DETAILED PROJECT REPORT
ON
CONVENTIONAL TURRET PUNCH MACHINE WITH CNC TURRET PUNCH MACHINE
(BANGALORE MACHINE TOOL CLUSTER)











Bureau of Energy Efficiency

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REPLACEMENT OF CONVENTIONAL TURRET PUNCH MACHINE TO CNC TURRET PUNCH MACHINE

BANGALORE MACHINE TOOL CLUSTER

BEE, 2010

***Detailed Project Report on Replacement of Conventional Turret Punch* Machine to CNC Turret Punch Machine**

Bangalore Machine Tool cluster, Karnataka (India)

New Delhi: Bureau of Energy Efficiency;

Detail Project Report No.:

For more information

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Petroleum Conservation Research Association

Bangalore.

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List of Abbreviations

BEE	Bureau of Energy Efficiency
MSME	Micro Small and Medium Enterprises
CNC	Computer Numerical Controlled
DPR	Detailed Project Report
DSCR	Debt Service Coverage Ratio
EE	Energy Efficiency
GHG	Green House Gas
INR	Indian National Rupee
IRR	Internal Rate Of Return
kWh	kilo Watt Hour
NPV	Net Present Values
O&M	Operational & Maintenance
PAT	Profit After Tax
PBT	Profit Before Tax
ROI	Return on Investment
MoMSME	Ministry of Micro Small and Medium Enterprises
SIDBI	Small Industries Development Bank of India

EXECUTIVE SUMMARY

Bureau of Energy Efficiency (BEE) appointed Petroleum Conservation Research Association as the executing agency for Machine Tools of Bangalore under BEE's SME programme. Under this project, the executing agency carried out studies in the Machine Tools of Bangalore. Out of a total of 100 machine tools units, study was conducted in 30 units. Preliminary audits were undertaken in all the 30 units whereas detailed energy audits were conducted in 10 of these units.

Bangalore has evolved as one of the most important production centers in the Machine tool sector despite there being nothing favorable for proliferation of a cluster. The place lacks all possible resources, from raw materials to fuels and to skilled man power newer technologies as well which is the most important for processing of Machine tools. Today there are 100 units in Bangalore alone and the production capacity of machine tool units in Bangalore cluster is in the range of 1500 kg per Annum –1050000 kg per Annum.

Energy forms a major chunk of the processing cost with over 30% weight age in the cost basket. As per the preliminary and detailed energy audit findings, there exists potential of saving over 30% electricity and 50% fuel in the applications in power process industries with over all general payback period of less than six year. The payback period in these industries is higher due to their working schedule and lower utilization of facilities.

Based on the energy audits, the executing agency submitted their report to BEE in form of a cluster manual with recommendations for energy conservation & savings potentials in the Machine Tools sector. The one of the recommendations made in the cluster manual is listed below:

Replacement of conventional Turret Punch machine with CNC Turret Punch Machine or new CNC Turret Punch Machine

The CNC Turret Punch Press gives remarkable productivity for the components having many perforations or requiring many punches. It is able to punch 6mm in M.S., 6mm in Aluminum & 4mm in S.S. and has vast tooling potential for the increased versatility. With a 3 meter long table, it can handle sheet size of 1270 x 3000 mm with auto repositioning beyond 1500 mm. So up to 1.5mtr, machine can punch without repositioning and thus avoiding time loss and further improving quality. With its unique 30 Tons capacity it can easily punch 6.4 mm thick MS/4mm thick SS. This means ability to produce variety of components without re-tooling. This results in significant saving in production cost and noticeable increase in productivity. This has a great impact on job work cost and so we are able to do job work with excellent quality at affordable cost. The CNC Turret Punch Press gives high productivity in an economical way. It has the ability to produce variety of components without re-tooling and thereby saving in production cost. It is best suitable for

regular and repetitive job work. And under proper maintenance will serve the owner for a period of 12 to 16 years.

This bankable DPR also found eligible for subsidy scheme of MoMSME for "Technology and Quality Upgradation Support to Micro, Small and Medium Enterprises" under "National Manufacturing and Competitiveness Programme". The key indicators of the DPR including the Project cost, debt equity ratio, monetary benefit and other necessary parameters are given in table below:

S.No	*Particular*	*Unit*	*Value*
1	Project cost	` (in lakh)	88.66
2	Electricity saving	kWh	400
3	Monetary benefit	`/year	51.27
4	Simple payback period	Year	1.73
5	NPV	` (in lakh)	137.58
6	IRR	%age	41.54
7	ROI	%age	22.80
8	DSCR	ratio	2.84
9	CO_2 Reduction	Tonne / Annum	68.51
10	Procurement and implementation schedule	week	7

The projected profitability and financial indicators shows that the project will be able to earn profit from inception and project is financially viable and technically feasible.

ABOUT BEE'S SME PROGRAM

Bureau of Energy Efficiency (BEE) is implementing a BEE-SME Programme to improve the energy performance in 25 selected SMEs clusters. Gujarat Dairy Cluster is one of them. The BEE's SME Programme intends to enhance the energy efficiency awareness by funding/subsidizing need based studies in SME clusters and giving energy conservation recommendations. For addressing the specific problems of these SMEs and enhancing energy efficiency in the clusters, BEE will be focusing on energy efficiency, energy conservation and technology up-gradation through studies and pilot projects in these SMEs clusters.

***Major activities in the BEE -SME program are furnished below*:**

Activity 1: Energy use and technology audit

The energy use technology studies would provide information on technology status, best operating practices, gaps in skills and knowledge on energy conservation opportunities, energy saving potential and new energy efficient technologies, etc for each of the sub sector in SMEs.

Activity 2: Capacity building of stake holders in cluster on energy efficiency

In most of the cases SME entrepreneurs are dependent on the locally available technologies, service providers for various reasons. To address this issue BEE has also undertaken capacity building of local service providers and entrepreneurs/ Managers of SMEs on energy efficiency improvement in their units as well as clusters. The local service providers will be trained in order to be able to provide the local services in setting up of energy efficiency projects in the clusters

Activity 3: Implementation of energy efficiency measures

To implement the technology up-gradation project in the clusters, BEE has proposed to prepare the technology based detailed project reports (DPRs) for a minimum of five technologies in three capacities for each technology.

Activity 4: Facilitation of innovative financing mechanisms for implementation of energy efficiency projects

The objective of this activity is to facilitate the uptake of energy efficiency measures through innovative financing mechanisms without creating market distortion*.*

1 INTRODUCTION

1.1 Brief about the SME cluster

About SME cluster

The Machine Tools Cluster of Bangalore is located in the Bangalore district. Bangalore, also known as Bengaluru is the capital of the Indian state of Karnataka, located on the Deccan Plateau in the south-eastern part of Karnataka. Bangalore was inducted in the list of Global cities and ranked as a "Beta World City" alongside Geneva, Copenhagen, Boston, Cairo, Riyadh, Berlin, to name a few, in the studies performed by the Globalization and World Cities Study Group and Network in 2008. These machine units have been classified into following clusters within the district:

- Abbegere
- Bommasandra
- Peenya

Bangalore is the “HUB” for machine tools in India. The cluster accounts for 60% of the value of production of machine tools in the country. Bangalore is predominantly a metal cutting cluster. The structure of machine tool industry in Bangalore has at its apex 6 large machine tool manufacturers, about 100 small and medium machine tool manufacturers, their suppliers and vendors in large numbers.

Product Manufactured

In SME cluster of Machine Tools at Bangalore, there are varieties of products manufactured that include spindles, centre hobbing machines, ID hobbing machines, Self centering Steady Rests, Bar feeding attachments, Rotary tables, Index tables, Special purpose machines, Co-ordinate Measuring machines, aerospace fixtures, CNC Machine enclosures, Sound proofs, armature rewinding machines etc. There are supporting industries like heat treatment are also located in the cluster. These products/ machines are usually utilized in automobile industry, aerospace industry, CNC Machine industry across the globe. These are products custom made to suit the requirements of ISRO, HAL, BEML, MICO, BHEL, Kirloskar Electric, Bayforge Ltd etc.

Production Process

Typically, process for machine tool units in Bangalore is not the same for all industries involving various activities, as the end products of the industry are different for each industrial unit. Therefore, there is some variation in the flow of activities depending on the customized requirement of the products. However, these activities could be grouped together as shown below, though not in the same order as mentioned.

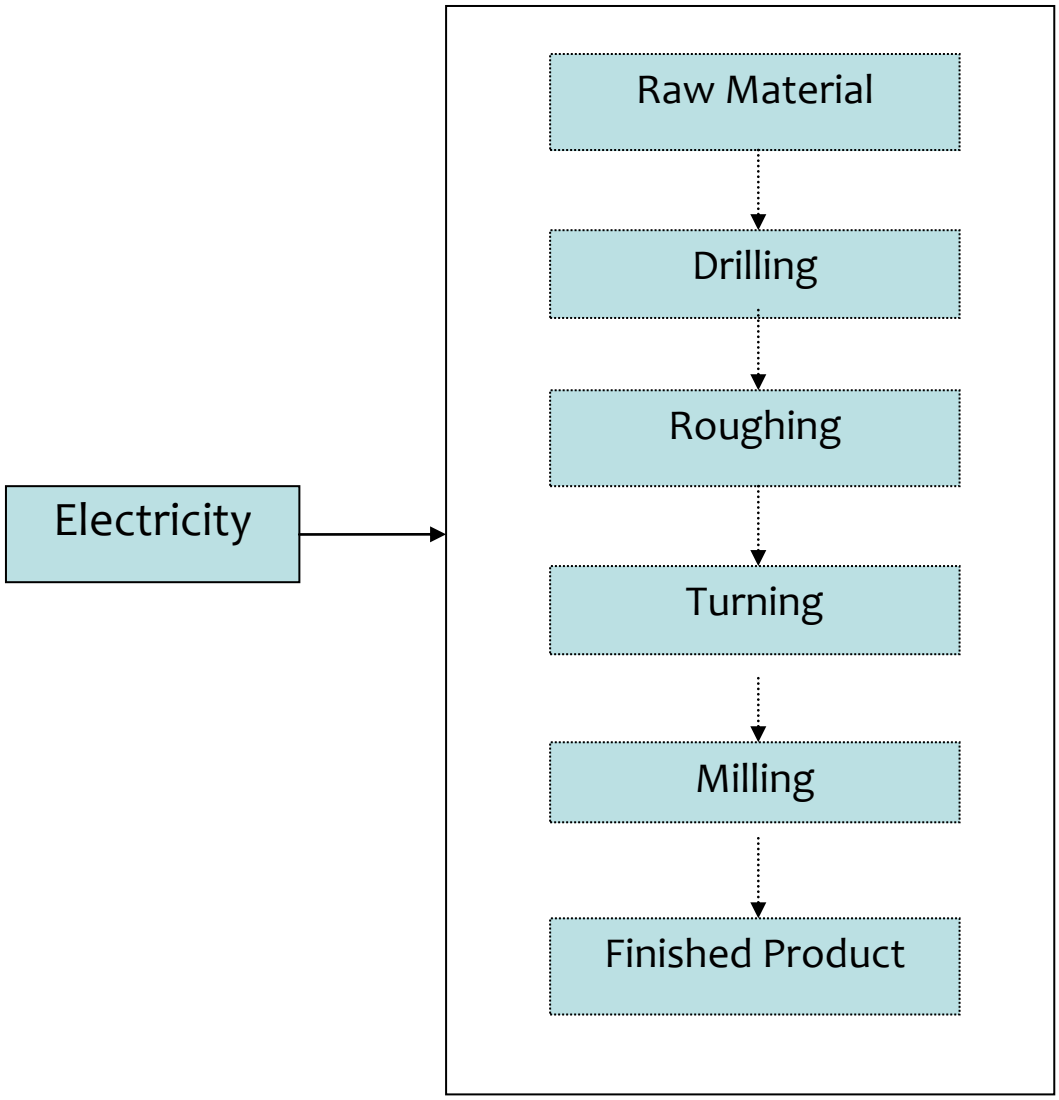
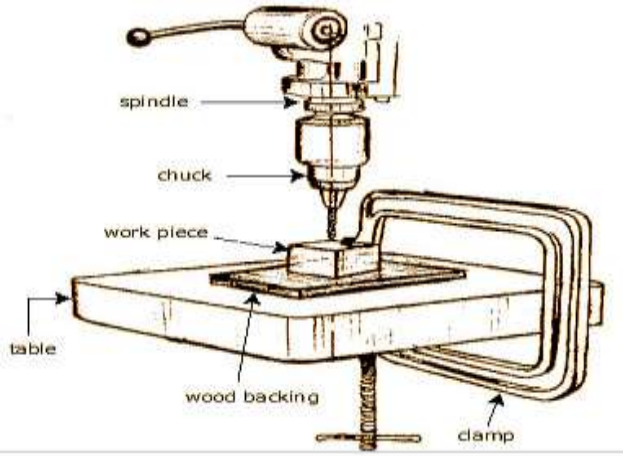


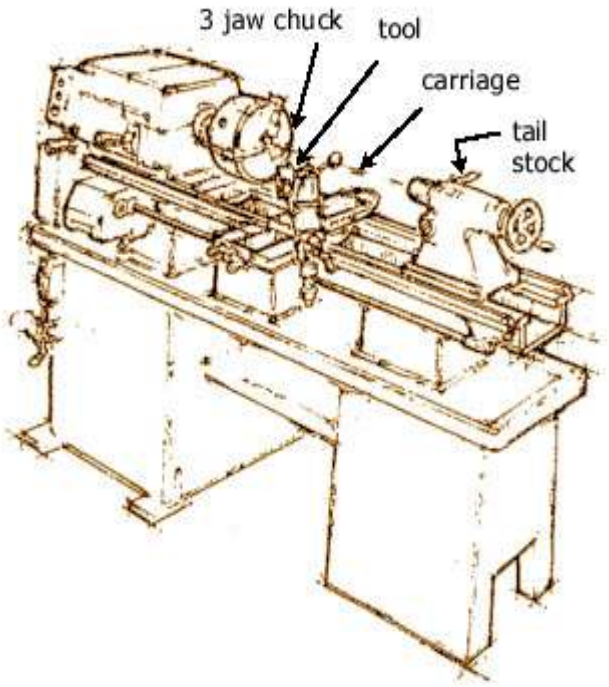
Figure 1.1 Process flow chart of typical Machine Tools Unit

Drilling Process

Drilling is the most common machining process whereby the operation involves making round holes in metallic and nonmetallic materials. Approximately 75% of all metal- cutting process is of the drilling operation. Drills usually have a high length to diameter ratio that is capable of producing deep hole, however due to its flexibility, necessary precaution



need to be taken to maintain accuracy and prevent drill from breaking.



Drilled holes can be either through holes or blind holes. A through holes is made when a drill exits the opposite side of the work; in blind hole the drill does not exit the workpiece.

Drilled holes are characterized by their sharp edge on the entrance side and the presence of burrs on the exit side (unless they have been removed). Also, the inside of the hole usually has helical feed marks.

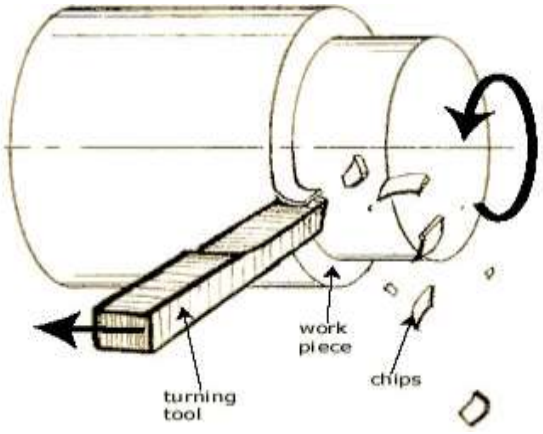
Drilling may affect the mechanical properties of the work piece by creating low residual stresses around the hole opening and a very thin layer of highly stressed and disturbed material on the newly formed surface. This causes the work piece to become more susceptible to corrosion at the stressed surface.

For fluted drill bits, any chips are removed via the flutes. Chips may be long spirals or small flakes, depending on the material, and process parameters. The type of chips formed can be an indicator of the machinability of the material, with long gummy chips reducing machinability.

When possible drilled holes should be located perpendicular to the work piece surface. This minimizes the drill bit's tendency to "walk", that is, to be deflected, which causes the hole to be misplaced. The higher the length-to-diameter ratio of the drill bit, the higher the tendency to walk.

