1.Introduction:

Fig.1: Bosch Logo

1.1 About Bosch

Robert Bosch GmbH is widely known the world over as a pioneer in automotive technology for 120 years. The name BOSCH is synonymous with innovations in automotive technology, industrial technology and consumer goods and building technology founded in 1886in Germany as a ‘Workshop for Precision Mechanics and Electrical Engineering ‘by Robert Bosch. Today the Bosch is largest automotive technology supplier in the world with a global group turnover of Euro 41.5 billion in the year 2005.Interestingly, every year Bosch files on an average over 2800 patent application across the globe.

Bosch is now present in every continent with more than 280 subsidiaries, associated companies and 12000 service centers located in over 140 countries. Bosch operates 260 manufacturing locations worldwide. Of these 200 are located outside Germany in Europe, North and South America, Africa, Asia and Australia. In Fiscal2015, Bosch employed more than 251,000 people worldwide.

The Special ownership structure of the Bosch Group guarantees it financial independence and entrepreneurial freedom. The structure also enables the group to undertake significant up-front investments for the future and do justice to its social responsibilities in a manner reflecting the spirit and will of its founders. Ninety-two percent of the shares in Robert Bosch GmbH are held by the charitable Bosch Foundation.

Bosch India is regional branch of the Bosch Group, one of the world's biggest private industrial corporations. Headquarters in Stuttgart, Germany. In India, the Bosch Group has about 15,044 employees, and in business year 2015 achieved total consolidated sales of Rupees 40 billion (Euro 729 Mio). Bosch has grown phenomenally in India, way back since 1922 when the company established a Bosch agency in British India. The founding of Motor Industries Company Limited in 1951 spurred off an accelerated growth in the automotive industry segment which has stopped till date. Bosch has a strong and voracious presence in the country today, in diverse industry segments at numerous locations.

In India, Bosch is represented in by its subsidiary companies:

1) Motor Industries Company Limited - MICO

2) Robert Bosch India Limited - RBIN

3) Bosch Rexroth India Limited - BRIN

4) Bosch Chassis System India Limited

1.1.1About Motor Industries Co. Ltd. :

The flagship of the Bosch Group in India, Motor Industries Co. Ltd (MICO) was established in 1951, and has been a pioneer and leader in the Indian automotive segment for the past 65 years. In India it is the largest auto component manufacturer and the largest Indo-German Company.

The Bosch Group holds a 60.55% stake in the company. With access to state of the art technologies from Bosch and commitment to world class quality, the company is the country's largest manufacturer of Diesel Fuel Injection equipment

The Company is headquartered in Bangalore with Manufacturing facilities at Bangalore, Nashik, Naganathpura and Jaipur. All four Plants are TS 16949 and ISO 14001 certified. With approximately 25000 associates working in these facilities, the company manufactures and trades products as diverse as Diesel and Gasoline Fuel Injection Equipment, Energy and Body Systems, Spark Plugs, Car Multimedia Systems, Power Tools, Security Systems, Packaging Machines, industrial Equipment and Gear Pumps.

1.1.2 MICO Nashik:

BOSCH Nashik also abbreviated as Bosch/Nap in the Bosch World, is one of the four pillars of Bosch Group in India. The Company is situated in city which is one of the holy cities of India and is full of natural resources and manpower. This has contributed in the development and growth of the company in the city. The Bosch/Nap is located at Satpur in Nashik. The Plant is Situated on a land area of 405,060 sq.m. of the built up area.

The Plant has five functioning workshops with well-planned and international quality structure. The plant and buildings are well supplied with necessary facilities such as water, electricity and ambiators, which make the working as pleasure. The good landscaping is the characteristics of the plant

AREA:100Acres

Strength:3000 Employees

No. of production Shop in Nashik Plant and Products as follows:

Shop Name	Products and Work
101	DLL Nozzle Manufacturing
102	Maintenance Electronic and Mechanical
103	Heat Treatment Process
104	CRI & DSLA Assembly

105	CRI & DSLA Manufacturing

Table 1-No of Production Shop

1.1.3 14 Quality Principles of Bosch:

1) Stop Sign

- A STOP sign process with all of the 8D elements is displayed on the shop floor.
- A standard review process involving the production/logistics management and quality management takes place.
- The decision to end the STOP sign process is taken by production/logistics management after a review of the measures' effectiveness.
- It is necessary to ensure that customer complaints are communicated quickly over the entire supply chain from supplier to customer.

2) Quality Deviation:

- There is a systematics (e.g. Andon cord, blocking/ escalation process, reaction plan) in place that allows the operator, if he notices deviations, to choose to prevent the passing-on / further processing of parts (by stopping/blocking) and to escalate immediately.

- Deviations can occur if control limits are exceeded, and also based on subjective observations (for example, the power screwdriver is not running smoothly, material has been funneled into the incorrect chute, or the associate is not working to the standards set, label badly readable or incomplete).
- After stopping the system there needs to be a well-defined process governing the restarting and release of the system by shop floor management.

3) Instructions:

- The work, production and inspection instructions are clearly visible at every work place. A consistent set of symbols is available. If appropriate, the right/left hand movement becomes evident from the instruction. The failure modes from the FMEA and special characteristics from the control plan are taken into account. Detailed photos support the process.
- There is a feedback loop in place that ensures the consistency of the control plan, FMEA, and directions. Health and safety instructions are carried out according to the plan. Participation is compulsory and will be documented.
- All deviations regarding safety, work, production and inspection instructions or safety and health briefings shall be resolved using the 8D method.

4) Process Parameters:

All process parameters (e.g. press-in force, maximum storage time) that affect product quality are clearly defined and systematically checked on basis of the control plan. All required inspection criteria are implemented according to specification. Process validations are performed to determine whether target values/tolerances of the defined parameters have been observed. Deviations are systematically recorded and eliminated permanently.

5) Testing Equipment:

- The type of measuring and test equipment (e.g. gages, scanners) incl. auxiliary means and its uses is defined for all processes in the control plans.
- All measuring and test equipment is calibrated and only utilized within the permissible inspection interval.
- The inspection status of the measuring and test equipment is recognizable at its place of usage (e.g. marked by inspection certificate sticker, tag).
- In case of suspected malfunctions/damages this has to be notified.

6) Check the Checkers:

- The suitability of processes used to prevent or detect errors (e.g. camera-monitored processes, sensor-based measurements, inspection processes, scanning of labels) needs to be checked according to a predefined standard.
- Possible errors, such as loading the incorrect camera software/testing program or incorrect MAE software versions/updates, entry of wrong inspection parameters, or improper sensor calibration, need to be prevented by carrying out the inspection. These inspection processes, need to be evaluated using appropriate methods (e.g. FMEA).
- Check-the-Checker-parts are included in the control of inspection measurement and test equipment.
- Generally speaking, mistake-proofing is always preferable to error detection (e.g. Poka Yoke).

7) TPM (Total Productive Maintenance):

- The four-pillar TPM model, particularly the autonomous and preventative maintenance, is instituted at every machine, device, facility. This contains both the roles and responsibilities for production and the supporting areas.

- Systematic damage and dirt built-up on machinery and device components (e.g. work piece carriers, storage facilities, stackers) need to be consistently analyzed, recognized, and remedied.
- The restart after maintenance (see principle 9), has to consider potential influences on product quality.

8) Tool Management:

- Wear-prone tools with influence on product quality (e.g. processing, assembly, molding tools, work piece fixtures/carriers) have been recorded and are controlled (e.g. defined service lives, control on basis of product characteristics, inspection during maintenance).
- A warning system promptly displays when tools need to be replaced or serviced.
- Each tool needs to be inspected when installed, removed or disassembled to check for recognizable abnormalities (e.g. damage/wear and tear). In case of deviations, it is necessary to follow measures to ensure product quality is maintained.

9) Re-Start of Machine:

- Each disruption to the continuous production process (tool change, set-up, break, shift change, maintenance, power failure, upgrade, MAE software update, parameter changes) presents a potential risk to quality. A predefined standard for post-restart is therefore necessary. This should detail how to deal with products in the process after a disruption.
- All devices have been inspected according to a defined standard for quality risks in connection with disruptions (for example, an unplanned disruption to the welding process, the injection molding process stops.

10) Identification:

In the entire value stream products must always have a clear status. Therefore, a consistent identification/labeling concept at the production site and adherence to the following rules are necessary.

Within the production flow:

Filled boxes must always be labeled (e.g. card, sticker, RFID).

Outside the production flow:

White card with a red diagonal stripe: Product blocked;

Green card: Product after additional test back in production flow and in good condition;

Yellow card: Product for rework; Red card: Product is scrap; White card: Product in good condition.

