugal force resulting from the rotation of the wheel. Production application of buffing process which produces mirror-like finish.



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### 5.3 COMPARISION:

Following tables represent the comparisons of honing stick and buffing wheel

S.NO	PROCESS	HONING STICK	BUFFING WHEEL
1	Cycle time	Honing stick=5mins Burnishing=3mins	4 minutes
2	Tool cost	Honing stick= Rs:1800/1stk Burnishing= Rs:250	Rs:30-2000
3	Machine	Honing and burnishing are used in different machine	Single machine
4	Coolant	Need	No need
5	Machine cost	High	Less
6	Accuracy	Less	More
7	Stock	More	Less
8	Current	High	Low
9	Production rate	Decreased	Increased
10	Labor cost	Increased	Decreased

**Table 5.3- Comparison table**

### 5.4 ADVANTAGE

- Tool cost is less
- Labor cost is reduced
- Production rate is increased
- It has more accuracy

Machining time is reduced compared to the other process Nagel has successfully installed thousands of honing systems all across the globe in automotive, aerospace, hydraulic and lawn & garden, oil & natural gas, appliance, medical and other industries.

Engine: cylinder bore, cylinder liner, crank bore, connecting rod, diesel fuel injection components, crankshafts pulley, rocker-arm, turbo charger valve, roller lifter, VVT components.

Hydraulics: axial flow pumps, rotary oil pumps, gear pumps, radial piston housing and valves.

Transmission and chassis: pinion gear, differential gear, ABS control valve, steering housing, brake-drum, brake-cylinder, brake-valve and stator.

## VI. CONCLUSION

In a day to day arriving technologies the exposure of industrial based technical mechanisms are also growing up by providing the way to implement the new designs in the machines and tools to enrich the standard. In this way, stroke length is reduced in the honing machine by implementing abrasive buffing wheel to the working tool instead of using honing sticks. While machining the internal surface using honing machine the tool is designed buffing wheel in the tool diameter. Considering the design to reduce time, cost and to increase the quality a new design is made for the buffing wheel which it performs the task by improved design structure. The improved design structure helps to reduce the cycle time up to 40% of the full process cycle. This changing methodology in a tool

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design helps in leading stages to increase the performance of the honing process. In the process honing and burnishing are used different machine but use buffing wheel in single machine. Finally through the tool design production efficiency is partially improved and cycle time is reduced.

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