Turning Process

Turning is a form of machining, a material removal process, which is used to create rotational parts by cutting away unwanted material. The turning process requires a turning machine or Gear Hobbing, work piece, fixture, and cutting tool. The work piece is a piece of pre-shaped material that is secured to the fixture, which itself is attached to the turning machine, and



allowed to rotate at high speeds. The cutter is typically a single-point cutting tool that is also secured in the machine, although some operations make use of multi-point tools. The cutting tool feeds into the rotating work piece and cuts away material in the form of small chips to create the desired shape. Turning is used to produce rotational, typically axi-symmetric, parts that have many features, such as holes, grooves, threads, tapers, various diameter steps, and even contoured surfaces. Parts that are fabricated completely through turning often include components that are used in limited quantities, perhaps for prototypes, such as custom designed shafts and fasteners. Turning is also commonly used as a secondary process to add or refine features on parts that were manufactured using a different process. Due to the high tolerances and surface finishes that turning can offer, it is ideal for adding precision rotational features to a part whose basic shape has already been formed.

Turning is the process whereby a single point cutting tool is parallel to the surface. It can be done manually, in a traditional form of Gear Hobbing, which frequently requires continuous supervision by the operator, or by using a computer controlled and automated Turret Punch which does not. This type of machine tool is referred to as having computer numerical control, better known as CNC, and is commonly used with many other types of machine tool besides the Turret Punch.

When turning, a piece of material (wood, metal, plastic, or stone) is rotated and a cutting tool is traversed along 2 axes of motion to produce precise diameters and depths. Turning can be either on the outside of the cylinder or on the inside (also known as boring) to produce tubular components to various geometries. Although now quite rare, early Gear Hobbings could even be used to produce complex geometric figures, even the platonic solids; although until the advent of CNC it had become unusual to use one for this purpose for the last three quarters of the twentieth century. It is said that the Turret Punch is the only machine tool that can reproduce itself.

The turning processes are typically carried out on a Turret Punch, considered to be the oldest machine tools, and can be of four different types such as straight turning, taper turning, profiling or external grooving. Those types of turning processes can produce various shapes of materials such as straight, conical, curved, or grooved work piece. In general, turning uses simple single-point cutting tools. Each group of work piece materials has an optimum set of tools angles, which have been developed through the years.

The bits of waste metal from turning operations are known as chips (North America), or swarf (Britain). In some areas they may be known as turnings.

Turning specific operations include:

- ***Hard turning***

Hard turning is a turning done on materials with Rockwell C hardness greater than 45. It is typically performed after the work piece is heat treated.

The process is intended to replace or limit traditional hobbing operations. Hard turning, when applied for purely stock removal purposes, competes favorably with rough hobbing. However, when it is applied for finishing where form and dimension are critical, hobbing is superior. Hobbing produces higher dimensional accuracy of roundness and cylindricity. In addition, polished surface finishes of Rz=0.3-0.8z cannot be achieved with hard turning alone. Hard turning is appropriate for parts requiring roundness accuracy of 0.5-12 microns, and/or surface roughness of Rz 0.8–7.0 microns. It is used for gears, injection pump components, hydraulic components, among other applications.

- ***Facing***

It is part of the turning process. It involves moving the cutting tool at right angles to the axis of rotation of the rotating workpiece. This can be performed by the operation of the cross-slide, if one is fitted, as distinct from the longitudinal feed (turning). It is frequently the first operation performed in the production of the work piece, and often the last- hence the phrase "ending up".

- ***Parting***

This process is used to create deep grooves which will remove a completed or part-complete component from its parent stock.

- ***Grooving***

Grooving is like parting, except that grooves are cut to a specific depth by a form tool instead of severing a completed/part-complete component from the stock. Grooving can be performed on internal and external surfaces, as well as on the face of the part (face grooving or trepanning).

- ***Non-specific operations include:***

- ***Boring***

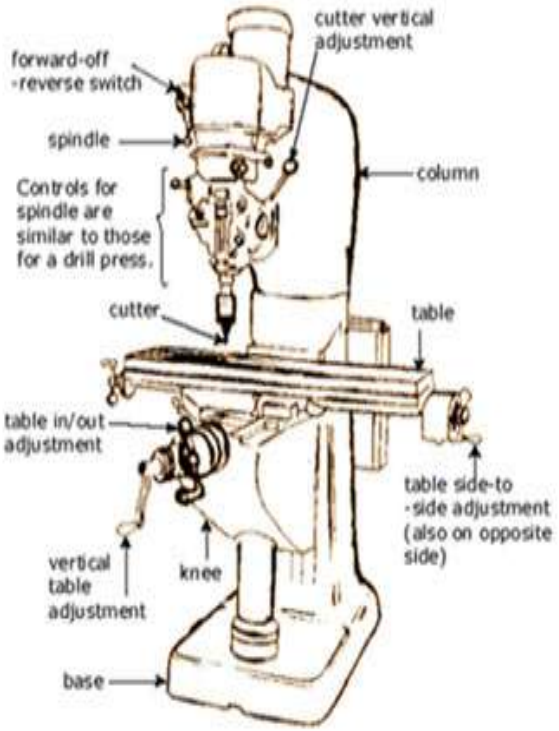
Machining of internal cylindrical forms (generating) a) by mounting work piece to the spindle via a chuck or faceplate b) by mounting work piece onto the cross slide and placing cutting tool into the chuck. This work is suitable for castings that are to awkward to mount in the face plate. On long bed Turret Punches large work piece can be bolted to a fixture on the bed and a shaft passed between two lugs on the

work piece and these lugs can be bored out to size. A limited application, but one that is available to the skilled turner/machinist. In machining, boring is the process of enlarging a hole that has already been drilled (or cast), by means of a single-point cutting tool (or of a boring head containing several such tools), for example as in boring a cannon barrel. Boring is used to achieve greater accuracy of the diameter of a hole, and can be used to cut a tapered hole.

- There are various types of boring. The boring bar may be supported on both ends (which only works if the existing hole is a through hole), or it may be supported at one end. Lineboring (line boring, line-boring) implies the former. Backboring (back boring, back-boring) is the process of reaching through an existing hole and then boring on the "back" side of the workpiece (relative to the machine headstock).

- ***Knurling***

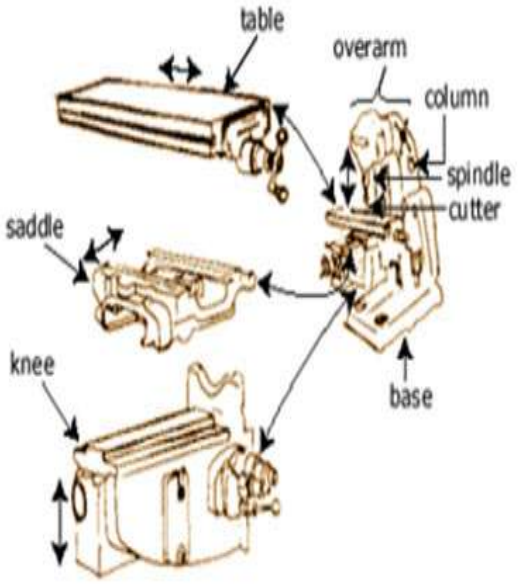
  The cutting of a serrated pattern onto the surface of a part to use as a hand grip using a special purpose knurling tool. Threading both standard and non-standard screw threads can be turned on a Turret Punch using an appropriate cutting tool. (Usually having a 60, or 55° nose angle) Either externally, or within a bore. [Generally referred to as single-point threading. tapping of threaded nuts and holes a) using hand taps and tailstock centre b) using a tapping device with a slipping clutch to reduce risk of breakage of the tap threading operations include a) all types of external and internal thread forms using a single point tool also taper threads, double start threads, multi start threads, worms as used in worm wheel reduction boxes, lead screw with single or multi start threads. b) by the use of threading boxes fitted with 4 form tools, up to 2" diameter threads but it is possible to find larger boxes than this.



Milling Process

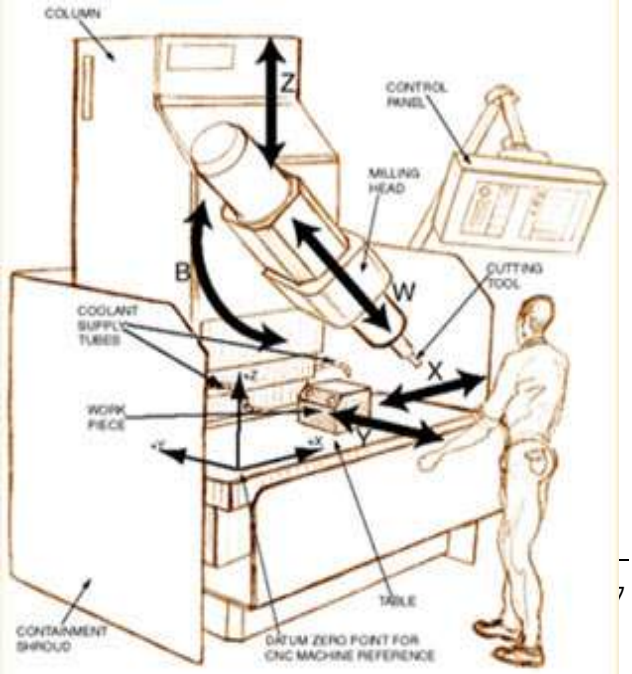
Milling is the most common form of machining, a material removal process, which can create a variety of features on a part by cutting away the unwanted material. The milling process requires a milling machine, work piece, fixture, and cutter. The work piece is a piece of pre-shaped material that is secured to the fixture, which itself is attached to a platform

inside the milling machine. The cutter is a cutting tool with sharp teeth, which is also secured in the milling machine and rotates at high speeds. By feeding the workpiece into the rotating cutter, material is cut away from this work piece in the form of small chips to create the desired shape.



Milling is typically used to produce parts that are not axially symmetric and have many features, such as holes, slots, pockets, and even three-dimensional surface contours. Parts that are fabricated completely through milling often include components that are used in limited quantities, perhaps for prototypes, such as custom designed fasteners or brackets. Another application of milling is the fabrication of tooling for other processes. For example, three-dimensional molds are typically milled. Milling is also commonly used as a secondary process to add or refine features on parts that were manufactured using a different process. Due to the high tolerances and surface finishes that milling can offer, it is ideal for adding precision features to a part whose basic shape has already been formed.

Milling is as fundamental as drilling among powered metal cutting processes. Milling is versatile for a basic machining process, but because the milling set up has so many degrees of freedom, milling is usually less accurate than turning or hobbing unless especially rigid fixturing is implemented. For manual machining, milling is essential to fabricate any object that is not axially symmetric. Below is illustrated the process at the cutting area. A typical column-and-knee type manual mill is shown. Such manual mills are common in job shops that specialize in parts that are low volume and quickly fabricated. Such job shops are often termed 'model shops' because of the prototyping nature of the work.



The parts of the manual mill are separated below. The knee moves up and down the column on guide ways in the column. The table can move in x and y on the knee, and the milling head can move up and down.

CNC Milling: Computer Numerical Control (CNC) Milling is the most common form of CNC. CNC mills can perform the functions of drilling and often turning. CNC Mills are classified according to the number of axes that they possess. Axes are labeled as x and y for Turret Punch movement, and z for vertical movement, as shown in this view of a manual mill table. A standard manual light-duty mill is typically assumed to have four axes: Table X, Table Y, Table Z and milling head Z.

A five-axis CNC milling machine has an extra axis in the form of a Turret Punch pivot for the milling head. This allows extra flexibility for machining with the end mill at an angle with respect to the table. A six-axis CNC milling machine would have another Turret Punch pivot for the milling head, this time perpendicular to the fifth axis.

CNC milling machines are traditionally programmed using a set of commands known as G-codes. G-codes represent specific CNC functions in alphanumeric format.

1.2 Energy performance in existing situation

1.2.1 Fuel and electricity consumption

The machine tool industries in this cluster use electricity from grid to meet their electrical energy requirement. Some of the industrial units having the backup power generator (Diesel Based) to meet the demand in case of grip power supply failure or scheduled power cut from the grid. The main and primary energy for machine tool industries is the electricity for operation of production and utility services. In manufacturing of some category of products, heat treatment process required to achieve the desired material properties. In heat treatment units of the clusters, which are very few in numbers (only 14 %) are using electricity as the main source of energy even in the process of heat treatment, which is usually outsourced. The percentage segregation of used energy in the cluster is given in figure 1.2, which reveals that the 95.9% of energy used in the cluster is drawn from the Bangalore Electricity Supply Company Limited (BESCOM) grid whereas only 4.1% of total energy required is being generated by thermal energy (High Speed Diesel) using DG sets.

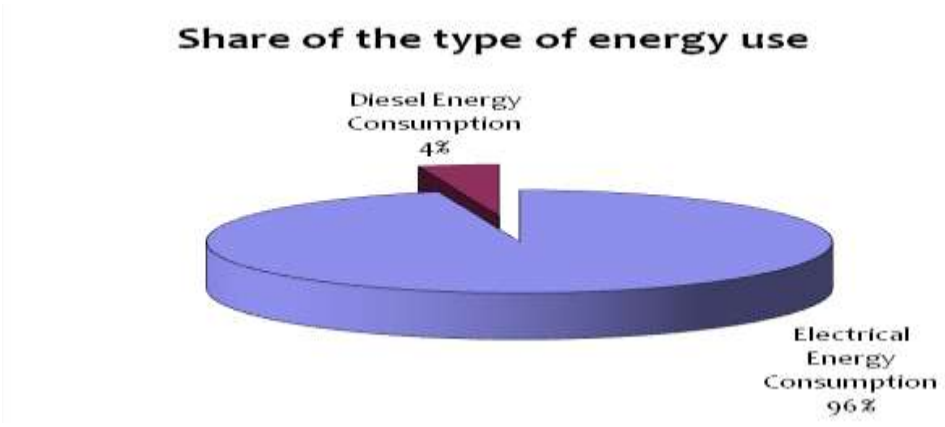


Figure 1.2: Share of Energy Type used in the Machine Tool Units

1.2.2 Average production

Production capacity of machine tool units in Bangalore cluster depends on the type of product being produced in unit. Production capacity of machine tool units in Bangalore cluster is in the range of 1500 kg per Annum –1050000 kg per Annum. The following figure shows the classification of machine tool units in Bangalore cluster based on production capacity. The production capacity as the weight of the metal removed in case of components, accessories and SPM making industries. In case of Heat treatment, weight of the material treated has been considered as the production capacity. The above methodology is adopted as major energy is spent towards removing the metal, as per the specifications of the product, while carrying out jobs such as milling, turning, hobbing and drilling. In case of heat treatment units, major energy is spent in the heat treatment furnaces. Hence, the weight of material processed is taken as production capacity.

1.2.3 Specific energy consumption

The specific energy consumption depends on the final product being manufactured by the machine tool units; therefore SEC has been classified according to the types of products produced in the cluster. Details of the SEC depending on the type of products is shown in the following table

Table 1.1 Energy Consumption Pattern of Machine Tools Cluster

Type of units	Specific Energy Consumption, GJ/Tonne	Specific Energy Consumption, kWh/Tonne
Components	24.8	6472
Accessories	19.7	5118
Machines	2.2	600
Heat Treatment	64.2	15057
Average	27.7	6811.8

1.3 Identification of technology/equipment

The existing process or technology used in the cluster is mixed type. Some units are using 2 axis CNC machines and performing jobs in two or three steps for CNC Turret Punch Projects whereas some units also using the conventional machines which are completely depends on operators skills.

The existing technology required two or three times setup of the job on 2 – axis CNC machine and result in higher energy consumption and lower production rate. The error in product and material rejections also increased due the multiple setup requirements for a job.

1.3.1 Description of technology/equipment

The machine tools industry can be divided into metal cutting and metal forming sectors. The metal cutting sector can be further classified into conventional and computer numerically controlled (CNC) machines, while the metal forming sector can be segregated into conventional and numerically controlled (NC) machines. Some commonly used metal cutting machines include electrical discharge machining systems (EDMS), machining centers, Turret Punchs and automats, boring, milling, drilling, hobbing, honing and polishing machines, total NC machines and so on. Metal forming machines include bending, folding, straightening, flattening machines, punching and/or shearing machines, die casting machines and others.

The NC machines developed in the 1950s and 1960s did not possess CPU's. The CNC machine tools are essentially NC machines with microprocessors as the CPU.

The first American machine tools with a CNC system was developed in 1972 and the first Japanese machine tools with a CNC system was developed in 1976. CNC systems made it possible for microprocessors and programmable logic controllers to work in parallel. This allowed simultaneous servo position and velocity control of several axes of a machine, monitoring of the controller and machine tools performance, and monitoring of the cutting process. For a basic three axes milling machine, with the CNC systems, there could be coordination of feeding velocity and position control of all the three axes. The spindle speed could also be controlled simultaneously. These features enhanced the versatility of a traditional milling machine. Moreover, by employing multiple CPU's, the versatility of the machine tools was increased manifold.