- Rejected parts in the red box (scrap container).

- Red boxes must be secured against unintended access (e.g. by locking them, covering, spatial separation, covering during transport).
- Containers for rejects must be emptied in line with standards and the parts must be analyzed.
- Parts at the analysis station are spatially separated from the production flow and clearly identified.
- Only parts with the same status in the same container
- No good parts in the red box.
- A blocking process for production and logistics is defined.
- Products are protected against environmental influences (e.g. contamination) in line with regulations.

11) Rework/Scrap Management:

Basic rule: Inspection or processing of a part that, contrary to the control plan, is removed from the standard process, is rework.

If rework is unavoidable it takes place on an approved device and is limited in time or quantity. A concession is necessary.

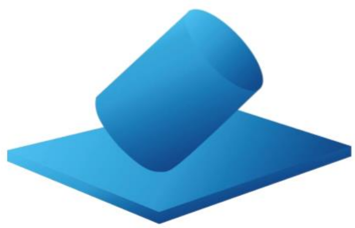
A rework process that is permanently required must be transferred to a standard process.

Sorting inspections require a

- risk assessment,
- description of the workplace,
- work / inspection instruction.

They are approved by the responsible for production and the responsible for quality. Scrap must be disposed of in line with the standard and unauthorized further use of these products must be prevented (for example, by destroying them).

12) Fallen Parts Handling:



- Each individual employee must adhere to this standard regardless of what part of the organization he/she belongs to or his/her position within the company.
- In case of repeated occurrence, the shop floor management must be notified by the employee. Repeat events are analyzed regarding systematic causes and improvement measures are implemented.
- Nonconforming products or products that cannot be classified must be scrapped according to procedure.

13) Correct Parts:

- Only the correct product may be available to the associate at the time of assembly.
- All other variants or versions that are stored at the assembly station/workplace must not be accessible to the employee (e.g. closed/covered containers).
- If several variants need to be available (e.g. mating of parts), an inspection takes place after the handling operation.

14) Leftover Parts:

- Remaining quantities must be clearly labeled (e.g. white card with part number, number of units, date, name, remaining quantity in the comments field) and stored securely (e.g. shelf for remaining items).
- The “First In, First Out” principle must be observed. Maximum storage times must not be exceeded.
- Close attention must be paid to ensure tidiness and cleanliness as the goods have yet to be placed in the final packaging.
- The quantity of remaining items must be taken into consideration with regard to engineering change requests.

1.2 Products of Bosch Nashik Plants:

At the Nashik plant Nozzle, Nozzle holders and Injectors are manufactured which are used in the fuel injection system of diesel engine. The Bosch Nap is specialized in manufacturing a variety of nozzles and nozzle holders and that of cheapest rate

1.2.1 Types of Nozzle:

1.DN Nozzle:

These are the pintle type nozzle. Pintle type nozzles have a coaxial jet and are used in pre combustion chamber engine and turbulent chamber engines. The nozzle opening pressure it between 115 and 400 bar.

Fig.2:DN Nozzle

2.<u>Orifice Nozzle:</u>

These nozzles have several spray orifices and are required for engines with direct injection. The nozzle opening pressure is between 180 to400 bar. These are termed as DL, DLL, DSLA etc. These types are of orifice diameter but difference in the shaft diameter and length of collar.

Fig.3:Orifice Nozzle

1.2.2 Type of Injectors:

The main Purpose of the system is to deliver fuel to the cylinders of a diesel engines.it is how that fuel is delivered that makes the difference in engine performance, emission and noise characteristics.

1.Conventional Injectors:

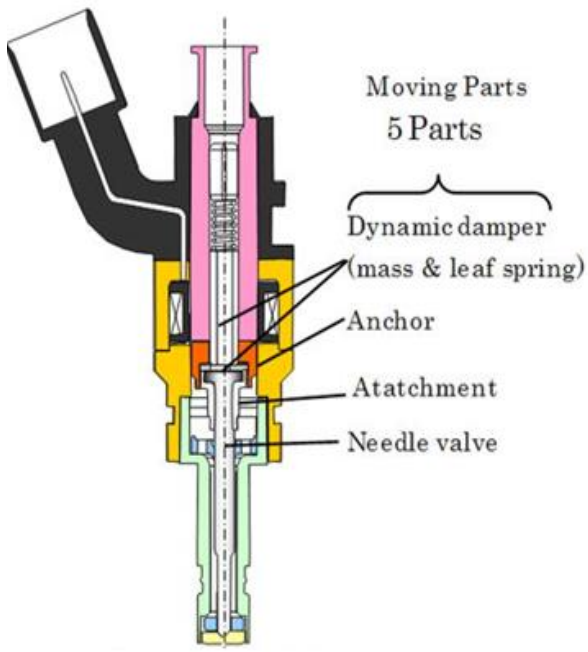


Fig.4:Conventional Injector

2.Comman Rail Injector:

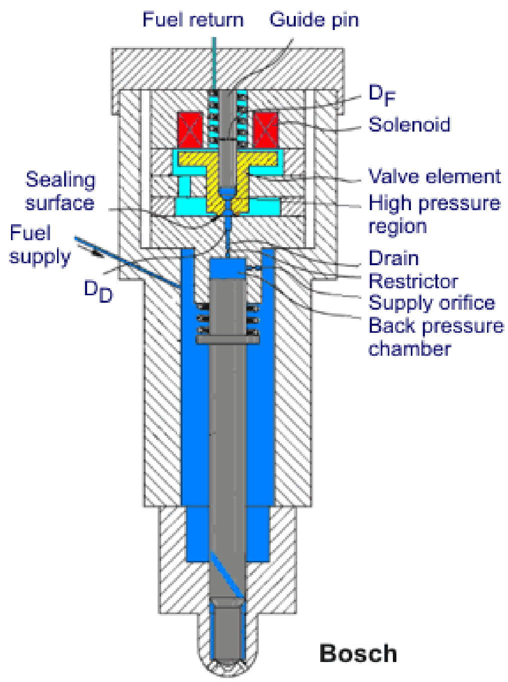


Fig.5:Common Rail injector

1.3 OVERVIEW:

1)Area of Working: Production Shop no. 101

Product-DLL Nozzle

2)Project Definition: Needle Lapping Elimination

3)Current Problem Statement:

Lapping is Finishing process which eliminates the taperness of the shaft and provide good surface finish paste used for lapping contains some chemicals which is harmful to human health and it contains mutton swallow hence it has adverse effect on environment and Highly skilled and experienced operator are required for lapping. The main aim of our project is eliminate the lapping process.

4)Proposed Problem Solution: Improve the conventional or old processes more effectively to eliminate the lapping

Examples:

1.In finish Grind Process Operator check the dimensions of 2-3 parts in 50 parts set but if we check 2-3 parts in 15 set of parts we can reduce the variation of size and feed the required setting to the machine.

1.4 OBJECTIVE AND SCOPE:

1)Production rate faster

2)Machining cost saved

3)skilled labor may not required

4)Accurate result can be achieved

5)Save time as one process is eliminate.

2 PROJECT THEORY

2.1 Product Information

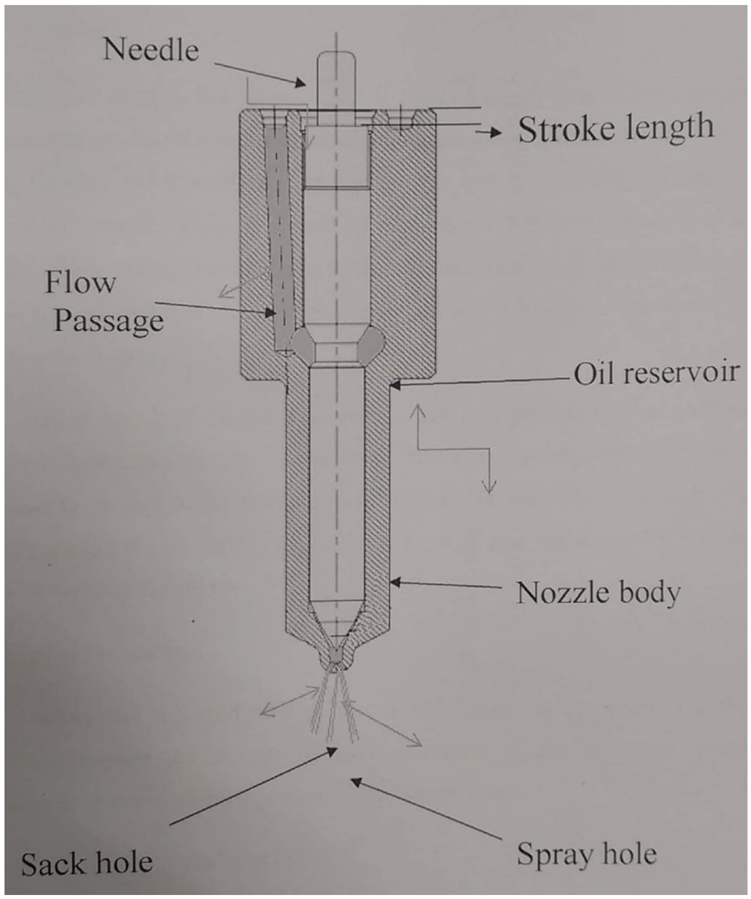


Fig.6:DLL Nozzle Assembly

2.1.1 Material

Body: Nickel Chromium Steel

Needle: HSS

2.1.2 Working

Fuel from fuel pump is fed down to nozzle mouth through long drilled passage. The fuel pressure acts on the differential area of the nozzle valve (needle) which lift against the spring pressure and thus allows the fuel to enter into the cylinder via small hole in the form of an atomized spray. It should be noted that valve spring pressure is always less than the valve closing pressure due to the fact that once the valve lift from the seat the area in contact with high pressure fuel increases and therefore less pressure is needed to keep the valve open.