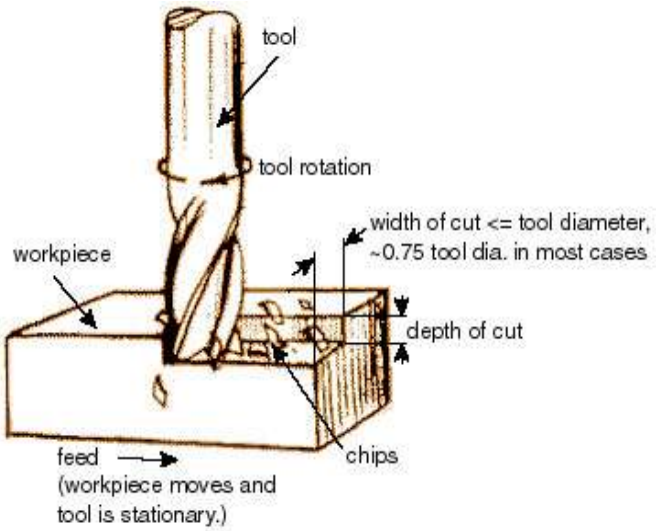
As with CNC turning centers, the Indian machine tools industry produces a range of CNC machining centers covering small to very large sizes. These machines are technologically more complex than turning machines. Typically, a CNC machining center has 3 linear movements, one rotary movement, apart from features such as tool changers, pallet changers etc. Indian machine tools meet the basic requirement of machining center operations, and a number of models are produced with both Turret Punch and vertical spindle configurations. Machines with spindle speeds of upto 10000 rpm, traverse rates of upto 60 rpm are produced by the Indian industry.

The current trend in machining centers is to have additional axes of movements to take on complex machining requirements (sometimes as many as 6 or 7), high traverse rates of 100 to 120 mpm, spindle speeds of 10000 to 50000 rpm, some turning and even hobbing capabilities on the machining center. Internationally, machining centers are mostly built with at least 5 axes. Modern machines incorporate linear motors for high traverse rates, and integral motor spindles are universally used. At the simpler end of the product

spectrum, machines are configured to occupy very small floor space suitable for line integration for mass production of auto components.

1.3.2 Role in process

Machining is a critical process in machine tools manufacturing industries. Design standards in all application areas are becoming increasingly more demanding. Expectations in terms of ergonomics, the air drag coefficient (CW value) or simply aesthetic appeal are creating a need for more complex surface geometries to be achieved in less time and with greater precision. The design primarily comes from CAD systems, the machining programs from CAM stations.



Nevertheless, the skilled machine tool operator still has overall responsibility (in terms of technology) for the quality of the mold and the complete tool. Conventional machining, one of the most important material removal methods, is a collection of material-working processes in which power-driven machine tools, such as Turret Punchs, milling machines, and drill presses, are used with a sharp cutting tool to mechanically cut the material to achieve the desired geometry.

1.4 Benchmarking for existing specific energy consumption

The baseline data has been established based in the energy audits conducted in a total number of 30 machine units out of which 20 were preliminary audits and 10 were detailed audits. The total production cost estimated based on the various technology dependent cost of production of these units. It can be onserved that the total production cost is about ` 41091188 anually and `314875 per tonne.

Table 1.2 Energy Consumption Pattern of Existing Technology

S. No	Particular	Benchmarking	
		Unit	Value
1	Specific Energy Consumption	kWh/Tonne	975
2	Average Energy Cost	`/Tonne	4875
3	Cost of Material	`/annum	300000

S. No	Particular	Benchmarking	
		Unit	Value
4	Other Cost (Man Power/Utility)	`/tonne	10000
5	Average Production	`/tonne	314875
6	Annual Production	Tonne/annum	130.5
7	Annual Production Cost	`./annum	41091188

1.4.1 Design and operating parameters /specification

In present scenarion of the machine tools industries, machine cannot afford to breakdown, frequent change of the job settings and dependency on manpower since the investment cost of the machine is high. Each downtime is a lost for the investor. From economic point of view, in order to produce part at effective cost is by producing at high volume. Machine components become expensive which requires new type of maintenance to cater this problem.

S. No.	Particulars	Value
1	Annual Electricity Consumption, kWh	1,27,212
2	Annual Fuel (HSD) consumption, Lt	0
3	Annual Energy Consumption, GJ	458.0
4	Total Annual production, Tonne	130.5
5	Average Specific Energy Consumption, GJ/T	3.5

***Energy consumption Pattern of existing system on the basis of annual electricity usage**

1.4.2 Operating efficiency analysis

To determine the Energy use and technical study, individual units were identified within different locations of the Bangalore Machine Tools clusters in Bangalore district. It is integral to target different units in the clusters as it accounts for deviations in type of prudcts, job properties, sourcing of raw materials, and variations in manufacturing and housekeeping operations. The overall step by step methodology followed for Energy use and technical study is as below:

Figure 1.3 Energy auditing methodology

Preliminary energy study

The preliminary study is the first stage in conducting an energy and technology assessment of the machine tools manufacturing units in the cluster. The aim of the preliminary study is collecting information relating to production, machinery and energy use to get an overview of energy sources, raw materials, processes involved, etc of the units within the cluster. Preliminary energy studies were conducted at 30 machine tools manufacturing units in the Bangalore cluster and the time taken for each study was 1 – 2 days.

Detailed energy study

Detailed energy studies are conducted to get an in depth break up of energy usage of each of the associated processes in the machine tools manufacturing. It covers the quintessential steps in preliminary study and provides a thorough analysis of the functioning of units. Since electricity is the main source of energy used, there are some guidelines which need to be maintained while analyzing and measuring the electricity consumption pattern of the individual unit.

1.4.3 Specific fuel and electricity consumption

The main and basic energy used in the manufacturing process of machine tools is electricity in this unit. The liquid fuel (HSD) energy is mainly using to operate the diesel power generators during the power cut/non-availability of the electrical power from state electricity board.

1.5 Barriers for adoption of proposed technology/equipments

1.5.1 Technological Barrier

Technology obsolescence in the machine tool business is extremely rapid. Product lifecycles are declining and currently average life cycle is no more than 3 years! Thus, in a globalized India, SMEs have been and will continue to face challenges they have not seen before. In the past, most of the products have been a result of 'Reverse Engineering'. Unlike the Japanese and Koreans, the Indian manufacturers have not graduated to the next level of 'Improving' the technology of reverse engineered products. Thus, product technology obsolescence is a major issue facing the Bangalore machine tools industry today. There is a definitive void in development and existing facilities for Research and Development in this sector. Institutes in the past have been integral in facilitating technology transfers and improvement in the machine tools manufacturing cluster all over India, However there is need for continuous Research and Development associated processes.

1.5.2 Financial Barrier

The restricted availability and the inability to raise resources are common to all types of small businesses. However, the machine tools sector, by its very nature, is a high financial outlay driven business. Average product costs are greater, gestation period of investments – longer, time to market – higher and a purchasing system – not yet fully matured. All this means greater, than most other businesses, financial resource requirement. This, in turn, puts the machine tool SMEs in a particular disadvantage.

1.5.3 Manpower Skill

Machine downtime ranged from 1 percent to as high as 20 percent in some cases. Labour efficiency ranged between 60 percent to 95 percent. Lower labour efficiency and labour utilization has manifested in lower employee productivity. Labour utilization has been lower as compared to other sectors because of surplus labour since only 26 percent of the companies have undergone downsizing and lack of awareness of productivity methodologies. Only 65 percent of the companies used CNC or NC machines because most of the smaller players get almost 95 percent of their products outsourced and they only do assembling. In fact, as high as 17 percent of the companies get 100 percent of the manufacturing activities subcontracted. However, on an average 75 percent of the companies subcontracted some amount of their manufacturing. The subcontracting was mainly done due to capacity constraints followed by cost considerations.

1.5.4 Vendor Linkages:

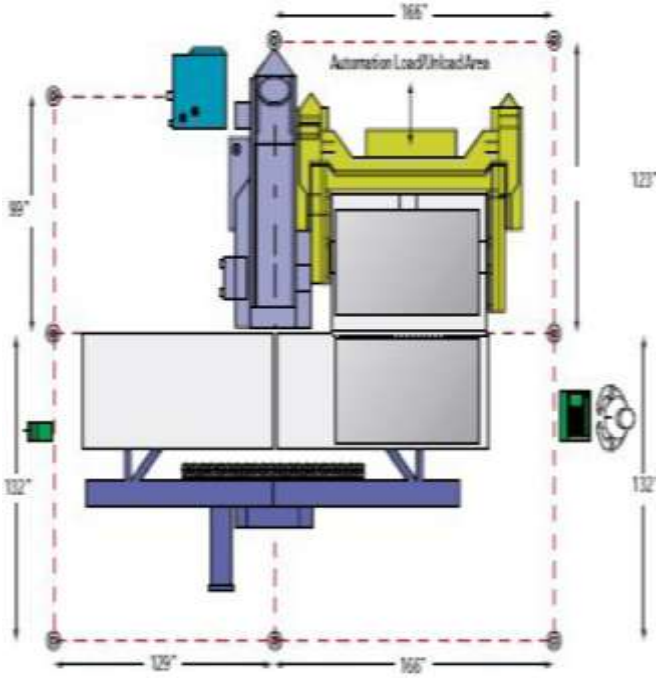
No other business requires such complex level of vendor linkages as the machine tools. For materials, electrical, electronics, hydraulics, pneumatics, metallurgy, tribology, measurement controls – the list of myriad technology linkages is endless. This requires exceptional networking capabilities and plenty of time to be spent by owner of accompany/CEO himself.

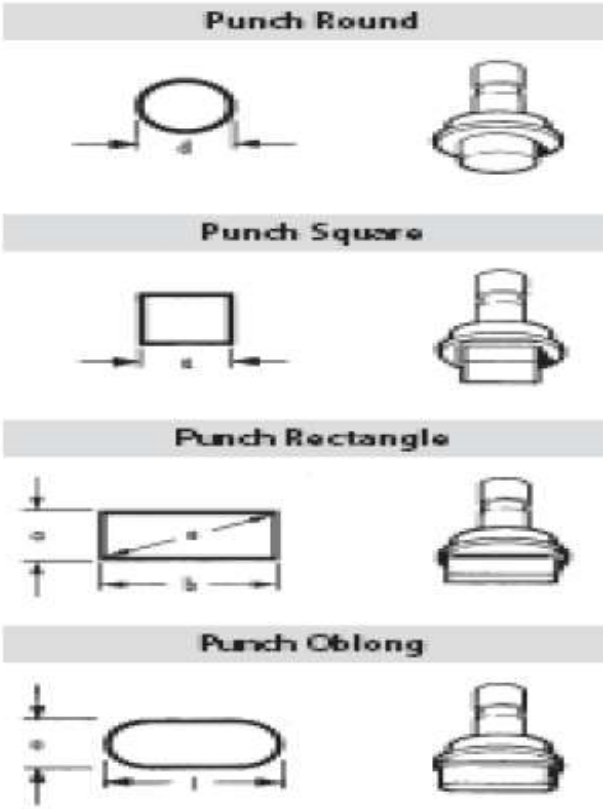
2 TECHNOLOGY OPTION FOR ENERGY EFFICIENCY IMPROVEMENTS

2.1 Detailed description of technology selected

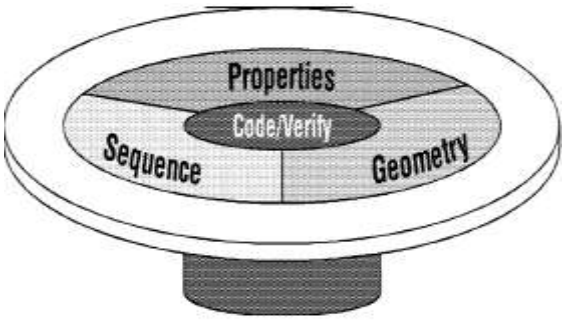
2.1.1 Description of technology

The turret punch machine is machining which capable of doing cutting process, punching process, shearing and etc. The Turret punch machine is Compact offers a 50" x 100" working range and the ability to accommodate industry standard 4' x 8' sheets. This offers users the ability to minimize costs by purchasing pre-cut sheets rather than shearing them to size on the shop floor. A larger work area also allows more freedom to create nested sheet layouts optimizing material utilization. The Turret punch machine is Compact designed to ensure users do not sacrifice accuracy for speed. The linear tool changer is fully integrated into the coordinate guide rail and the ball-transfer table to form a single structure. This reduces vibrations and allows accurate punching at high speeds across an entire sheet. Stroke rates are 2200 per minute for marking/ beading and 900 per minute for punching (at 0.040" pitch). The PC control on the Turret punch machine is Compact is simple and easy to use. The platform is a Pentium processor with Windows. It can be networked for fast program downloads and is equipped with ToPs Lite basic CAD/CAM software. All machine processes can be monitored at a glance and integrated on-line help can answer most questions as they arise. The PC Controls are equipped to identify in advance which tools should be changed for an upcoming job. This





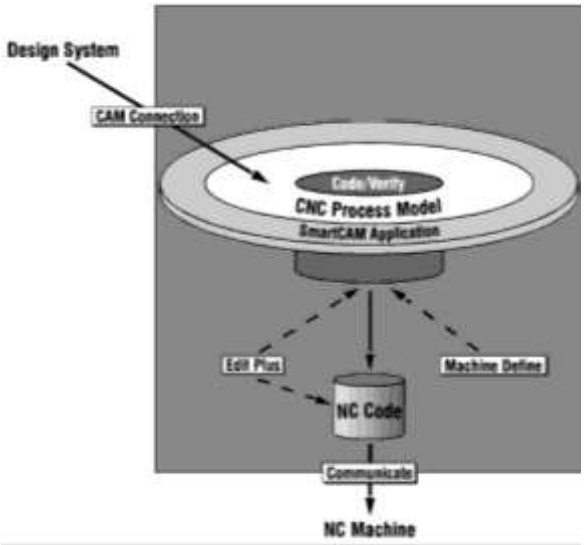
General overview of a CNC Turret Punch machine & Punching Tools Shapes



feature simplifies the process of changing tooling cartridges off line and minimizes downtime during tooling change-over. For the turret punch machine, it has many different types of tool used to do processes such as slitting, cutting and shearing. There are many different sizes and shapes of tool available. Shapes of tool available are such as oblong, rectangle, square and round. The Machine tooling is made of high-speed tool steel. Small punches are manufactured from M2 tool steel. Special high-speed PM M4 steel is used for the medium-sized and heavy-duty punches for plate and high tensile strength materials. The approach to CNC machining captures the mental model you have when you create a part and display it on your computer screen as a graphic model. This enables you to create, change, and interact with the model of the manufacturing process. This model is called the CNC Process Model. The part geometry and tool path are incorporated as you build the model, and you can view the tool path at any time. When the machining process is correct, you generate code directly from the model. Considerations such as feeds and speeds, tool availability, fixtures, and machine idiosyncrasies are part of the model. When changes are required, you can easily revise the model and generate code again. When you add a new machine, you simply select the new machine and template files and regenerate the code.

2.1.2 CNC Turret Punch Machine operations

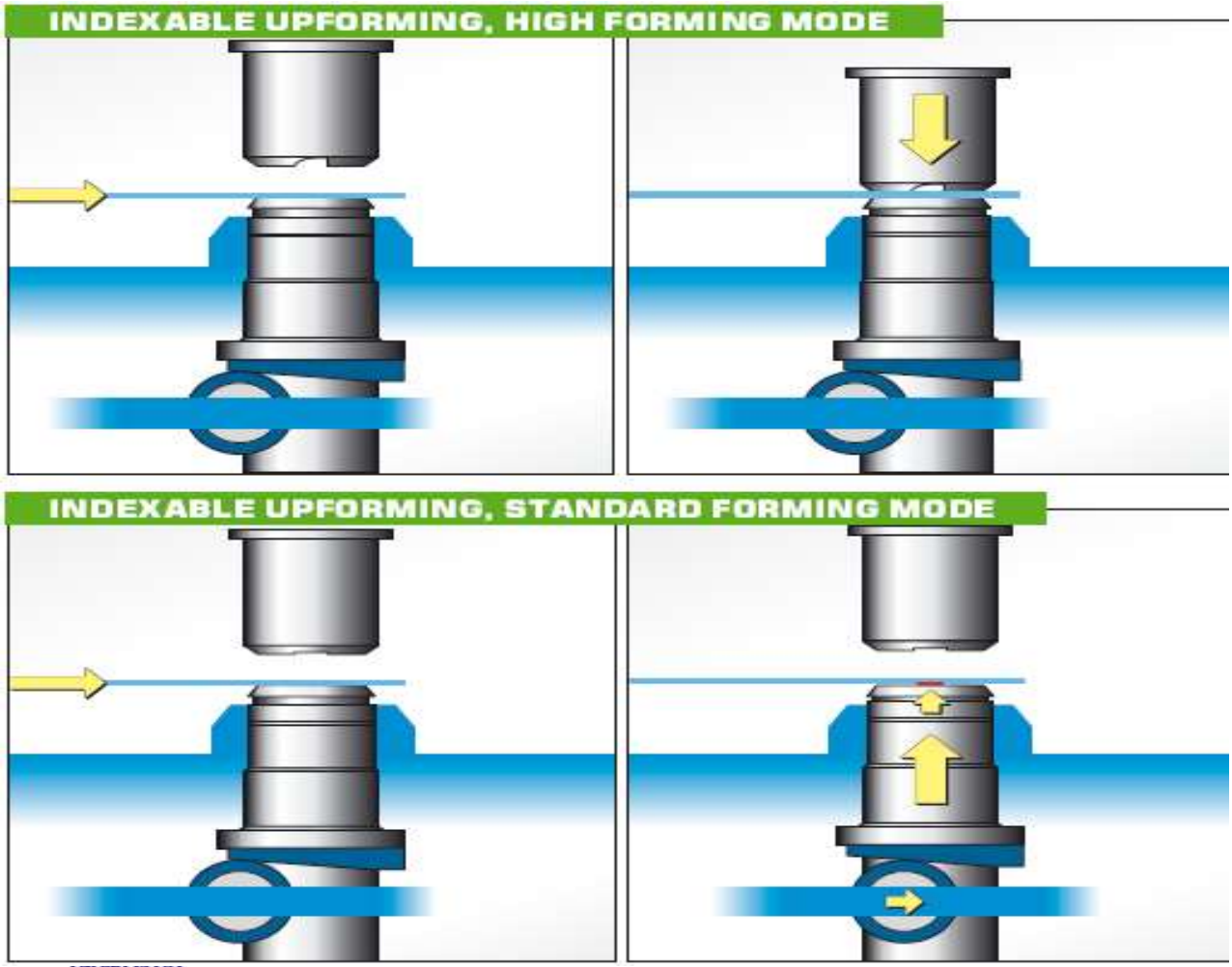
Modern CNC Punching Machines are fully automated machines that come in many sizes, because they need to be able to punch anything from tiny instrument. Each Turret Punch machine typically consists of a chuck and tailstock, to hold the workpiece or a spindle, a spindle on which the hob is mounted, and a drive motor. For a tooth profile which is a theoretical involute, the fundamental rack is straight-sided, with sides inclined at the pressure angle of the tooth form, with flat top and bottom. The necessary addendum correction to allow the use of small-numbered pinions can either be obtained by suitable modification of this rack to a cycloidal form at the tips, or by hobbing at other



A CNC Turret Punch Machine Operation

than the theoretical pitch circle diameter. Since the gear ratio between hob and blank is fixed, the resulting gear will have the correct pitch on the pitch circle, but the tooth thickness will not be equal to the space width. A Process Model is a dynamic, sequential toolpath database. Part geometry is immediately converted into toolpath, sequenced in the way the machine will cut the part. Any changes you make to the model immediately update the database. Because there is no separation of part geometry and toolpath, you do not need to wait until you finish creating the geometry to specify its sequence and properties. You can make changes at any time and instantly view the resulting tool motion. As you build a CNC Process Model, you incorporate the following:

- Sequence (when the operation should occur)—the order that machining operations and toolpath become part of the model.
- Properties (how the operation should occur)—machining parameters, such as tool selection, depths, tool offset direction, and machine-control behavior, are assigned to the toolpath.
- Geometry (where the operation should occur)—elements defining the toolpath, such as linear or circular cutting, rapid traverses, and lead-in moves, are added to the model.



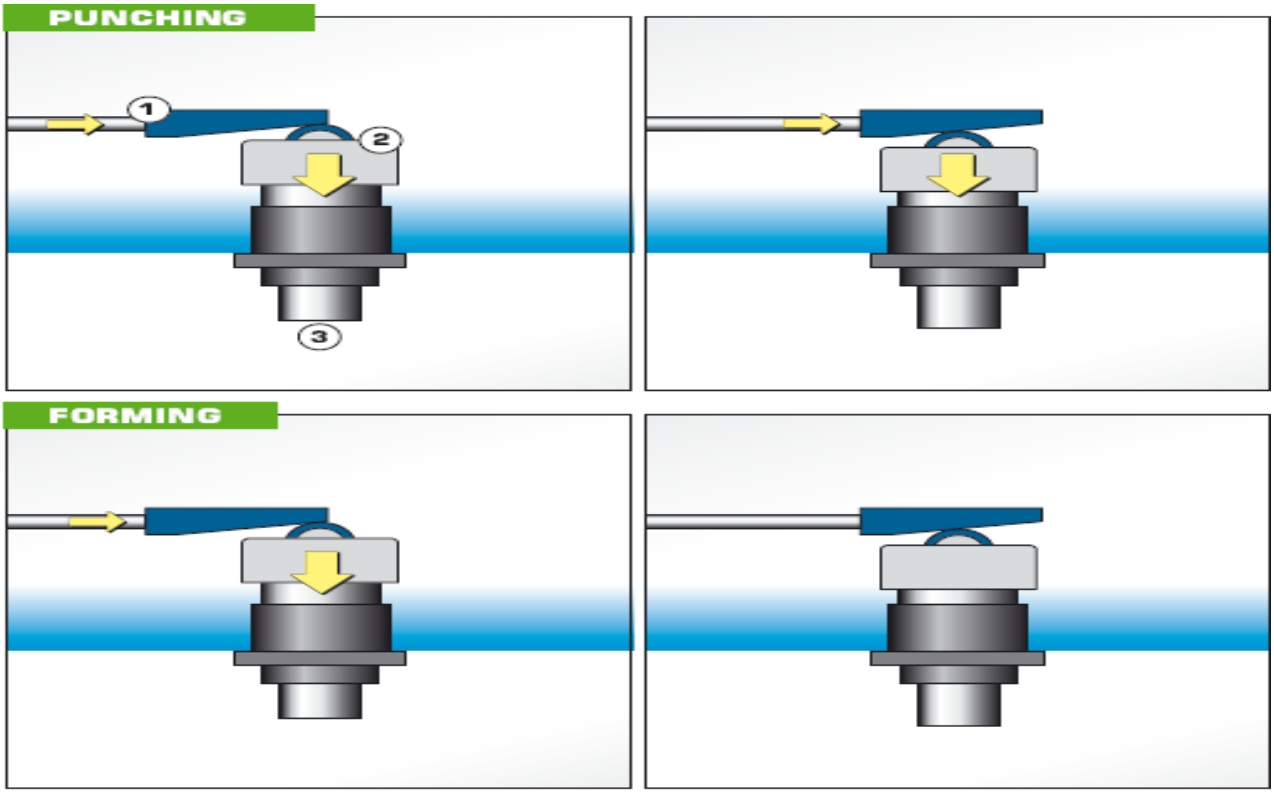


Figure 2.1 CNC Turret Punch Machine operations

An important part of the CNC Process Model is the information about the tools and operations you use to machine the part. This information, known as the *job operations setup,* is stored in the job operations file. All job operations files have a .jof extension. Each process model is linked to a .jof file. The job operations setup links tools and operations together as *process steps*. As you develop a process model, you assign steps to the toolpath elements. Each step contains all the parameters for a specific tool and a specific operation. When you generate NC code accesses the .jof file and uses the tool and operation parameters. This information can be printed and used by the machine operator to set up the machine.

2.1.3 Technology specification

Turret Punch is considered to be the most productive and viable of all a generating process. With Turret Punch process toothed wheels of gears are manufactured with high quality and gives excellent performance. However, Hobbing is only used to produce spur and worn gears. Internal gears or shoulder gear cannot be worked up in Hobbing process. The hobbing process works like this. The hob is applied for generating the involute teeth. The helix pattern of a rotating hob is identical to that of a moving rack. Turret Punch is an efficient process however it comes with complicated process kinematics, and somehow difficult tool wear mechanisms. The punching and forming stroke are based on horizontal

movement, made by a servo motor, which is converted into vertical ram movement and transmitted to a punching or forming tool. The turret layout is customer-specific. Various tool holder sizes can be changed or switched from station to station. Thick turret tooling style is used, and you can often use your existing tooling. Additional index stations can be added up to 10 (optional). Dead zones are completely eliminated with an individual clamp movement as well as using traditional repositioning. While moving one clamp, the sheet is held by the two other clamps. The main specifications are shown in Table 2.1.

Table 2.1 Equipment Speciation

Machine Speciation	
Press Drive	Servo Motor Ram Drive
Punching Capacity	20 tons
Maximum sheet size (YxX)	1250 x 2500 mm 49.21"x 98.43"
Tool index speed	100 rpm
Turret index speed	30 rpm
Number of turrets	main machine 8+ α(pre setter)
Upward Forming	max H=20 mm max H=0.79"
Downward forming	max H=5 mm max H=0.20"
Work Chute Large	500 x 500 mm 19.7"x 19.7"
Work Chute Small	220 x 200 mm 8.7"x 7.9"
Maximum sheet thickness	SPCC: 3.2 mm SPCC: 0.125"-
	SUS: 2.0 mm SUS: 0.08"
Punching accuracy	±0.1 mm ±0.004"
Max. sheet thickness (Mild steel)	6.35 mm 0.25"
Max. sheet size Without-repositioning	1525 x 2500 mm 60.04" x 98.43"
Max. sheet size With one reposition	1525 x 5000 mm 60.04" x 196.85"
Laser Oscillator	Fast axial glass flow type. Co2 Laser
Rated laser output	2000W, 4000W
No. of turret stations	44 / 54

In the punching mode, a servo operated wedge moves over the roll connected to the ram causing it and, consequently, the tool to move downwards. After the ram has reached its programmed lower position, it returns back to its programmed upper position, actuated by

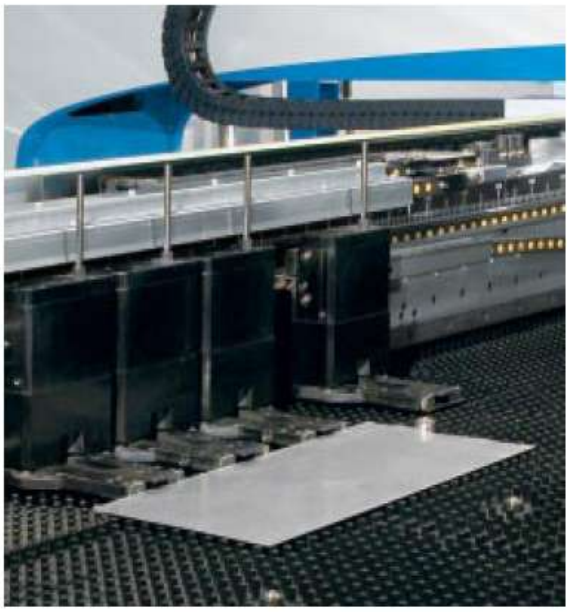
pneumatic pressure. In the forming mode, ram movement is programmed to stop when the desired forming stroke position has been reached, after which the return movement of the roll and the ram begins. The stroke is NC-controlled and thus forming accuracy is outstanding. The static counter-force required in forming equals the maximum punching force even at zero ram speed.

2.1.4 SUITABILITY OR INTEGRATION WITH EXISTING PROCESS

The index able up forming option is a servo operated ram installed in the lower machine frame. It lifts the lower forming tool to a programmed position. The tool is retracted after forming, preventing a collision with the moving sheet. Forms up to 16 mm (0.63") in height (inclusive of sheet thickness) can be made. Due to the possibility of indexing the parts can be freely nested, resulting in major savings both in raw material and tooling cost. The position of consecutive forming ram strokes can be programmed individually. Thus progressive forming and bending are simple to perform. The new control solution of the forming cylinder allows new possibilities for e.g. fast forming and sophisticated use of roll forming tools.

EASY TO OPERATE

Easy load features



Material flow

The turret layout is customer-specific. Various tool holder sizes can be changed or switched from station to station. Thick turret tooling style is used, and you can often use your existing tooling. Additional index stations can be added up to 10 (optional) Multi-Tool allows the astonishing versatility of 200 tools simultaneously in the turret, with both indexable and fixed Multi-Tools available. In machine construction, special

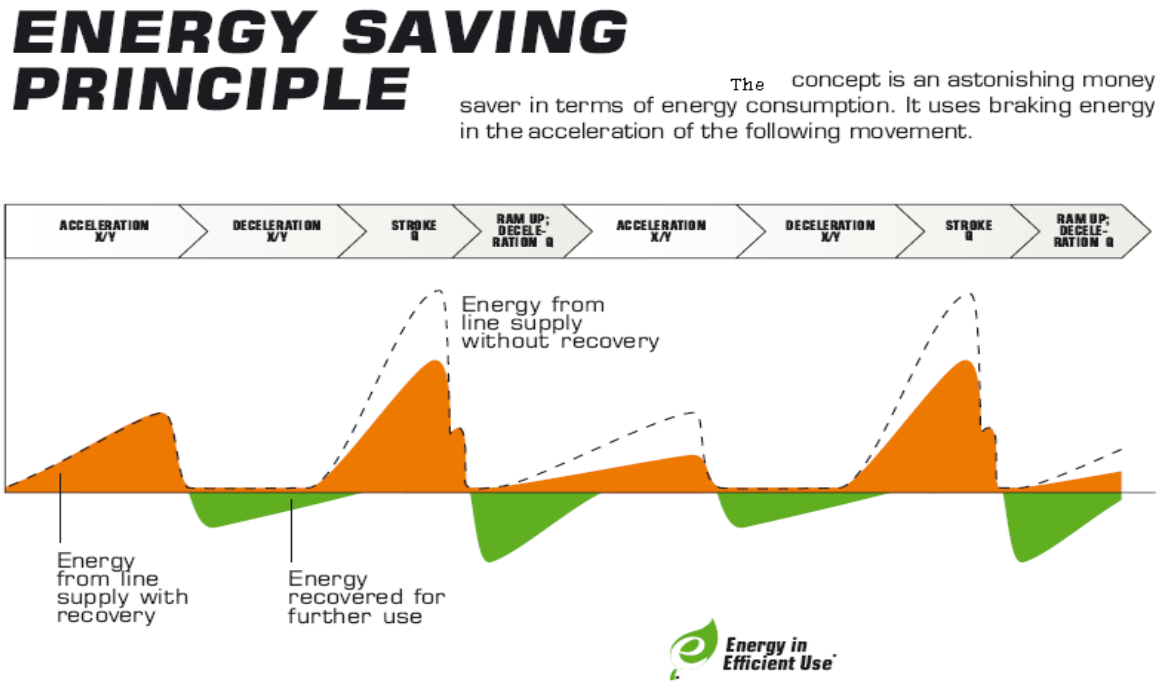
care has been taken to ensure as easy access to service points as possible. The need for maintenance is reduced by central lubrication and control cabinet cooler, which are included as standard. Up to 10 large index stations (88.9 mm / 3.5") and even 80 indexable tools with R Multi-Tools can be installed. The fast auto-index system is based on an AC servo motor; the rotation mechanism of the punch and die is mechanically engaged and disengaged vertically. Tool rotation can be programmed in 0.001° increments and throughout the 360° rotation. The system automatically selects the shorter path to desired angle. Full tonnage and punch speeds can be used in any station, with any tool size.

The turret adopts the specialized fixture for pair processing, ensuring the coaxiality of the upper and lower dies, which can extend their service life greatly. The inlay structure simplifies the structure of the turret, which also helps to extend its service life. The worktable with hard brush and ball is wide enough to reduce the noise and vibration when the machine is running, and protect the plates from getting scratched. The CNC system has clamp self protection Junction, which can ensure that the protected area is not punched to avoid damaging the die and clamp. The auto-index adopts high precision worm wheel and worm mechanism. The maximum die diameter can reach 88.9mm and the auto-index can be expanded to four. The concentrated lubricating mechanism can lubricate directly the various points to reduce work load and pair friction, thus improving its service life. The integrated beam and carriage structure enhances the rigidity and accurate positioning, which ensures stable feeding at high speed and prevent Axis X and Y of the worktable having dynamic offset

2.1.5 SUPERIORITY OVER EXISTING TECHNOLOGY

The traditional CNC punching machine, the representative of the basic CNC turret punching machine in India, adopts the mechanic main drive with simple structure, stable and reliable performance and easy maintenance. The maximum punching speed can reach 300 times per minute. The machine comes equipped with precision ground ball screws for positioning accuracy and linear guides for table & carriage travel and support. Both are products of Japan and Germany to ensure the highest quality and years of reliable operation. The machine is controlled by a FANUC CNC system which includes the CPU and digital AC servo motors. G code programming, self diagnostic function, clamp auto protection zones, and manual pulse generator. The fully high precision turret is fully bushed for longevity and available in 24 and 32 tool styles. The upper and lower turrets are machined together for precision station alignment. Auto indexing is handled by combined synchronization of belt and worm gear for highest accuracy. Sectionalized worm and gear construction allow for extremely good repeatability.