Oil at very high pressure (more than 100 bar) provided to flow passage. This oil collected in oil reservoir. High pressure oil then travel at very high velocity to the sack hole due to up and down movement of the needle. Oil which is very high pressure and velocity passed through spray holes in the form of fine particles which is required for effective running of engines.

2.2 Nozzle:

2.2.1 Nozzles:

Nozzle is the part of injector, through which the fuel is sprayed into the combustion chamber. Injection nozzle consist of

1.Nozzle Body

2.Nozzle valve

Fuel is supplied through small holes drilled along the nozzle body which terminate in an angular gallery before the valve seating. The inner face of the nozzle holder and the outer face of the nozzle body perfectly match each other. An angular groove is made in the nozzle face to connect the oil holes drilled along the nozzle body with those in nozzle holes. Nozzle valve is stepped in diameter to give differential area upon which the fuel pressure is applied for fitting the valve against the spring loading.

2.2.2 Function of the Nozzle:

1.Correct Atomization: Correctly atomize the fuel into small particles so that it mix properly with air.

2.Proper Distribution: The spray from nozzle should be such that fuel is evenly distributed in the combustion space.

3.Injector Pressure: Higher the injection pressure better the dispersion and penetration of the fuel into all the desired location in combustion chamber.

4.Density of air in the cylinder: if the density of compressed air in the combustion chamber is high then the resistance to the moment of the droplets is higher and dispersion of the fuel is better.

5.Prevention of Impingent on Walls: prevention of fuel from impinging directly on walls of combustion chamber or piston because striking the walls decomposes and produces carbon deposit. This cause smoky exhaust as well as increase fuel combustion.

6.Mixing: Mixing of fuel and air in case of non-turbulent type of combustion chamber should be taken care by the nozzle.

7. Metering: The nozzle should meter the injected fuel and prepare the fuel.

2.3 PROCESS MAPPING:

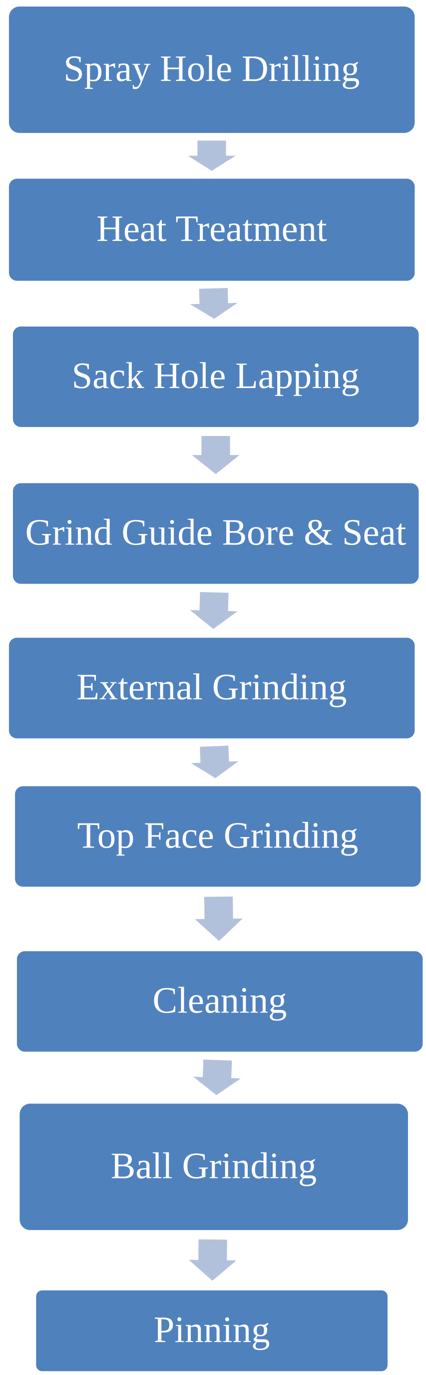


Fig.7: Process Flow of DLL Body

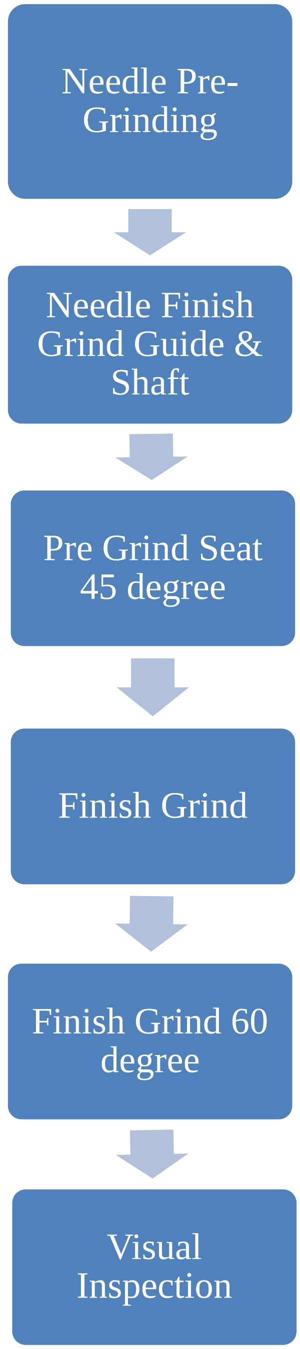


Fig.8: Process Flow of DLL Needle

Raw material for nozzle body and needle come in department just in time before they use from the stock department. There are three suppliers for raw material of nozzle assembly.

2.3.1 Operations Carried Out on Nozzle Body:

1)<u>Spray Hole Drilling:</u>

Spray holes are the holes through which oil come out from nozzle assembly in the form of fine particles of air fuel mixture. Spray hole drilling operation is carried out on spray hole drilling machine. Numbers of holes' drill on part varies according to part wise like, 1320 type part have 3 spray holes. Diameter of drill is very small which is varying according to type of nozzle. Generally, it is 200 to 300 micron. Out of three holes two holes has angle 82.22 degree and another hole is having angle 35 degree. These angle are considered with reference to 2 Dia. Here the depth of drilled hole is equal to thickness of the ball of nozzle. This operation is carried out in three stages, first pre drilling operation is carried out after that rough drilling operation is done and at last finish drilling operation is done. Finishing operation is carried on the spray hole to obtain the appropriate Rota value.

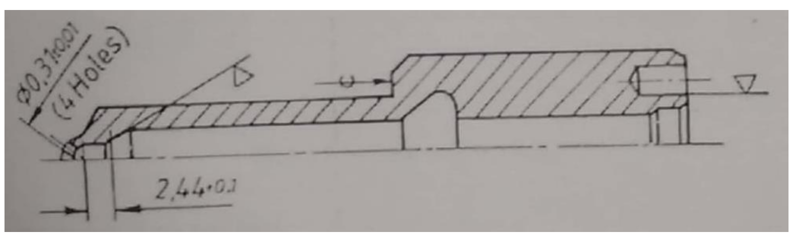


Fig.9:Spray hole Drilling

2)<u>Heat Treatment:</u>

Heat Treatment is process carried out in heat treatment shop i.e. 103. Ram material is heated at very high temperature about more than 500 degree celsius(generally 450-550). Due to heat treatment process hardness of material increases. In this process shrinkage pattern data is consider.