Maximum tool diameter is 88.9 mm (3.5”). Pneumatic clamping is standard and hydraulic clamping optional. The floating pneumatic clamp is built to have room for up and down sheet motion. There is a small “dead zone” between clamp and punch, increasing the utilization of sheets. Combination of brushes and roller balls fully supports the sheet, but lowers the noise, vibration, and scratching of the material. Flexible configuration of the machine can be achieved with thick or thin tooling styles selected by the requirements of the customer. The imported die ensures long service life.



The CNC system has clamp self protection function, which can ensure that the protected area is not punched to avoid damaging the die and clamp. The auto-index adopts high precision worm wheel and worm mechanism. The maximum die diameter can reach 88.9mm and the auto-index can be expanded to four. The concentrated lubricating mechanism can lubricate directly the various points to reduce work load and pair friction, thus improving its service life. The integrated beam and carriage structure enhances the rigidity and accurate positioning, which ensures stable feeding at high speed and prevent Axis X and Y of the worktable having dynamic offset. The Japan FANUC CNC punching machine specialized system is configured to realize field and background programming. RS232 standard port is for connecting and communicating with computer conveniently. It also features pulse encoder semi loop feedback, numerical AC servo driver and motor, strong self diagnostic and protection function to realize remote diagnosis. VT series are modified to meet Chinese market on the basis of RT series. Plain and economic, it can be regarded as the elite of RT series. With German numerical hydraulic system, its punching speed can reach 600 times per minute and 350 times per minute at 25mm pace.

- Low connection power

- Low power consumption
- Low maintenance costs
- High speed
- High accuracy
- High repeatability

- ***It is equipped with hydraulic system manufactured in Germany, numerical proportionate servo valve. Full loop control, good dynamic and static response characteristics. High resolution, low hysteresis. No middle dead zone. Resistance to temperature variation and interference. Punching speed up 1000 times per minute. Punching speed up to 390 times per minute at 25mm pace.***
- The turret adopts the specialized fixture for pair processing, ensuring the coaxiality of the upper and lower dies, which can extend their service life greatly. The inlay structure simplifies the structure of the turret, which also helps to extend its service life.
- ***The pneumatic, hydraulic and electric components are all famous brand products like Festo, Schneider, SMC, SMB and Turck, thus ensuring the reliability of the whole unit.***
- The pressure adjustable hydraulic clamp is used to hold materials of different nature and thickness at different press, thus ensuring that the plates can be held tightly while leaving no dent on the soft and thin plates. The vacuum waste collector is installed to ensure that waste can drop through the waste hole during high speed cutting, eliminating waste rebounding, which can extend the service life of the die.
- ***The worktable with hard brush and ball is wide enough to reduce the noise and vibration when the machine is running, and protect the plates from getting scratched. The large lead ball screw and linear guide from Japan THK, NSK, NTN, German Bosch Rexroth and INA are used to ensure processing accuracy.***

2.1.6 Availability of technology

CNC based technology providers are basically multinational companies providing the services in all the major cities of the country. The technology is widely available and lots of national and multinational manufacturers are suppling their products to these industries including the machine tools industry.

2.1.7 Source of technology

This technology is already in use in some machine tools units in the cluster where the production requirment is ame. They also got the results of reduction in energy consumption as well as reduction in rejection of material and the technology is running successfully.

2.1.8 Service/technology providers

There are about 5 technology providers are available in the cluster for this system including Ace Micromatic Machine Tools Pvt. Ltd., Haas Automation, Jyoti CNC automation Pvt. Ltd., DMG Mori Seiki India Machines and Services Pvt. Ltd. And Mazak company is the service provider for this technology. They have the experience in supplying the multi – axis machine and provided consultancy & implementation support. The detailed contact information of all service providers is provided in annexure - .

2.1.9 Terms and condition of sales

Sales and after implementation of technology support information is provided in the annexure.

2.1.10 Process down time during implementation

The installation of CNC Turret Punch machine can be done in the 14 - 21 days, However the CNC Turret Punch machine is end to end solution of Turret Punch machine production process, implementation will not affect production. Thus implementation of this technology will not affect the process.

2.2 Life cycle assessment and risks analysis

In case installation of CNC Turret Punch machine, the technology and machine will continue to work up to 12 to 16 years under proper maintains. No need to any further huge modification after one time installation, in case of risk analysis there is a need of proper maintains and timely oiling.

2.3 Suitable unit/plant for implementation of proposed technology

CNC Turret Punch machine is suitable for the units involved in the production of more fast machining than conventional Turret Punchs hense increase in productivity and Quality of the product is defenitely enhanced.

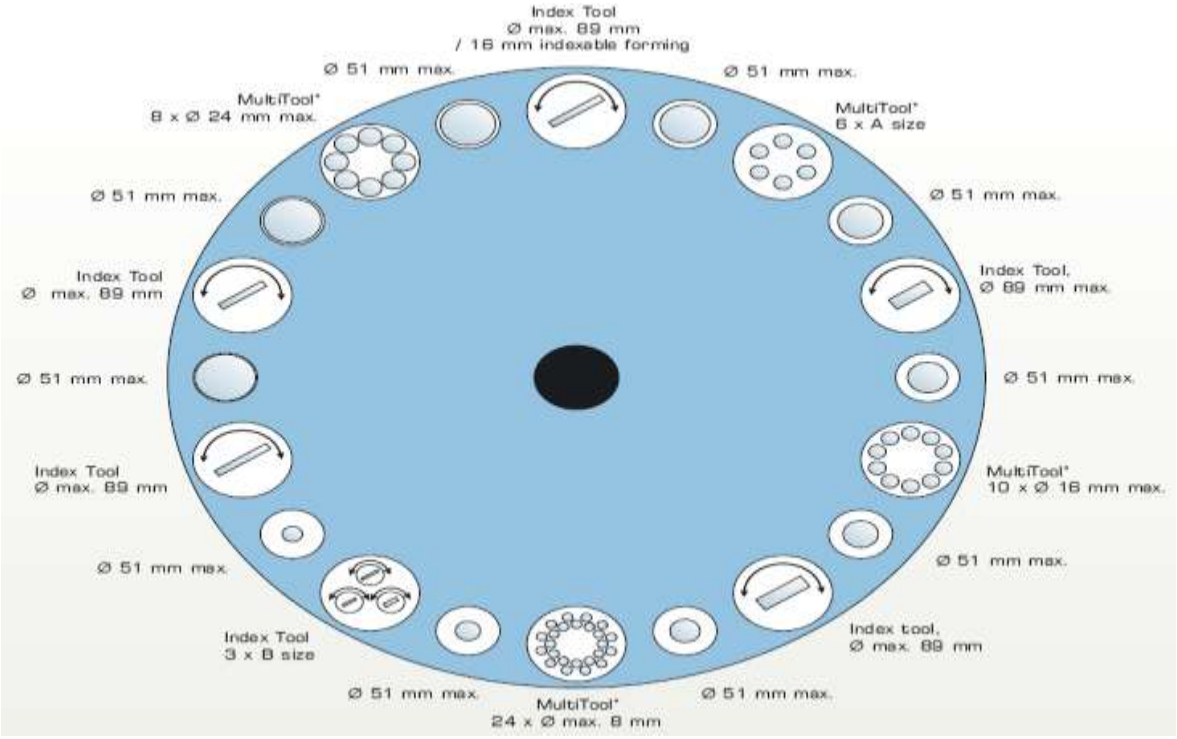
Finished Quality Product by A CNC turret Punching Machine

3 ECONOMIC BENEFITS FROM NEW ENERGY EFFICIENT TECHNOLOGY

3.1 Technical benefits

3.1.1 Fuel saving

CNC Turret Punchs are rapidly replacing the older production Turret Punchs (multispindle, etc) due to their ease of setting and operation. They are designed to use modern carbide tooling and fully utilize modern processes. And over all they are saving many a working hours for the same and thus saving eletricity on same production output. The above mentioned features makus them to save eletricity exponentially which as much ah 1200 kwh per month. The part may be designed by the Computer-aided manufacturing (CAM) process, the resulting file uploaded to the ma chine, and once set and trialled the machine will continue to turn out parts under the occasional supervision of an operator. The machine is controlled electronically via a computer menu style interface, the program may be modified and displayed at the machine, along with a simulated view of the process. The setter/operator needs a high level of skill to perform the process, however the knowledge base is broader compared to the older production machines where intimate knowledge of each machine was considered essential. These machines are often set and



operated by the same person, where the operator will supervise a small number of machines (cell). And saving capacity of the producting unit is enhanced without effecting the annual production of the unit.The design of a CNC Turret Punch has evolved yet again however the basic principles and parts are still recognizable, the turret holds the tools and indexes them as needed.

The machines are often totally enclosed, due in large part to Occupational health and safety (OH&S) issues. Installation of CNC Turret Punch machine is the ability to machine complex shapes in a single setup. This reduces the machinist setup time and incerease the production rate. The main advantage of CNC Turret Punch machining is the ability to save time by punching complex shapes in a single set-up. Additional benefit comes from allowing the use of shorter cutters that permit more accurate machining. Oil-air lubrication system this oil-air lubrication system insures constant and reliable lubrication to the spindle bearingspreventing periodic repacking of grease or replacement of bearings in case of the grease pack lubrication system.

Productivity increases are huge. Not 10 or 20% but numbers like 500% and 1000% are realistic in many cases. This is especially true when using a tombstone to mount multiple parts on all 4 sides. One tool can complete, for example 16 or 20 parts, when stacked 4 or 5 high on each side. Tool changes take 12 to 15 seconds on most machines. That non-chip making time is lost only once to machine 16 or 20 parts with the one tool before it is changed. Larger parts like gear boxes and housings are obvious winners on this machine. Being able to complete most operations on 5 sides in a single set up leads to large reductions in lost time AND much improved tolerances because the part is not re-fixtured. When a large component is mounted on a rotary table, the size of the part that can be swung to allow machining on the front and back only can reach about 78” on the diagonal. This machine will produce parts to general commercial tolerances of just under one thou. It is not meant to replace traditional Turret Punch machining centers weighing and costing 2 to 3 times these machines, producing very fine tolerances. Energy & Cost saving including the energy, material rejection, man power cost and utility cost for a typical unit by installation of CNC Turret Punch machine are tabulated below:

Table 3.1 Energy savings estimation for CNC Turret Punch machine

S. No	Particular	Unit	Conventional Turret Punch Press machine	CNC Turret Punch Press machine
1	Specific Energy Consumption	kWh/Tonne	975	575
2	Average Energy Cost	`/Tonne	4875	2875
3	Cost of Material	`/annum	300000	281551.7
4	Other Cost (Man Power/Utility)	`/tonne	10000	8000
5	Average Production	`/tonne	314875	292426.7
6	Annual Production	Tonne/annum	130.5	130.5
7	Annual Production Cost	`/annum	41091188	38161684
8	Reduction in Production Cost	`/Tonne		22448.3
9	Annual cost reduction	`/Annum		2929504

A CNC Turret Punch machine will not only reduce the operartional cost of production but

also increase the rate of the production in the same time. The estimated or feedback received from amny users of CNC Turret Punch machine revels that the CNC Turret Punch machine may produce two times production/ material at same time and at same energy consumption.

***Note:-** *As in the proposed DPR Conventional Turret Punch machine is replaced by CNC Turret Punch Machine, it is assumed that it improves the overall productivity by 1.75 times i.e. 130.5 Tonnes/Annum in earlier case to 228.375 Tonnes/Annum after implementation. Accordingly, the energy saving could be achieved.Consequnetly, the O&M cost of machinery shall increase to 5 % with annual Escalation of 5 %.*

3.1.2 Improvement in product quality

CNC Turret Punch machine is presently one of the most versatile machine tools available and they are becoming increasingly common. This Punching not only improve the quality of the product which is totly desinged by CNC machine with comparision to the exisitng manual set up based product.The rejection of material in CNC Turret Punch machining is almost nill while comparing with existing system/technology. Finally, high-speed cutting parameter coordination is executed by a CNC cycle for easy set-up and user-friendly activation of advanced motion control features. Excessive programming time is eliminated, because the adaptation of the CNC set-up is done according to the particular machining technique being employed.

3.1.3 Increase in production

A CNC Turret Punch machine will not only reduce the operartional cost of production but also increase the rate of the production in the same time. The estimated or feedback received from amny users of Conventional Turret Punch machine machines revels that the CNC Turret Punch machine may produce two times production/ material at same time and at same energy consumption, as the processes in the figure shows.

3.1.4 Reduction in raw material consumption

The rejection of material in CNC Turret Punch machining is almost nill while comparing with existing system/technology. However, in the cost calculation about 40% of the existing rate of rejection is considered.

3.1.5 Reduction in other losses

Installation of CNC Turret Punch machine will result in reduction of the utility system like compressed air system to operate the numetic system and other general utility expanses due to fast rate of the production with comparision to the existing technology. Some of

them are listed below:-

- The CNC Turret Punch Press gives high productivity in an economical way.
- It has the ability to produce variety of components without re-tooling and thereby saving in production cost.
- It is best suitable for regular and repetitive job work.

3.2 Monetary benefits

Monetary savings in a typical unit after installation of CNC Turret Punch machine has been estimated around ` 51.27 lakh per annum. This figure has been arrived based on the annual reduction in energy, rate of material rejection and manpower cost savings in a typical unit multiplied by average annual production of the unit.

3.3 Social benefits

3.3.1 Improvement in working environment

The design of a CNC Turret Punch has evolved yet again however the basic principles and parts are still recognizable, the turret holds the tools and indexes them as needed. The machines are often totally enclosed, due in large part to Occupational health and safety (OH&S) issues.With the advent of cheap computers, free operating systems such as Linux, and open source CNC software, the entry price of CNC machines has plummeted.

3.3.2 Improvement in skill

Intervention of any new technology in any process/ industry requires improvement in skill set of workforce so as to run the process efficiently. This will also provide the development of skill sets of operators for CNC which will lead to energy efficient operations and quality product.

3.4 Environmental benefits

3.4.1 Reduction in effluent generation

As the existing and proposed technology is based on the low energy conservation and maximum output with saving of fuel and eletricity, hense saving nature and producing low carbon output per tonne.

3.4.2 Reduction in GHG emission such as CO_2, NOx, etc

There are significant reductions to be achieved in Green House Gas emission by adoption of advance CNC technology like CNC Turret Punch machine in machine tools industries. Reduction in electricity consumption translates into GHG reductions is estimated to be

68.51 tonne of CO_2 per annum for given energy saving and production.

3.4.3 Reduction in other emissions like SOx

As the existing and proposed technology is based on the clean fuel based operation therefore Sulphur is not present in electricity; hence there is no impact on SOX emissions.

4 IMPLEMENTATION OF NEW ENERGY EFFICIENT TECHNOLOGY

4.1 Cost of technology implementation

4.1.1 Cost of technology

The costs of equipments that will be required for Installation of CNC Turret Punch machine are provided in Table 4.1 below:

Table 4.1 Cost of equipment

S. No.	Particulars	Cost
1	Cost of CNC Turret Punch Press machine	` 8665524

Cost of machine is in US$ at the rate of (1US$ = INR 45.18)with 37% of Taxes and Duties.

4.1.2 Other costs

Table 4.2 Cost of civil work and consultancy

S. No.	Particulars	Cost
1.	Cost of civil work	`1, 20,000/-
2.	Electrical & Utility Expenses	` 35,000/-
3.	Cost of Consultancy and installation	` 45,000/-
Total	Two Hundred thousand only/-	` 200,000/-

Total project cost works out to be ` 88.66 lakh.

4.2 Arrangements of funds

Proposed financing for the replacement of conventional machine with new turn mill center is made considering a debt equity ratio of 3:1, which is normally allowed by financial institutions for financing energy efficiency projects. On the basis of debt equity ratio of 3:1 the promoter's contribution works out to 25% of the project cost and the balance would be term loan from the Bank / FIs.

4.3 Financial indicators

4.3.1 Cash flow analysis

Detail cash flow analysis for new proposed technology is given in Annexure–5.

4.3.2 Simple payback period

Payback period will be about 1.73 years.

4.3.3 Net Present Value (NPV)

Net Present Value of new project would work out ` 137.58 lakh.

4.3.4 Internal rate of return (IRR)

The after tax internal rate of return of the project works out to be 41.54%. Thus the project is financially viable.

4.3.5 Return on investment (ROI)

The average return on investment of the project activity works out at 22.80%.

Table 4.3 Financial indicator of proposed technology

Particulars	Unit	Value
Simple Pay Back period	Years	1.73
IRR	%age	41.54
NPV	` in lakh	137.58
ROI	%age	22.80
DSCR	ratio	2.84

4.4 Sensitivity analysis

In different situation energy saving may increase or decrease on the basis of this scenarios a sensitivity analysis in realistic, pessimistic and optimistic has been carried out on the basis of two scenarios as considers. (**Electricity saving increase by 10%, Electricity saving decrease by 10%)**

Table 4.4 Sensitivity analysis

Particulars	IRR	NPV	ROI	DSCR
Normal	41.54	137.58	22.80	2.84
10% increase in electricity savings	41.99	139.58	22.83	2.87
10% decrease in electricity savings	41.08	135.59	22.78	2.81

Assuming all provision and resource input would be similar during economic analysis

4.5 Procurement and implementation schedule

The installation of CNC Turret Punch machine can be done in the 14 - 28 days, However the CNC Turret Punch machineing production process, implementation will not affect production. Thus implementation of this technology will not affect the process.

Table 4.5 Implementation Schedule

S. No.	Activities	Weeks						
		1	2	3	4	5	6	7
1	Procurement and Delivery							
2	Civil & Electrical Work							
3	Commissioning							
4	Training							

ANNEXURE

Annexure 1: Energy audit reports used for establishing

The results of detail energy audit for a Bangalore Machine tool cluster production units with specefic energy consuption are given below:

Audit No. 1 Energy Consumption Pattern of Existing Technology

S. No	Particular	Benchmarking	
		Unit	Value
1	Specific Energy Consumption	kWh/Tonne	975
2	Average Energy Cost	`/Tonne	4875
3	Cost of Material	`/annum	300000
4	Other Cost (Man Power/Utility)	`/tonne	10000
5	Average Production	`./tonne	314875
6	Annual Production	Tonne/annum	130.5
7	Annual Production Cost	`/annum	41091188

Energy savings estimation for CNC Turret Punch machine

S. No	Particular	Unit	Conventional Turret Punch Press machine	CNC Turret Punch Press machine
1	Specific Energy Consumption	kWh/Tonne	975	575
2	Average Energy Cost	`/Tonne	4875	2875
3	Cost of Material	`/annum	300000	281551.7
4	Other Cost (Man Power/Utility)	`/tonne	10000	8000
5	Average Production	`/tonne	314875	292426.7
6	Annual Production	Tonne/annum	130.5	130.5
7	Annual Production Cost	`/annum	41091188	38161684
8	Reduction in Production Cost	`/Tonne		22448.3
9	Annual cost reduction	`./Annum		2929504

S. No	Particular	Unit	Conventional Gear Hobbing machine	CNC Gear Hobbing machine
1	Annual Production	Tonne/annum	130.5	228.375
2	Annual Production Cost	`/annum	41091188	66782948
3	Reduction in Production Cost	`/Tonne		22448.3
4	Annual cost reduction	`/Annum		5126631

*****The savings are due to increased production and reduced production costs.***

- ✓ ***`22448.3*** Cost reduction per tonne
- ✓ ***228.375 tonne*** increased production

22448.3 x 228.375 = 5126631

Annexure 2: Process sequence of dealing a workpiece at CNC Turret Punch machine

In the case of production of gears using Turret Punch, the economics of the production process restricts Punching in and punching off stages of the cutting cycle. The worktable with hard brush and ball is wide enough to reduce the noise and vibration when the machine is running, and protect the plates from getting scratched. The CNC system has clamp self protection function, which can ensure that the protected area is not punched to avoid damaging the die and clamp. The auto-index adopts high precision worm wheel and worm mechanism. The maximum die diameter can reach 88.9mm and the auto-index can be expanded to four. The concentrated lubricating mechanism can lubricate directly the various points to reduce work load and pair friction, thus improving its service life.

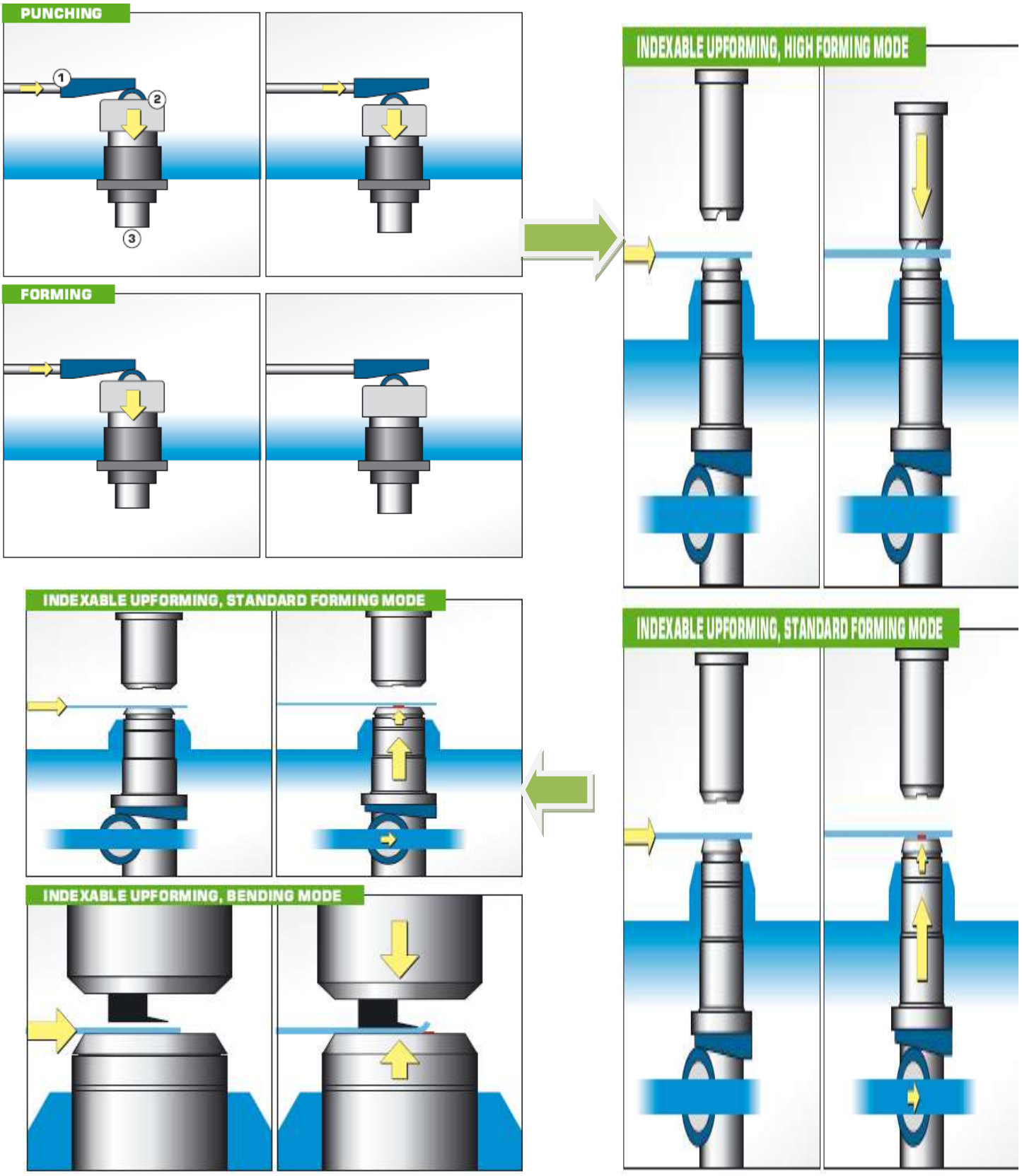
The integrated beam and carriage structure enhances the rigidity and accurate positioning, which ensures stable feeding at high speed and prevent Axis X and Y of the worktable having dynamic offset. Similar to RT series, it features O-type closed body, inlay turret, integrated beam, high precision worm wheel and worm auto-index, brush and ball mixed worktable. In addition, the control system, large lead ball screw, linear guide, pneumatic, hydraulic and electric components are made by world famous manufacturers, thus ensuring the reliability of the whole unit. What is more, it is equipped with float pneumatic clamp with large holding force and stable feeding characteristics. The integrated swallowtail type carriage is high in rigidity. The clamp is easy to move. The traditional ET series CNC punching machine, the representative of the basic CNC turret punching machine in China, adopts the mechanic main drive with simple structure, stable and reliable performance and easy maintenance.

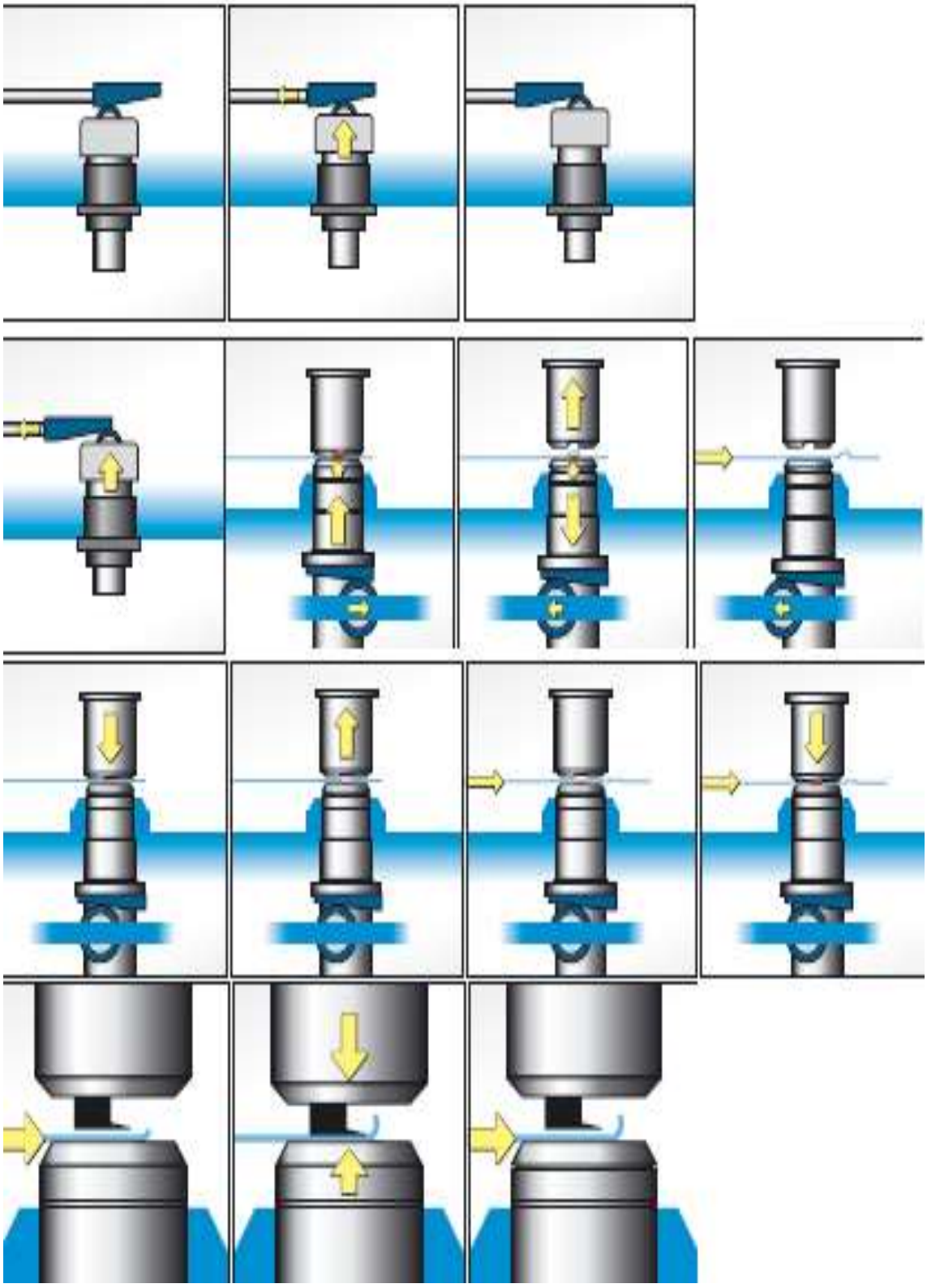
The maximum punching speed can reach 300 times per minute. Indexing motions, which help to improve process efficiency, the time moment of switching on or switching off of the forced feeding can be determined by using the closed loop according to the hob axis motor power used. Using the pulse type feed during cut in (cut off) stages, the indexing process also takes place during the forced feeding and the point of angular position on the workpiece surface at the end of the forced feeding overruns the angular position of the first contact point of the hob and workpiece. So, the position of switching on of each forced feed motion changes. The hob tooth cutting edge trace in the workpiece is composed of three additives created due to three relative motions the rotation of the hob around its axis, indexing motion between the hob and the workpiece, and axial feeding. These motions can be divided into two pairs, which determine the thickness of the chip cut: the first pairi s the hob rotation together with axial feeding motion and the chip is cut due to axial feeding, the second one is the hob rotation together with indexing motion and the chip is cut due to indexing motion. The frame is a closed O style to ensure rigidity and prevent the yawing

possible with C frame designs. This assures better punch & dies alignment, less tool wear, and better uptime. The high precision ram stroke is controlled by a hydraulic system that is the heart of the punching system for the machine. The ram speed and stroke are variable with the capability of 600 HPM.

There is full punch force throughout the full stroke, and it is adjustable to make louvers, emboss, and extrusions. The machine comes equipped with precision ground ball screws for positioning accuracy and linear guides for table & carriage travel and support. Both are products of Japan and Germany to ensure the highest quality and years of reliable operation. The machine is controlled by a FANUC CNC system which includes the CPU and digital AC servo motors. G code programming, self diagnostic function, clamp auto protection zones, and manual pulse generator. The fully high precision turret is fully bushed for longevity and available in 24 and 32 tool styles. The upper and lower turrets are machined together for precision station alignment. Auto indexing is handled by combined synchronization of belt and worm gear for highest accuracy.

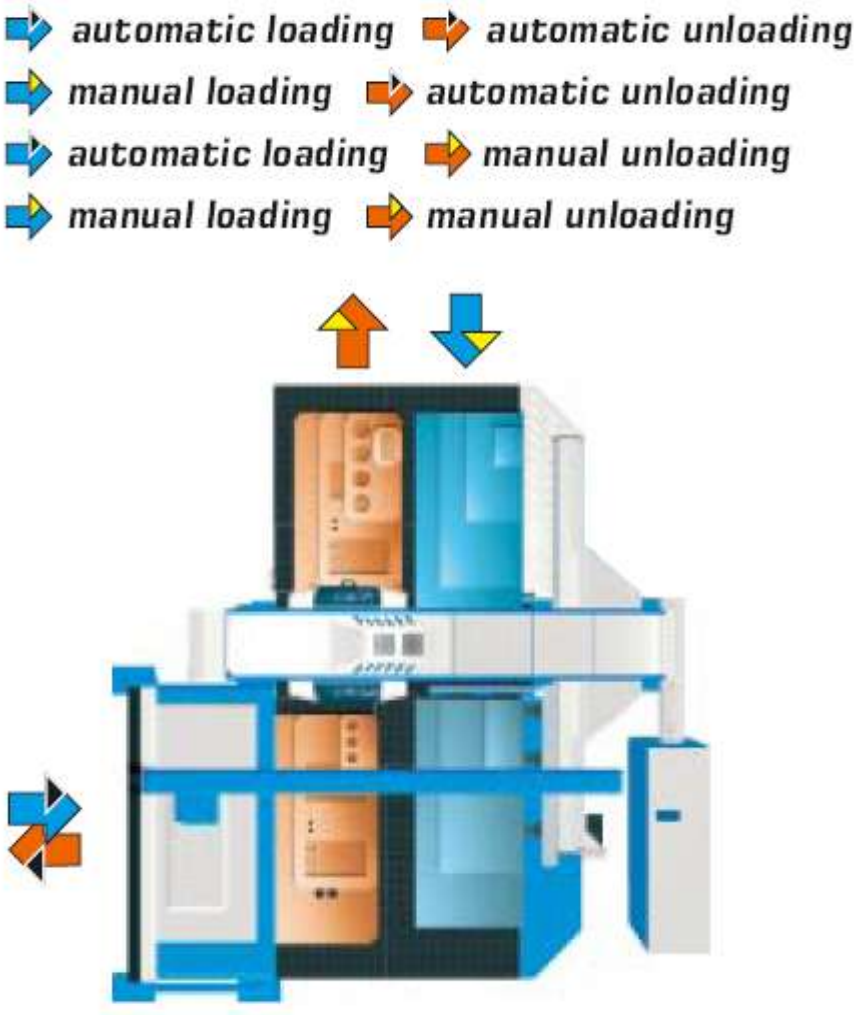
Sectionalized worm and gear construction allow for extremely good repeatability. Maximum tool diameter is 88.9 mm (3.5”). Pneumatic clamping is standard and hydraulic clamping optional. The floating pneumatic clamp is built to have room for up and down sheet motion. There is a small “dead zone” between clamp and punch, increasing the utilization of sheets. Combination of brushes and roller balls fully supports the sheet, but lowers the noise, vibration, and scratching of the material. Flexible configuration of the machine can be achieved with thick or thin tooling styles selected by the requirements of the customer. The working process is illustrated below in the figure.