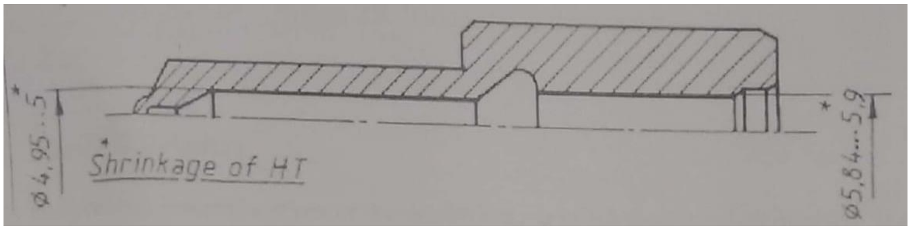


Fig.10:Heat Treatment

3)<u>Sack Hole Lapping:</u>

In this stage surface finish of sack hole is increase. This operation carried out on vertical lapping machine. In this operation numbers of nozzle bodies are arranged in circular manner and operation cycle is done within 2-3 minutes. Lapping paste is use for this operation. Generally diameter of sack hole is maintained at 1 mm. In lapping operation 0.02 mm of material is removed to achieve required surface finish.

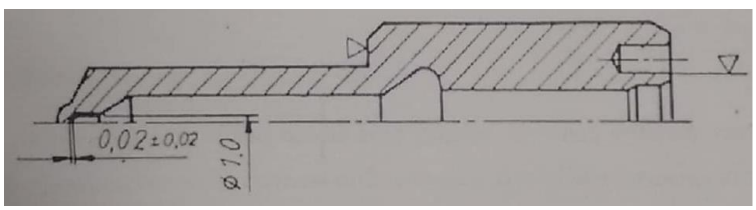


Fig.11:Sack Hole Lapping

4)<u>Grind Guide Bore and Seat:</u>

In this operation guide bore grinding is done. This operation os done on grinding machine. Guide bore is use for guiding the nozzle holder assembly.In this opertaion about 0.05 to 0.09 mm of material is removed from guide bore to achieve required surface finish.

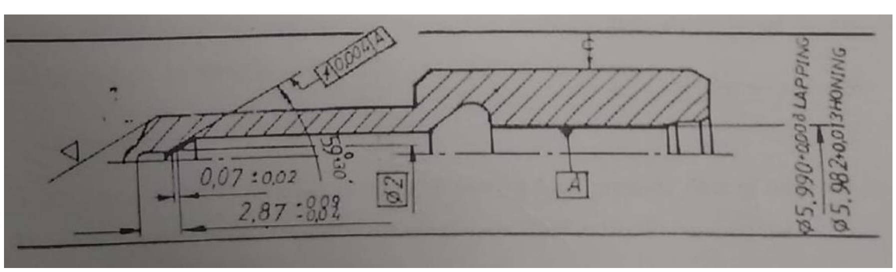


Fig.12:Grind Guide Bore and Seat

5)External Grinding:

In this process external surface of the nozzle body is grinded on grinding machine. In this grinding operation 0.1 to 0.2 mm depth of material are removed from body and surface finish of the body also increase.

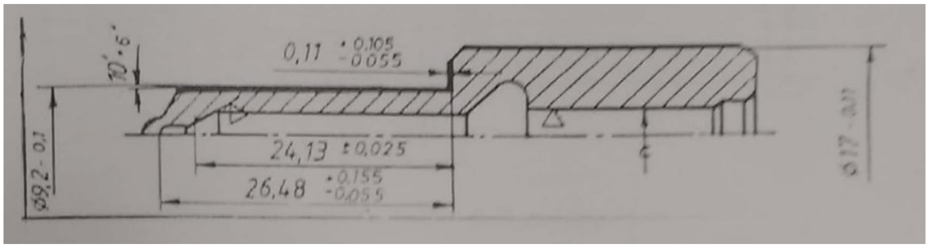


Fig.13:External Grinding Operation

6)Top Face Grinding:

In this process top face of the nozzle body grinded by using grinding machine.This grinding operation is done to increase surface finish and to obtain dimensional accuracy.

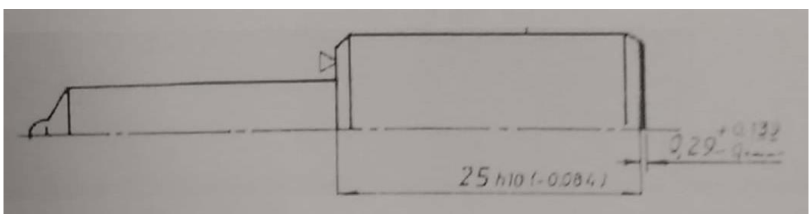


Fig.14:Top Face Grinding

7)Cleaning:

In this process nozzle cleaning is done by passing high pressur flow of turpentine oil through the nozzle body.After this the nozzles are dried in the drying machine.

8)Ball Grinding:

In this operation ball on nozzle body grinded on grinding machine.Diameters of ball vary as per type of nozzle. Generally diameter is in the range of 2 to 3 mm. Spray holes are drilled on the ball of nozzle body. Thickness of the ball is normally 0.8 mm, the dimension of the ball are achieve with respect to 2 Dia.

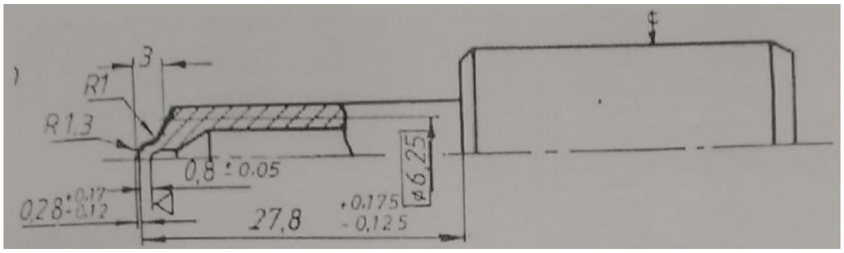


Fig.15:Ball Grinding

9)<u>Pinning:</u>

This Operation carried out by high skill operator, a wire of very small diameter of hard material is use for this operation. Diameter of wire depends on the size of spray holes diameter. This wire is inserted inside spray hole and dust, dirt particles are removed from spray holes.

10)<u>Spray Hole Rota Checking:</u>

In this work station high pressue air is passed to spray hole through nozzle body.Amount of air passed through nozzle body is measured in litre per hour. It check whether value of flow within specified limit or not. If rota value is not in specified lmit then part is rejected.

11)<u>Spray Direction Checking:</u>

In this operation with the help of standard test bowl gauge the angle between spray holes is check. The test bowl gauge has holes on its periphery, to check whether oil spray is in required direction or not. If oil spray from spray hole does not passes through the specified hole of the test bowl gauge then the part is rejected.

12)<u>High Pressure Cleaning:</u>

This process is done for cleaning of part. High pressure oil is passed through the nozzle body and cleaning process is done.

2.3.2 Opertions Carried Out on Needle:

1)Needle Pre-Grinding:

In this work station guide and shaft diameter of needle is grinded on grinding machine. Here the needle comes from the heat treatment shop to grind the pre profile of needle. In this stage the rough grinding operation is perform on the needle.

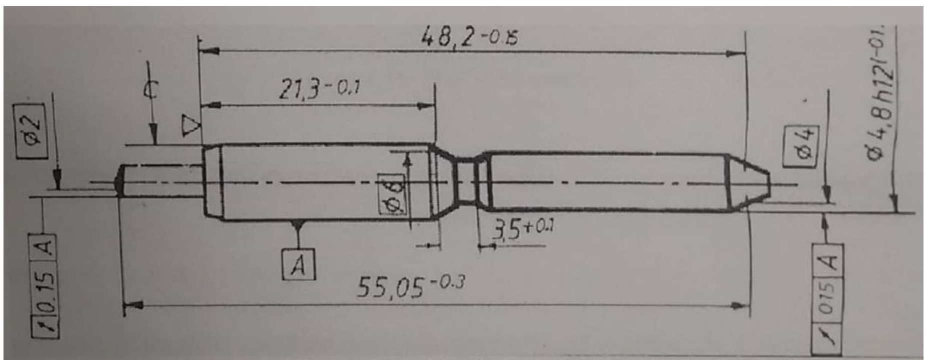


Fig.16:Needle Pre-Grinding

2)Needle Finish Guide and Shaft Grinding:

In this operation needle seat grinded again to increase surface finish and accuracy.this operation carries on Ghiringhelli machine.In this operation operator must check the shaft and guide diameter of the needle.

3)Pre-Grind Seat Angle:

In this stage pre seat angle operation is carried out on the needle with 60 degree angle. Here the operator check whether dressing line patches , damages are on the seat or not if not it taken for machining.