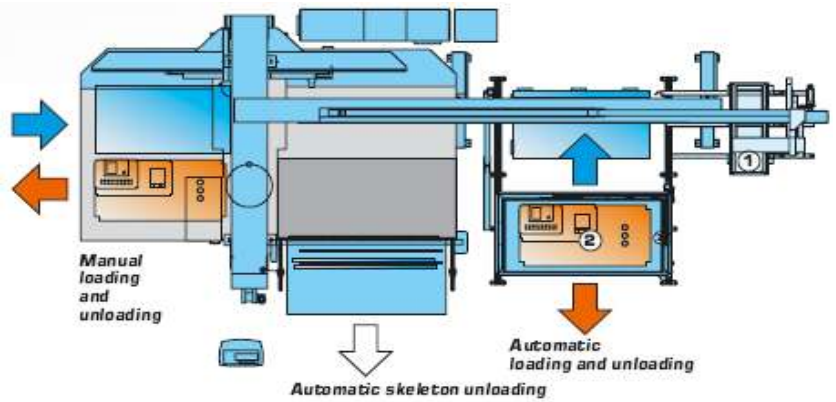

PUNCHING
1
2
3
FORMING
INDEXABLE UPFORMING, HIGH FORMING MODE
INDEXABLE UPFORMING, STANDARD FORMING MODE
INDEXABLE UPFORMING, STANDARD FORMING MODE
INDEXABLE UPFORMING, BENDING MODE

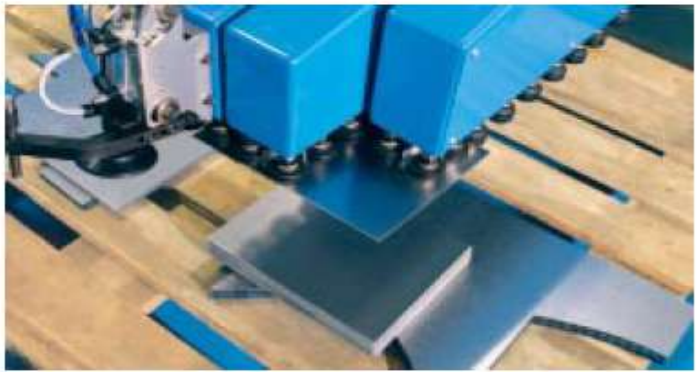


The Entire Punching Process Diagram

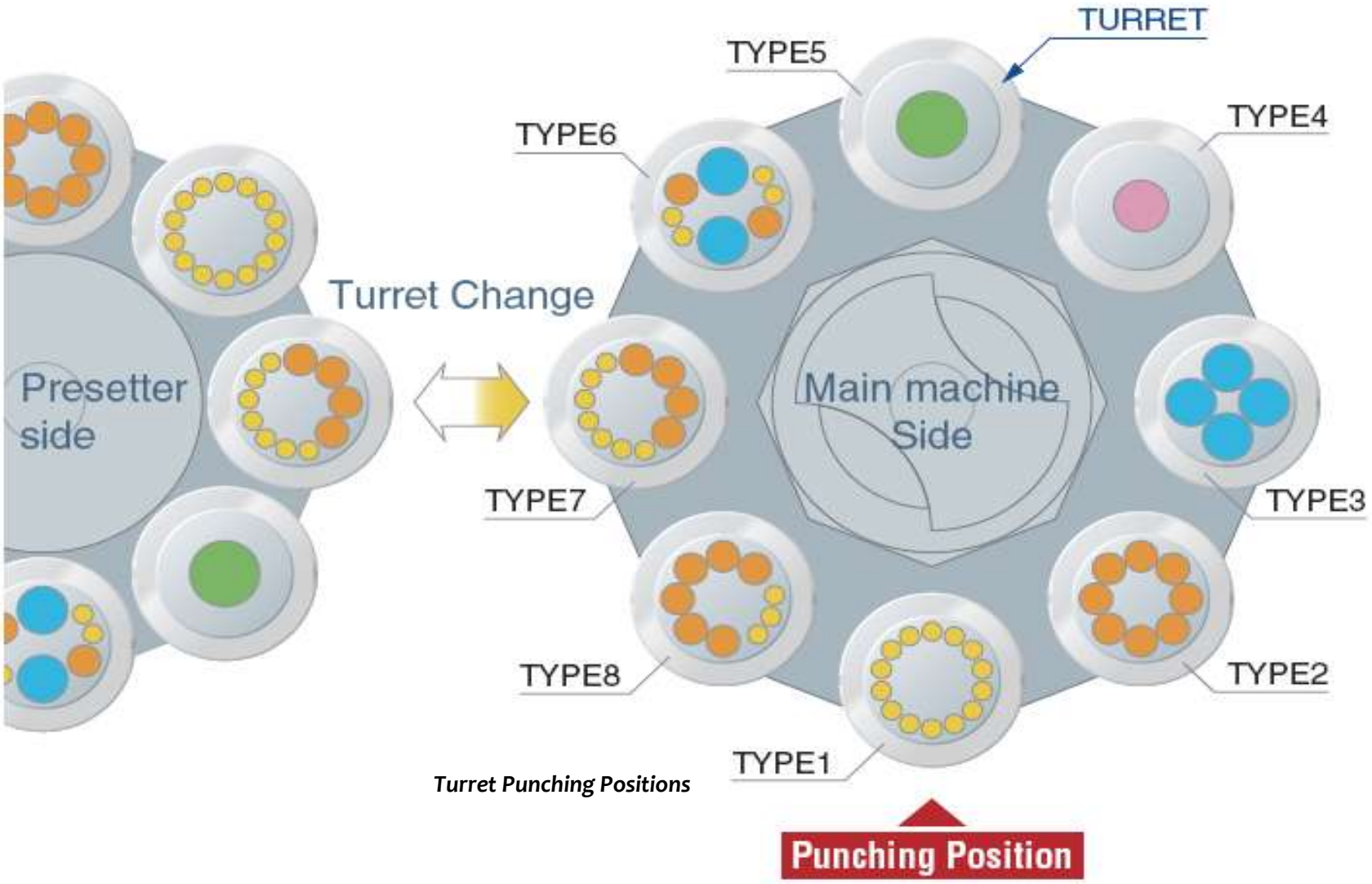
Annexure 3: Technical Drawing of CNC Turret Punch machine



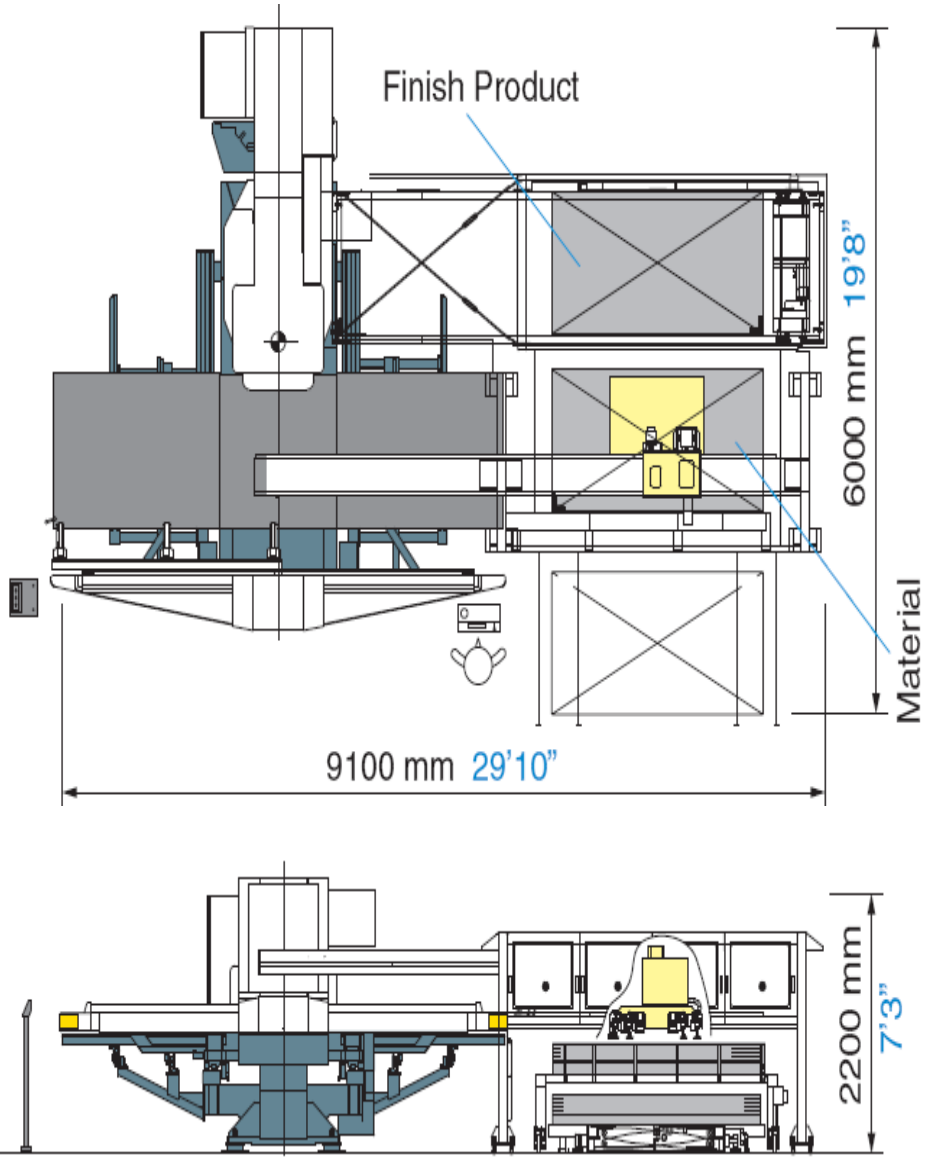


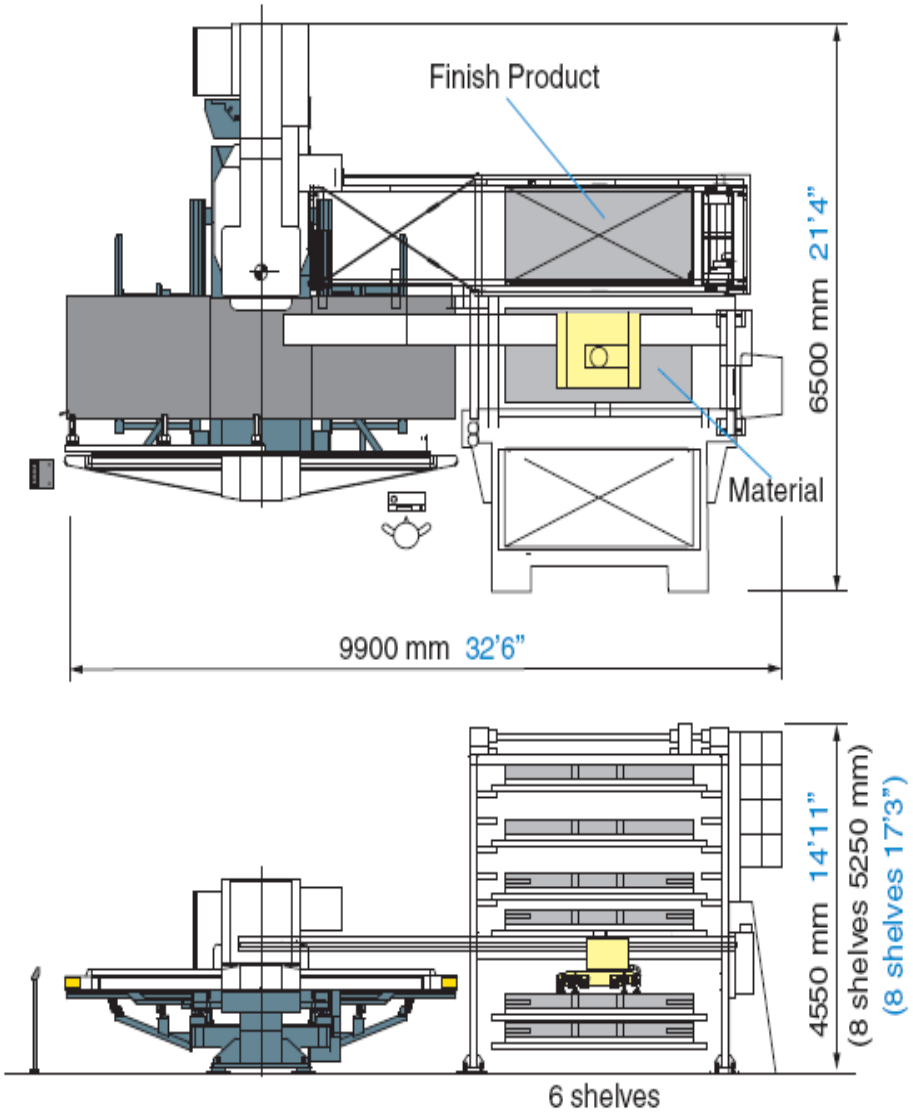


The CNC Turret Punch Machine (Process)

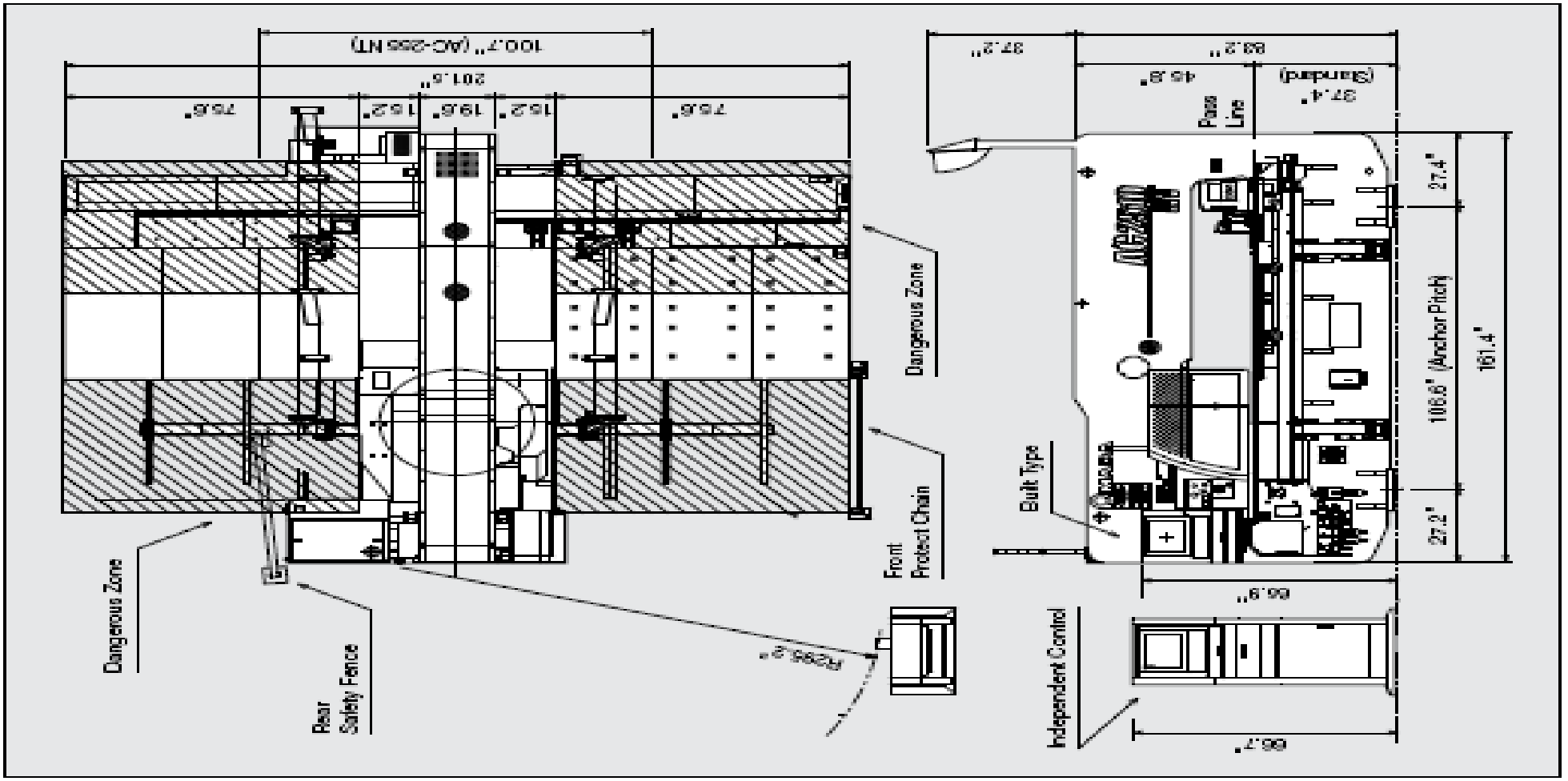


Turret Punching Positions


Finish Product
6000 mm 19'8"
Material
9100 mm 29'10"
2200 mm
7'3"