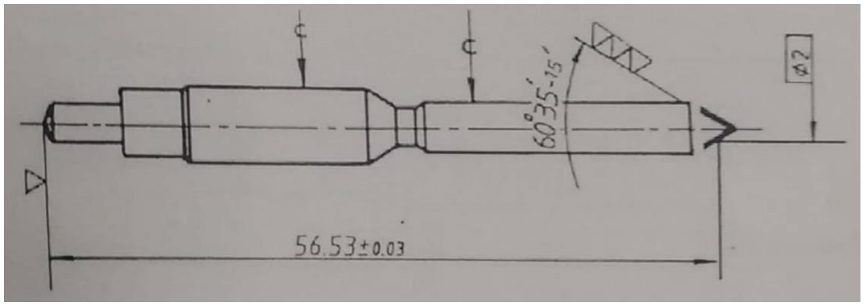


Fig.17:Pre-Grind Seat Angle

4)<u>Finish Grind 45 degree Angle:</u>

In this stage finishing operation is done to achieve the 45 degree angle. It is carried out on special purpose grinding machine (SPM).

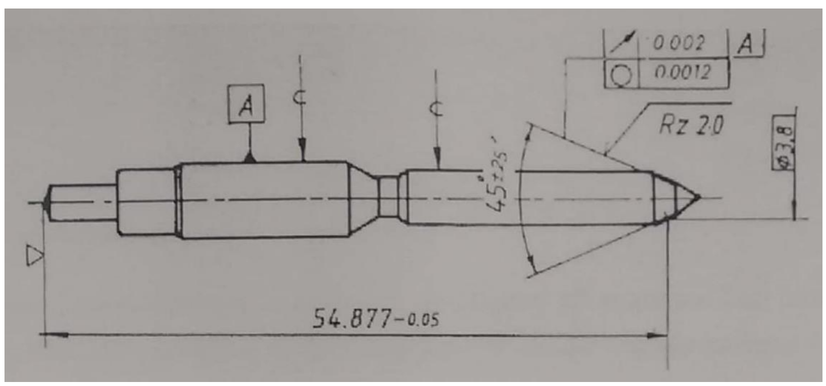


Fig.18:Finish Grind 45 degree angle

5)<u>Finish grind 60 degree Angle:</u>

In this stage finishing operation is done to achieve the 60 degree angle.both rough and finish grinding operation done in this stage.

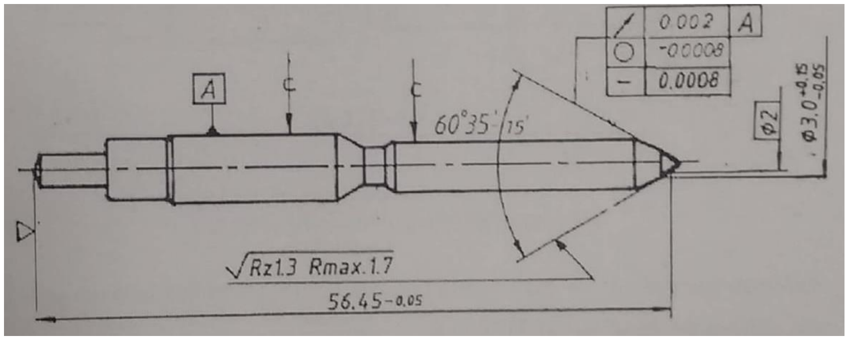


Fig.19:Finish Grind 60 degree Angle

6)<u>Needle Seat Final Visual:</u>

Here the Inspector check whether damage on seat, relief cone, pre stage and no dressing line in the seat. It is carried out under the microscope by the expensive holder.

7)<u>Needle Supermarket:</u>

In this satge type wise labelled trays of needle are placed on the rack to provide input for next operation in DLL assembly line.

8)<u>Needle Guide Lapping:</u>

In this stage lapping operation is carried on the diameter D1 to achieve final finish operation. Here 150 needles are place in cage which is circular with slot provided for placing needle.

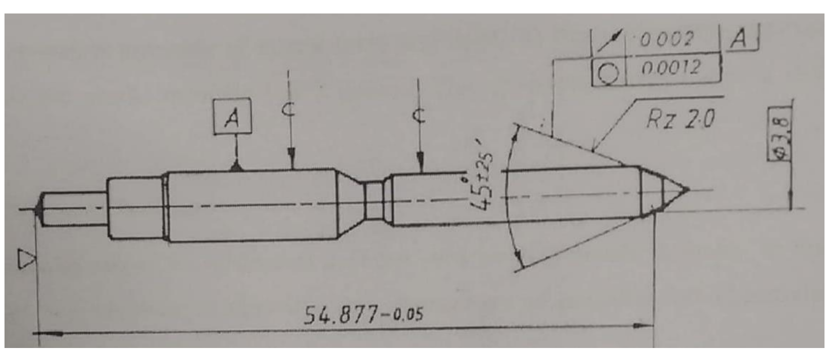


Fig.20:Needle Guide Lapping

One cycle is completed within 2-3 min. Lapping paste is used for the lapping operation and lapping is done with needles in horizontal position. Here per batch 10 Needles are inspected.

9)Stroke Grinding Operation:

In this stage strke grinding operation is carried out on stroke grinding machine. In this operation mandrel is used to check nozzle body dimension and according to thatdimension stroke is grind on the needle. Generally stroke value is kept within 0.22 -0.28 mm.

2.3.3 Assembly of DLL Nozzle:

1) G C Assembly:

In this work station assembly of nozzle body and needle is done. Clearance between nozzle body and needle maintain 1 to 3 micron. This operation carried out by skill worker.

2)High Pressure Cleaning:

This process also carries for removal of dust-dirt particles from nozzle assembly. In this work station high pressure oil is allowed to flow through nozzle assembly and all particles remove before initial inspection.

3)Visual and Repetition Checking:

In visual checking operation scratches,machining dents are check by skill operator. If any one of the above defect is observed on the nozzle assembly then part is rejected.

In repetition checking operation test oil about 100 bar is passed through the nozzle assembly,if the oil is coming out through the spray holes it is in atomized form then the part is accepted otherwise get rejected.

4)Hydraulic Through Flow(HTF) Checking:

In this work station final inspection is carried out. High pressure oil about more than 100 bar pressure allowed to apssing through nozzle assembly. Amount of oil flow through nozzle assembly is measured in cc per 30 seconds.If the hydraulic flow value is within the specific limit then the part go for next operation that is packing.If HTF value is less than specified limit then part go to reprocessing.If value is greater then part is rejected.

2.4 NEEDLE LAPPING ELIMINATION:

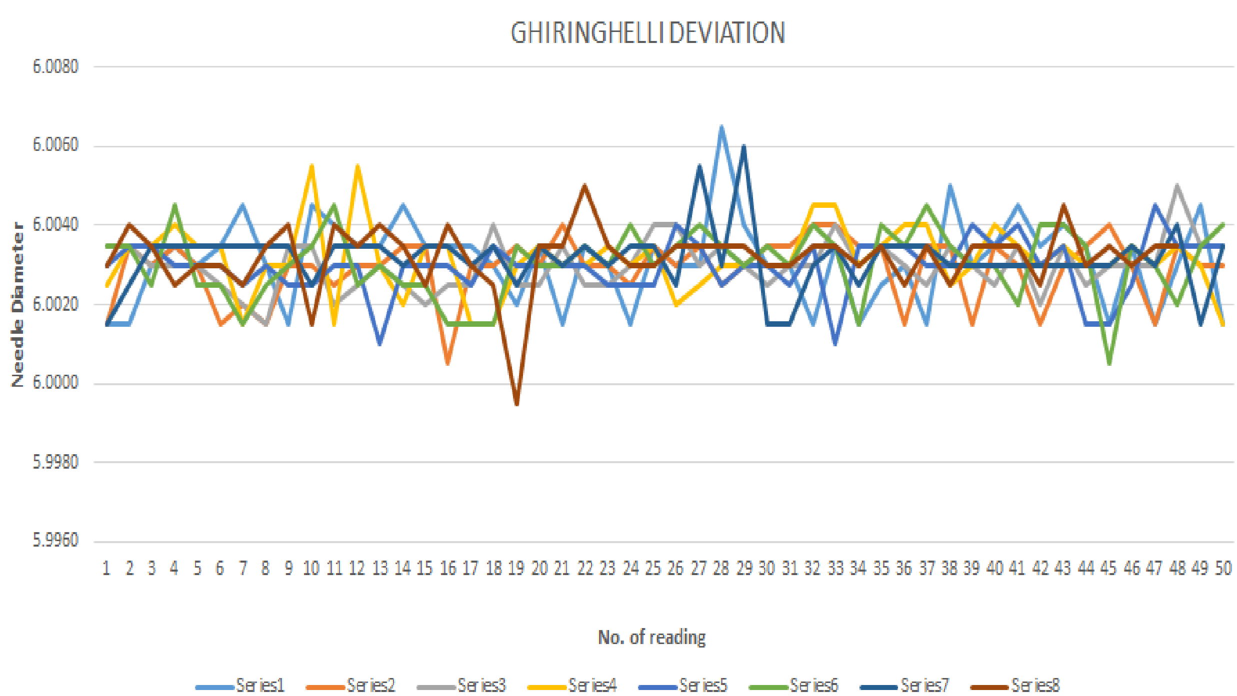
2.4.1What is Lapping?

Lapping is surface finishing process in which negligible amount of material is removed.

2.4.2Why we Carry out lapping?

In finish grind process the guide and shaft diameter in grind.but they are not properly grinded as some deviatios are there on surface.To eliminate these deviations and for good surface finish we carry out lapping.

*In these experiment we took the set of 50 readings and Plot the graph of deviation around its mean value.



Graph 1:Ghiringhelli Deviation

2.4.3Why we proposed to eliminate lapping?

Here are some dis-advantage of Lapping:

1)Lapping paste used in lapping contains hazardous chemicals.

2)It contains mutton swallow.

3)Highly skilled operator required.

3.FINISH GRIND OF NEEDLE:

3.1 Finish Grind of Shaft and Guide Diameter:

In these process Guide and Shaft diameter is reduced.The material removal rate is less as compared to pre-grind process.The needles are feed to the machine in metal box located on the Ghiringhelli machine in proper manner such that pressure pin is towards the machine.The hydraulic cylinder is used to feed the needle between the grinding wheel.After grinding the needle is dropped on the moving conveyor and collect in the tray. These collected needles then put in the magazine manually for seat grinding process

Fig.21:Ghiringhelli(Finish Guide and Shaft Grinding)

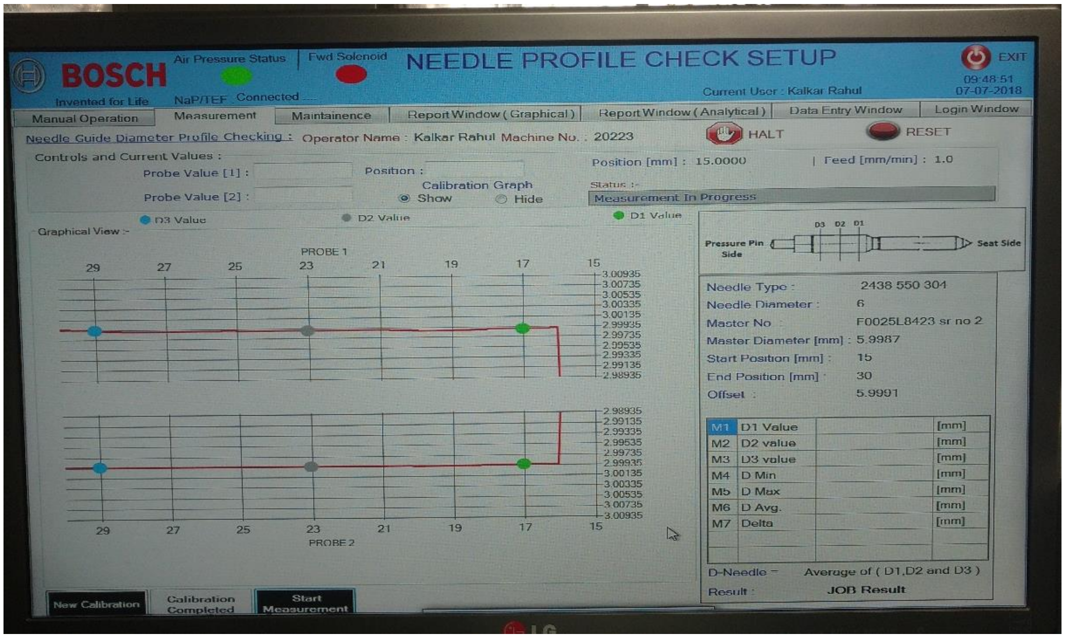
3.1.1Computerized Display:

Electric panel is used to give the command to machine.Digital display is provided to these panel which shows the current situation of machine.

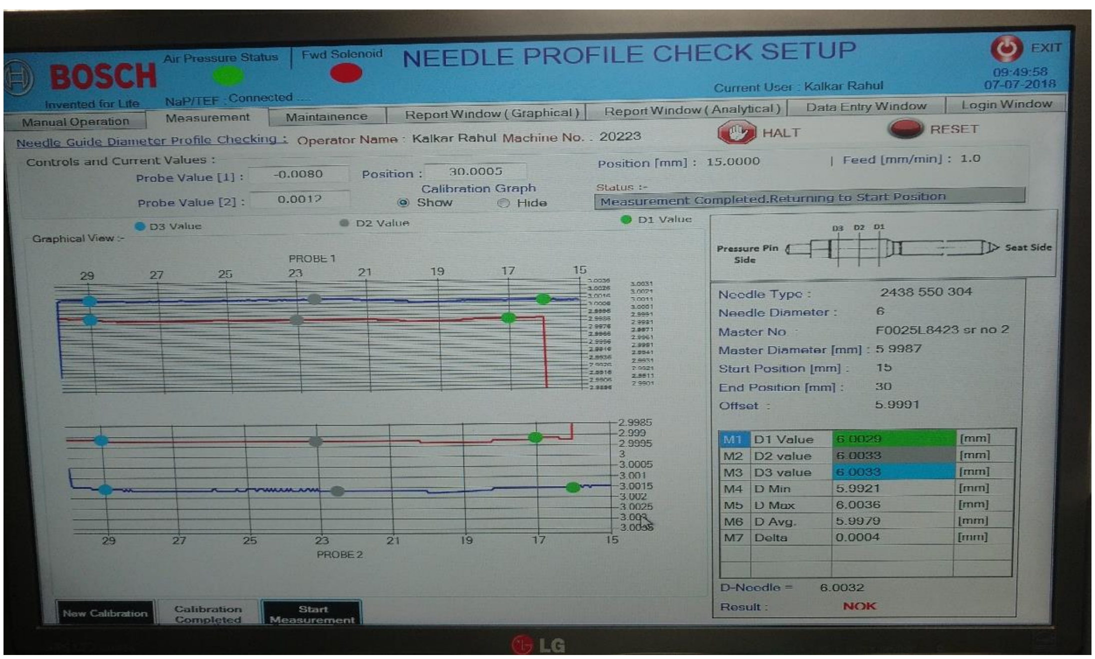
3.1.2 Needle Profile Check Setup:

Using softwere provided by Bosch we can check the deviation of surface with respect to standard gauge.First we have to calliberate the softwere by using standard gauges as shown in figure. Once the calliberation is done we can check the deviation.If the deviation is more than 0.0010 mm then softwere shows the error.

Fig.22:Standard Gauge



Graph 2:Calliberation



Graph 3: Comparison of Standard Gauge with Manufactured Needle

3.1.3 Instrument for Needle profile check setup:

It consist of two contact type of sensors which measures the deviation on the surface.An Inductine proximity sensor is used to detect the presence of needle.

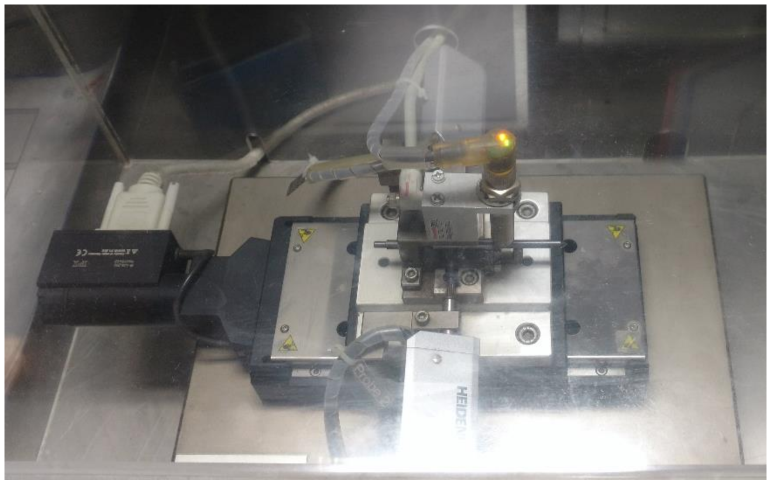


Fig.23:Needle Profile Check Setup

3.2 Pre Grind Seat 45 degree:

In this process seat is grinded to 45 degree.It is carried out on special purpose machine.This angle is called as relief angle.

3.3 Finish Grind Seat :

In this process the seat finishing is carried out.This operation is performed on SPM.