Finish Product
6500 mm 21'4"
Material
9900 mm 32'6"
4550 mm 14'11"
(8 shelves 5250 mm)
(8 shelves 17'3")
6 shelves

Dimensions


Dangerous Zone
Rear Safety Fence
Front Protect Chain
Dangerous Zone
Pass Line
Built Type
Independent Control
27.4"
106.6" (Anchor Pitch)
161.4"
27.2"

Floor Plan

Annexure 4: Detailed Financial Calculations & Analysis for Financial Indicators

ASSUMPTION

Name of the Technology	***CNC Turret Punch Presses Machine***		
Rated Capacity			
Details	***Unit***	***Value***	***Basis***
No of working days	Days	300	Feasibility Study
No of Shifts per day	Shifts	2	Feasibility Study
Proposed Investment			
Plant & Machinery	` (in lakh)	86.66	Feasibility Study
Cost of modification in civil construction	` (in lakh)	1.20	Feasibility Study
Cost of consultancy	` (in lakh)	0.35	Feasibility Study
IDC	` (in lakh)	0.45	Feasibility Study
Total Investment	` (in lakh)	88.66	Feasibility Study
Financing pattern			
Own Funds (Equity)	` (in lakh)	22.16	Feasibility Study
Loan Funds (Term Loan)	` (in lakh)	66.49	Feasibility Study
Loan Tenure	years	7	Assumed
Moratorium Period	Months	6	Assumed
Repayment Period	Months	90	Assumed
Interest Rate	%age	10.00	SIDBI Lending rate
Estimation of Costs			
O & M Costs	% on Plant & Equip	5.00	Feasibility Study
Annual Escalation	%age	5.00	Feasibility Study
Estimation of Revenue			
Electricity saving	kW/Tonne	400	
Annual production	Tonne/Annum	228.375	
Cost	`/kWh	5	
Other savings	`/Annum	20448.3	
St. line Depn.	%age	5.28	Indian Companies Act
IT Depreciation	%age	80.00	Income Tax Rules
Income Tax	%age	33.99	Income Tax

Estimation of Interest on Term Loan (` ***in lakh)***

Years	Opening Balance	Repayment	Closing Balance	Interest
1	66.49	3.60	62.89	7.70
2	62.89	7.20	55.69	5.96
3	55.69	7.80	47.89	5.21
4	47.89	9.00	38.89	4.38
5	38.89	9.60	29.29	3.46
6	29.29	10.80	18.49	2.44
7	18.49	11.80	6.69	1.32
8	6.69	6.69	0.00	0.20
		66.49		

WDV Depreciation

Particulars / years	***1***	***2***	***3***	***4***	***5***
Plant and Machinery					
Cost	88.66	17.73			
Depreciation	70.92	14.18			

Particulars / years	1	2	3	4	5
WDV	17.73	3.55			

Projected Profitability

Particulars / Years	1	2	3	4	5	6	7	8	9	10
Revenue through Savings										
Total Revenue (A)	51.27	51.27	51.27	51.27	51.27	51.27	51.27	51.27	51.27	51.27
Expenses										
O & M Expenses	4.43	4.65	4.89	5.13	5.39	5.66	5.94	6.24	6.55	6.88
Total Expenses (B)	4.43	4.65	4.89	5.13	5.39	5.66	5.94	6.24	6.55	6.88
PBDIT (A)-(B)	46.83	46.61	46.38	46.13	45.88	45.61	45.33	45.03	44.72	44.39
Interest	6.03	5.96	5.21	4.38	3.46	2.44	1.32	0.20	-	-
PBDT	40.81	40.65	41.17	41.76	42.42	43.17	44.01	44.83	44.72	44.39
Depreciation	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68
PBT	36.12	35.97	36.48	37.07	37.74	38.49	39.33	40.15	40.04	39.71
Income tax	-	9.00	13.99	14.19	14.42	14.67	14.96	15.24	15.20	15.09
Profit after tax (PAT)	36.12	26.97	22.49	22.88	23.32	23.82	24.37	24.91	24.84	24.62

Computation of Tax ***`(in lakh)***

Particulars / Years	1	2	3	4	5	6	7	8	9	10
Profit before tax	34.45	35.97	36.48	37.07	37.74	38.49	39.33	40.15	40.04	39.71
Add: Book depreciation	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68
Less: WDV depreciation	70.92	14.18	-	-	-	-	-	-	-	-
Taxable profit	(31.79)	26.47	41.17	41.76	42.42	43.17	44.01	44.83	44.72	44.39
Income Tax	-	9.00	13.99	14.19	14.42	14.67	14.96	15.24	15.20	15.09

Projected Balance Sheet ***`(in lakh)***

Particulars / Years	1	2	3	4	5	6	7	8	9	10
Liabilities										
Share Capital (D)	22.16	22.16	22.16	22.16	22.16	22.16	22.16	22.16	22.16	22.16
Reserves & Surplus (E)	36.12	63.10	85.59	108.47	131.79	155.61	179.98	204.89	229.73	254.35
Term Loans (F)	62.89	55.69	47.89	38.89	29.29	18.49	6.69	0.00	0.00	0.00
Total Liabilities D)+(E)+(F)	121.18	140.95	155.65	169.53	183.25	196.26	208.83	227.05	251.89	276.51
Assets										
Gross Fixed Assets	88.66	88.66	88.66	88.66	88.66	88.66	88.66	88.66	88.66	88.66
Less: Accm. Depreciation	4.68	9.36	14.04	18.72	23.40	28.09	32.77	37.45	42.13	46.81
Net Fixed Assets	83.97	79.29	74.61	69.93	65.25	60.57	55.89	51.21	46.53	41.85
Cash & Bank Balance	37.21	61.66	81.03	99.60	118.00	135.69	152.94	175.85	205.36	234.67
Total Assets	121.18	140.95	155.65	169.53	183.25	196.26	208.83	227.05	251.89	276.51
Net Worth	58.29	85.26	107.75	130.64	153.96	177.77	202.14	227.05	251.89	276.51
Dept equity ratio	2.84	2.51	2.16	1.75	1.32	0.83	0.30	0.00	0.00	0.00

Projected Cash Flow: ***`(in lakh)***

Particulars / Years	0	1	2	3	4	5	6	7	8	9	10
Sources											

Share Capital	22.16	-	-	-	-	-	-	-	-	-	-
Term Loan	66.49										
Profit After tax		36.12	26.97	22.49	22.88	23.32	23.82	24.37	24.91	24.84	24.62
Depreciation		4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68
Total Sources	88.66	40.81	31.65	27.17	27.56	28.00	28.50	29.05	29.59	29.52	29.30
Application											
Capital Expenditure	88.66										
Repayment of Loan	-	3.60	7.20	7.80	9.00	9.60	10.80	11.80	6.69	-	-
Total Application	88.66	3.60	7.20	7.80	9.00	9.60	10.80	11.80	6.69	-	-
Net Surplus	-	37.21	24.45	19.37	18.56	18.40	17.70	17.25	22.90	29.52	29.30
Add: Opening Balance	-	-	37.21	61.66	81.03	99.60	118.00	135.69	152.94	175.85	205.36
Closing Balance	-	37.21	61.66	81.03	99.60	118.00	135.69	152.94	175.85	205.36	234.67

Calculation of Internal Rate of Return ***`(in lakh)***

Particulars / months	***0***	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***
Profit after Tax		36.12	26.97	22.49	22.88	23.32	23.82	24.37	24.91	24.84	24.62
Depreciation		4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68
Interest on Term Loan		6.03	5.96	5.21	4.38	3.46	2.44	1.32	0.20	-	-
Cash outflow	(88.66)	-	-	-	-	-	-	-	-	-	-
Salvage value											41.85
Net Cash flow	(88.66)	46.83	37.62	32.39	31.94	31.46	30.93	30.37	29.79	29.52	71.15
IRR	41.54%										
NPV	137.58										

Break Even Point ***`(in lakh)***

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***
Variable Expenses										
Operation & Maintenance Exp (75%)	3.32	3.49	3.67	3.85	4.04	4.24	4.46	4.68	4.91	5.16
Sub Total (G)	3.32	3.49	3.67	3.85	4.04	4.24	4.46	4.68	4.91	5.16
Fixed Expenses										
Operation & Maintenance Exp	1.11	1.16	1.22	1.28	1.35	1.41	1.49	1.56	1.64	1.72
Interest on Term Loan	6.03	5.96	5.21	4.38	3.46	2.44	1.32	0.20	0.00	0.00
Depreciation *(H)*	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68
Sub Total (I)	11.82	11.81	11.12	10.34	9.49	8.53	7.48	6.44	6.32	6.40
Sales (J)	51.27	51.27	51.27	51.27	51.27	51.27	51.27	51.27	51.27	51.27
Contribution (K)	47.94	47.78	47.60	47.42	47.23	47.02	46.81	46.59	46.35	46.11
Break Even Point (L= G/I) (%)	24.65%	24.71%	23.35%	21.81%	20.09%	18.15%	15.99%	13.82%	13.63%	13.88%
Cash Break Even {(I)-(H)} (%)	14.89%	14.91%	13.52%	11.94%	10.18%	8.19%	5.99%	3.77%	3.53%	3.73%
Break Even Sales (J)*(L)	12.64	12.67	11.97	11.18	10.30	9.30	8.20	7.09	6.99	7.12

Return on Investment ***`(in lakh)***

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	***Total***
Net Profit Before Taxes	36.12	35.97	36.48	37.07	37.74	38.49	39.33	40.15	40.04	39.71	381.10
Net Worth	58.29	85.26	107.75	130.64	153.96	177.77	202.14	227.05	251.89	276.51	1671.26
ROI	22.80 %										

Debt Service Coverage Ratio ***`(in lakh)***

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	***Total***
Cash Inflow											
Profit after Tax	36.12	26.97	22.49	22.88	23.32	23.82	24.37	24.91	24.84	24.62	204.89
Depreciation	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	4.68	37.45

Interest on Term Loan	6.03	5.96	5.21	4.38	3.46	2.44	1.32	0.20	0.00	0.00	29.00
Total (M)	46.83	37.62	32.39	31.94	31.46	30.93	30.37	29.79	29.52	29.30	271.33

Debt

Interest on Term Loan	6.03	5.96	5.21	4.38	3.46	2.44	1.32	0.20	0.00	0.00	29.00
Repayment of Term Loan	3.60	7.20	7.80	9.00	9.60	10.80	11.80	6.69	0.00	0.00	66.49
Total (N)	9.63	13.16	13.01	13.38	13.06	13.24	13.12	6.89	0.00	0.00	95.49
Average DSCR (M/N)	2.84										

Note: - As the proposed machinery is CNC Turret punch machine it is expected that the machine will be fetching good market value even after the project period of 10 Years. Therefore, in this case the Salvage value is expected to be at least net value after providing Depreciation for the project life and this value is considered as the cash flow in the last i.e. 10th year of the project life for simplification. In the alternative case we have to consider the other model where cash flow has to be calculated beyond the project life of 10 Years (perpetuity).

Annexure 5: Details of procurement and implementation plan

S. No.	Activities	Weeks						
		1	2	3	4	5	6	7
1	Procurement and Delivery							
2	Civil & Electrical Work							
3	Commissioning							
4	Training							

Annexure 6: Details of technology/equipment and service providers

Name of Organization	*Communication Address*	*Contact No.*
GMT Engineers Pvt.Ltd.	H-7A Krupa Colony, First Avenue Ashok Nagar Chennai 600083	+91 44 24896028 23711881 email Chennai@gmtoffice.com www.gmtengineers.com
DMG Mori Seiki India Machines and Services Pvt Ltd	"Parimala Towers" #64 Jalahalli Camp Cross, Off MES Road, Yeshwanthpur IN-560022 Bangalore.	Phone: +91 80 40896508
Haas Automation	Manav Marketing Pvt Ltd 430-431,12TH cross, 4th Phase, Peenya Industrial Area, Bangalore 560058 India	91-80-4117 9452/53
Intelmac machine tools Pvt.ltd.	No.95/90, "Sowjanya" 1st Floor, 19th Main,1st 'N' Block, Rajajinagar, BANGALORE - 560 010. INDIA	kiran@intelmacindia.com Tel: +91-80-32982722, +91-80-23577655. Fax: +91-80-23474508

Annexure 7: Quotations or Techno-commercial bids for new technology/equipment

GMT ENGINEERS PVT LTD

R017-08/2011 August 12, 2011.

M/s. Petroleum Conservation Research Association,
(Under the Ministry of Petroleum & Natural Gas – Govt. of India)
" T.M.B. Mansion", 1st Floor, 739, Anna Salai, Chennai – 600 002.
Phone: 044 – 2841 8018 / 2852 0417. Fax: 044 – 2852 1662.
Mb: 09442630838.
Email : thangadurai@pcra.org / athangadurai1@gmail.com Web: www.pcra.org

Kind Attn.: Mr. A. Thangadurai, Deputy Director.

Dear Sirs,
On behalf of our Principals **M/s. JIANGSU YANGLI GROUP CO., LTD**, China, we take pleasure in submitting our **least and final offers** for supply of CNC Turret Punch Press Machine.

SL.NO.	PARTICULARS	Qty	Price in US$
1.	CNC Hydraulic Turret Punch Press Machine. With table size 1250 X 2500.		FOB, Shanghai
	MODEL : T30	One	1,40,000.00
		Total	1,40,000.00

TERMS & CONDITIONS of M/s. JIANGSU YANGLI GROUP CO., LTD.

- Please note that the prices mentioned above are after deducting all Trade discount applicable. The price is firm and is on FOB SHANGHAI basis.
- Note: Prices are Exclusive of First Fill of Oil and Grease.
- Customs Duties and other levies involved in Import to be borne by you.
- Sea Freight, Customs Clearing & Forwarding Charges, Loading & Unloading, Insurance, Local Transport Chennai Port to your factory extra to your a/c.
- The above cost does not include LC Opening charges & any other applicable charges between your Bankers & YANGLI's bankers.
- Payments: 100% IRREVOCABLE L/C AT SIGHT
- Despatch: 75 days from the date of receipt of your 100% atsight LC.
- Order in favor of: M/s.JIANGSU YANGLI GROUP CO., LTD
- The price is for Standard Specifications in case of Customer's special specification the price would be increased.
- Original Proforma Invoice for opening LC shall be forwarded from M/s. JIANGSU YANGLI GROUP CO., LTD at the time of placement of orders.
- VALIDITY: 10 DAYS.

Thanking you,

Yours faithfully,
for **GMT ENGINEERS PVT LTD,**

M. SANTHANA RAMAN,
PRODUCT MANAGER,
Mobile # 9003082277

H-7A, KRUPA COLONY, FIRST AVENUE, ASHOK NAGAR, CHENNAI 600 083
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Email: chennai@gmtoffice.com, visit us at: www.gmtengineers.com

Bureau of Energy Efficiency (BEE)
(Ministry of Power, Government of India)
4th Floor, Sewa Bhawan, R. K. Puram, New Delhi – 110066
Ph.: +91 – 11 – 26179699 (5 Lines), Fax: +91 – 11 – 26178352
Websites: www.bee-india.nic.in, www.energymanagertraining.com

PCRA, Southern Region
Petroleum Conservation Research Association T.M.B. Mansion, First Floor, 739, Anna Salai, Chennai – 600002
System & Solution (India)
www.sas.ind.in
ems@sas.ind.in

India SME Technology Services Ltd
DFC Building, Plot No.37-38,
D-Block, Pankha Road,
Institutional Area, Janakpuri,
New Delhi-110058
Tel: +91-11-28525534,
Fax: +91-11-28525535
Website: www.techsmall.com