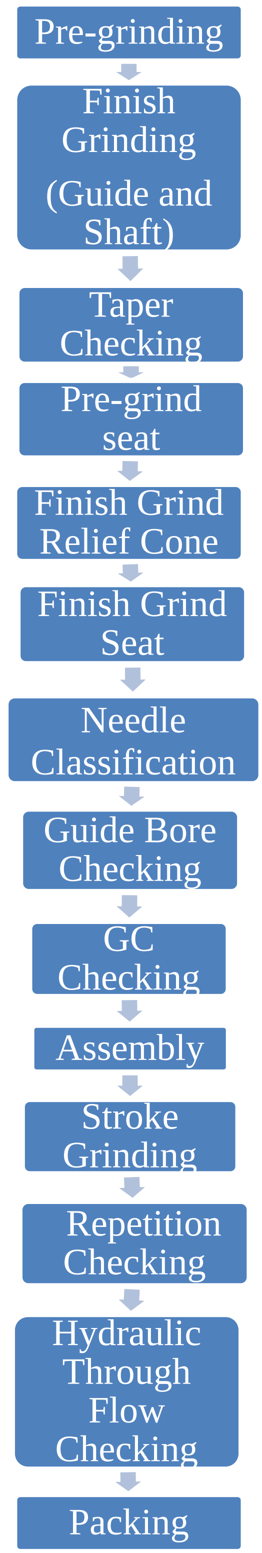
3.4 Finish Grind Seat 60 degree:

On this bench 60 degree angle is provided on the needle seat also called as seat angle.

3.5 Final Visual:

On this stage of operation Inspector check the defects in the needle seat.

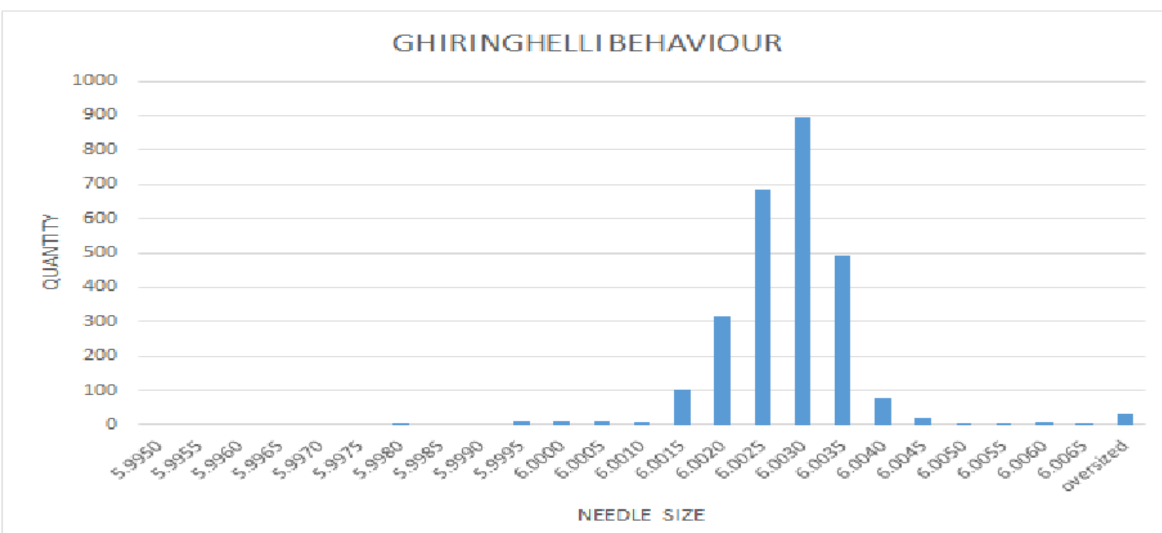
4. Methodology:



4.1 Needle Classification:

In this operation needles are classified accoring to their shaft diameter. Here are some photographs of these instrument.The needles are classified in the group from 5.9950 mm to 6.0045 mm. and some gauges are used to calliberate these machine.

Fig.24:Needle Classification Gauge and Instrument



Graph 4:Needle Classification

4.2 Guide Bore,GC checking and Assembly:

On this stage needle size are indicated as per the guide bore diameter by calculating the clearance and by inserting the needle we determine the GC of the assembly using GC measuring bench.If GC is within the range then further operations are done on this assembly.

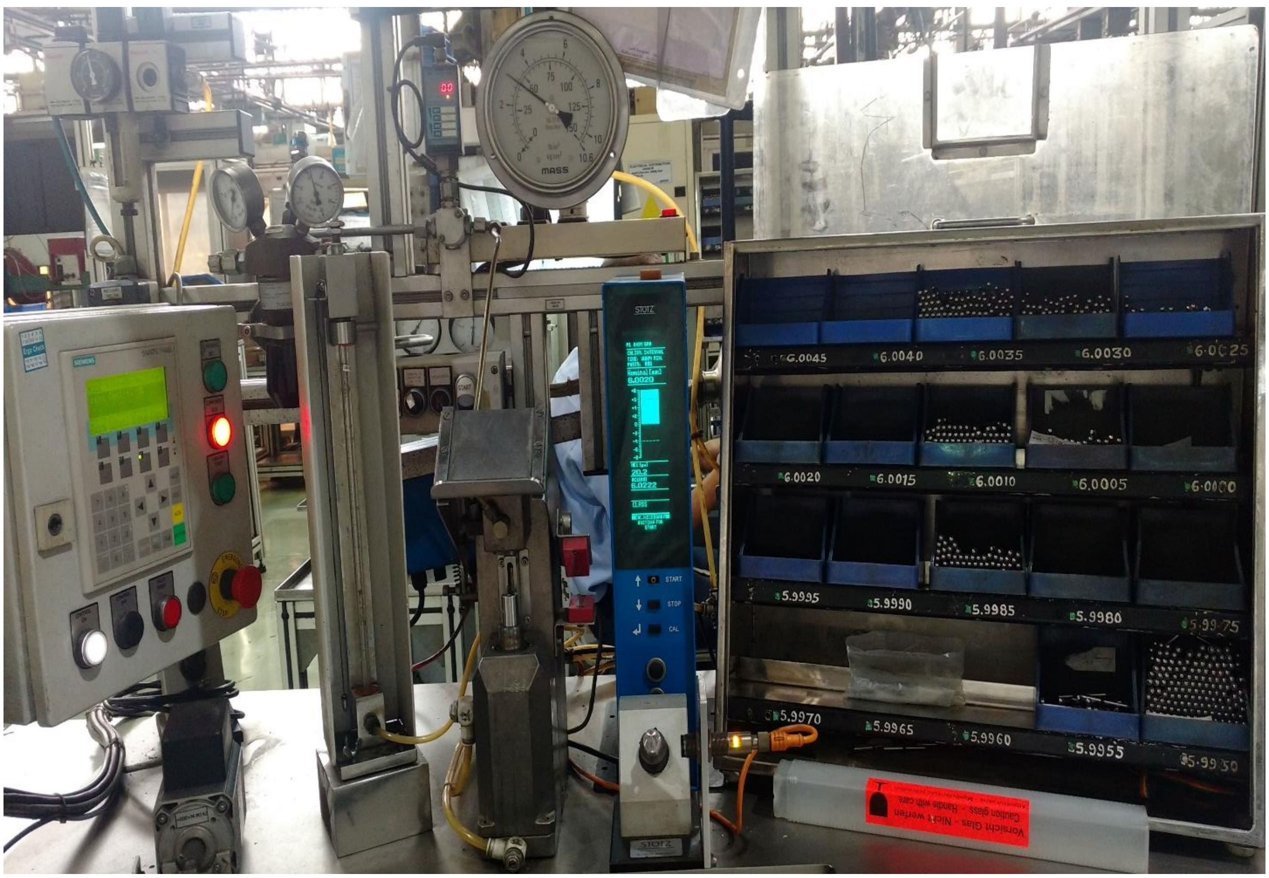


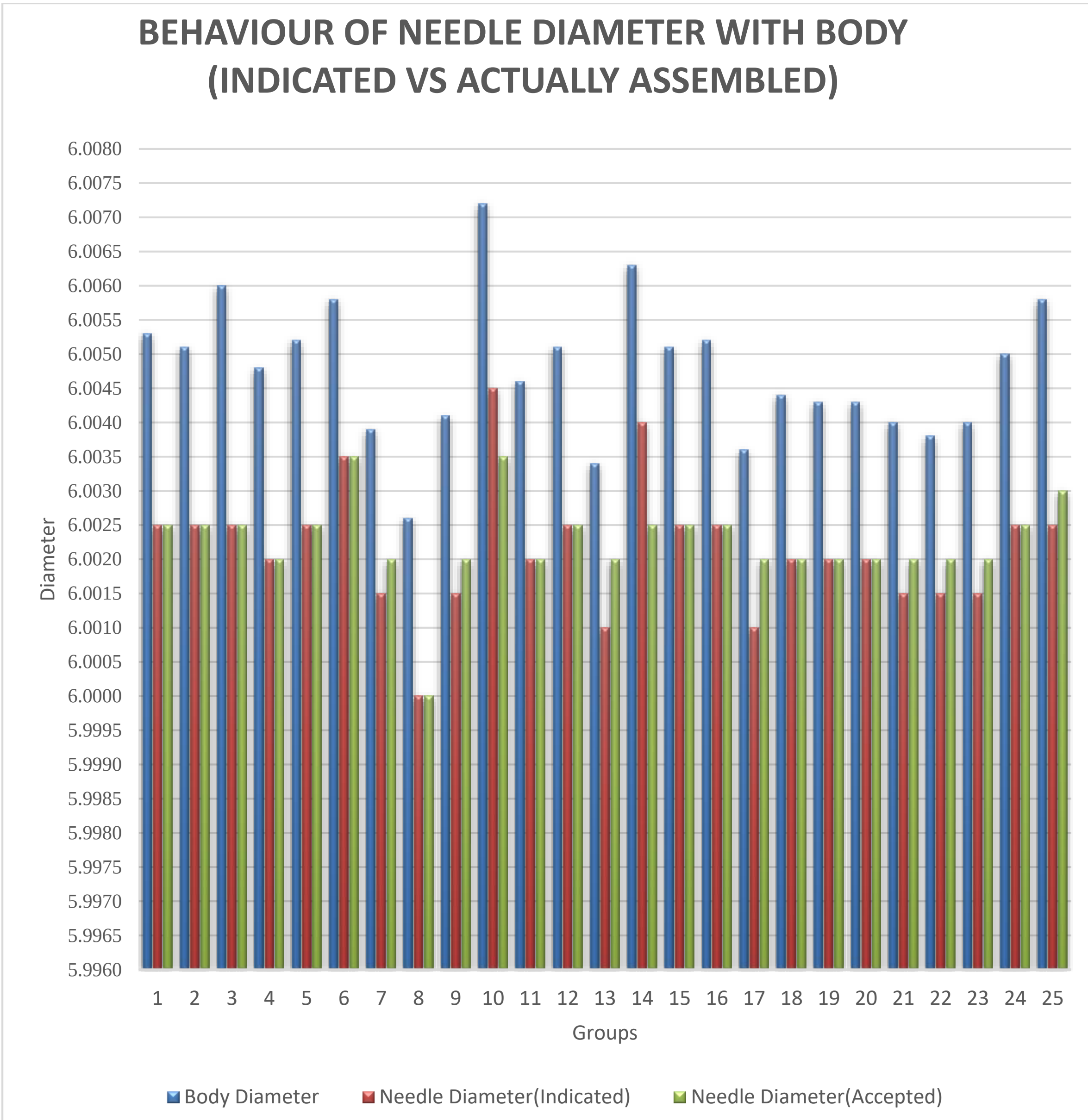
Fig.25:Assembly Bench

As shown in the figure,the blue column is used to measure the bore diameter of body.when internal diameter is shown, one of the group from the needle is indicated as the green light is blinked.By inserting the needle we check the GC(Guide Clearance).

Sr. No.	Body Diameter	Needle Diameter(Indicated)	Needle Diameter(Accepted)
1	6.0053	6.0025	6.0025
2	6.0051	6.0025	6.0025
3	6.0060	6.0025	6.0025
4	6.0048	6.0020	6.0020
5	6.0052	6.0025	6.0025
6	6.0058	6.0035	6.0035
7	6.0039	6.0015	6.0020
8	6.0026	6.0000	6.0000
9	6.0041	6.0015	6.0020
10	6.0072	6.0045	6.0035
11	6.0046	6.0020	6.0020
12	6.0051	6.0025	6.0025
13	6.0034	6.0010	6.0020
14	6.0063	6.0040	6.0025
15	6.0051	6.0025	6.0025
16	6.0052	6.0025	6.0025
17	6.0036	6.0010	6.0020
18	6.0044	6.0020	6.0020
19	6.0043	6.0020	6.0020
20	6.0043	6.0020	6.0020
21	6.0040	6.0015	6.0020
22	6.0038	6.0015	6.0020
23	6.0040	6.0015	6.0020
24	6.0050	6.0025	6.0025
25	6.0058	6.0025	6.0030

Table 2:Behaviour of Needle Diameter with Body

This are the some reading we have taken during the assembly and below graphical representation of this reading.Accuracy of the machine is around 60%.



Graph 5:Behaviour of Bore Diameter with Needle Diameter

4.3 Stroke and Repetition:

After the assembly we perform stroke and repetition

5. Result:

The Following results are obtained after the stroke and repetition:

Sr. No	Date	Quantity Assembled	Stroke Grinding	Repetition Checking	Ok Parts	Percentage	Bad parts
1	23/06/2018	43	2	3	38	88.37%	5
2	25/06/2018	50	0	2	48	96%	2
3	26/06/2018	100	0	0	100	100%	0
4	27/06/2018	50	0	0	50	100%	0
5	28/06/2018	150	0	0	150	100%	0
6	29/06/2018	130	0	4	126	97%	4
7	30/06/2018	100	0	0	100	100%	0
8	2/7/2018	350	0	2	348	99%	2
9	3/7/2018	180	0	5	175	97%	5
10	4/7/2018	200	0	0	200	100%	0
11	5/7/2018	100	0	0	100	100%	0

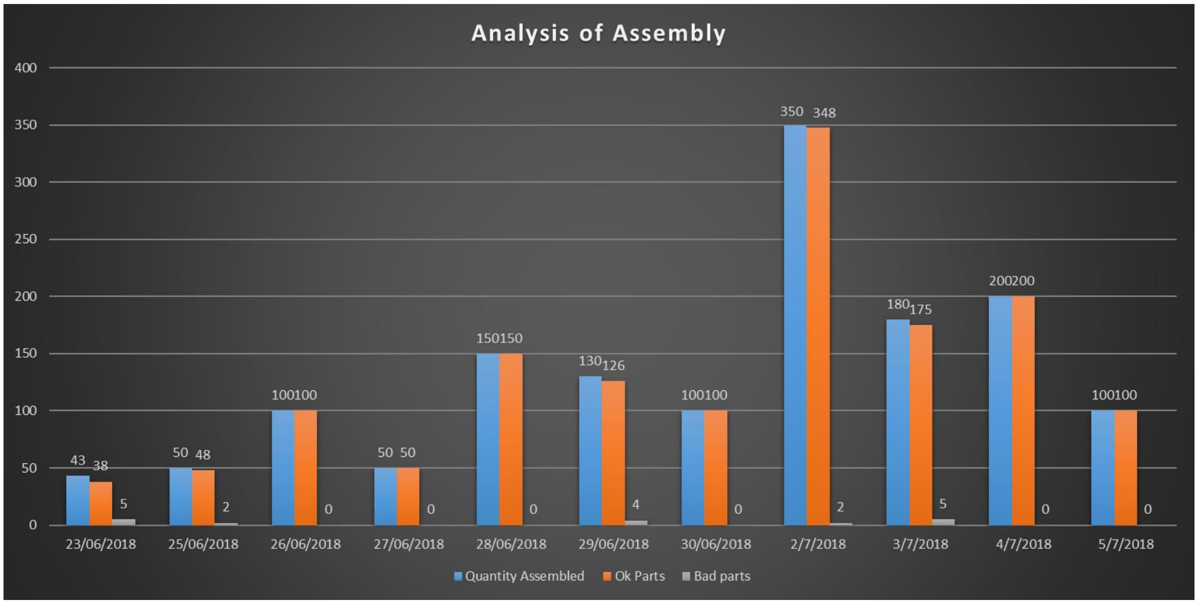
Table 3:Analysis of Assembly

Total Assembled Parts:1450

Total Bad Parts:18

% of Bad Parts:1.24

Hence Accuracy of these method is about 98.5%.



Graph 6:Analysis of Assembly

6.Conclusion:

Sr. No.	Date	Assembled Parts	Time Required
1	29/06/2018	50	24:46:69
2	30/06/2018	50	14:56:08
3	2/7/2018	50	13:09:08
4	3/7/2018	50	14:10:12
5	4/7/2018	50	15:46:37
6	5/7/2018	50	14:49:36

Table 4 :Time Analysis

From table, time required to assembled 50 parts is of average14 minutes.

Hence in one Ship that is in 450 minutes we can assembled (450/14)*50=1163 parts.

Hence this method is more benefetial than Lapping.