Modeling And Manufacturing Of Air Collet Closer

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Abstract:
The main aim of any industry is to increase their production rate by satisfying customers. The manufacturing process is to convert raw materials, components, or parts into finished goods that meet a customer's expectations or specifications. Some parts require dimensional accuracy and some parts require high surface finish depends on the requirement part should be manufactured and this demands for manufacturing components on CNC machines.

This front mounted 5C air operated collet chuck may be used for rotary table and single station applications. The rotary gland remains in place while the air cylinder rotates. This unit comes complete with air valve hoses, fittings and a collet wrench. Note: for use on a DMNC rotary table, a collet chuck adapter plate is required.

The term "high torque" refers to an air mechanical collet closer which uses an air cylinder and mechanical advantage to collapse the collet. This cylinder uses air pressure to move the piston, which actuates a series of balls and incline planes to increase the force of air pressure against the collet sleeve. The air against the piston in this collet closer does not directly hold the part, but compresses the balls between the inclined planes. The movement of the balls between the inclined planes lifts the collet sleeve, collapsing the collet. This increases the holding power to well above that attained by simple air pressure. The diameter of the piston can be considerably smaller while achieving the same clamping force of a simple air cylinder with a much larger piston. The part to be machined is also held firmly against the base of the fixture and not on a cushion of air.

In this project 3D modeling of Air collet closer was explained by using Unigraphics NX CAD and manufacturing the Air collet closer by using NX CAM and generation of NC program for manufacturing of air collet closer were explained clearly.

Keywords:- CAD, Air Collet Closer, 3D Modelling.

INTRODUCTION

1.0 Introduction about Air collet closer:

The 5C pneumatic collet closer enables 5C collets to be used on any manual lathe or work head. This new model, has been designed for heavy use under the most demanding manufacturing conditions. Fast opening/closing action makes the Royal pneumatic collet closer a great choice for high production applications. Closer is very easy to actuate, resulting in minimal worker fatigue and maximum productivity. The air cylinder incorporates a large diameter piston, providing strong grip force on the work piece. Unlike other collet closers, there are no exposed rotating parts on the outboard side of the machine. Pneumatic collet closer assembly includes air cylinder, custom-machined rear end spindle adapter, drawtube, and cam-lock collet adapter. Air controls sold separately.

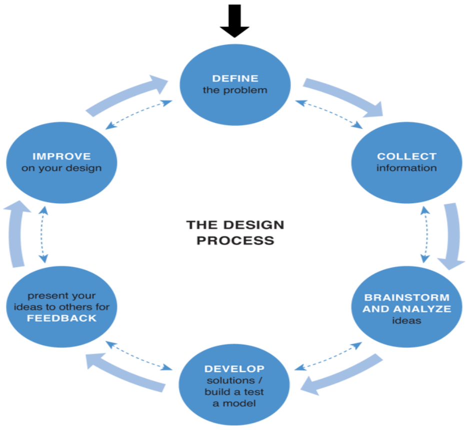
Air Collet Chuck works with Hainbuch style clamping heads, providing a high accuracy 0.015mm and very large chucking force. No extra rotary cylinder is needed. air collet chuck is designed for use in both rotary and stationary applications, and will mount to any American Standard, Cam lock, Flat Face style Spindles or Rotary Tables with the use of a Dunham spindle mounting adapter. Internal stops eliminate length changes due to drawback. Foot or hand valves free hands for efficient part handling.

Our manual collet chucks are offered in four types: 5C, 16C, 3J & 22J. They are designed to be used either stand alone, in multiples or for use on an indexer or rotary table. The collet chucks feature "dead length" holding (with zero part movement), and no "pull back." The collet is closed by turning the cam approximately 90°, using the wrench provided. As the cam rotates, the collet sleeve is lifted closing the Collet. The collet remains stationary so that linear tolerances can be maintained. Six mounting holes are provided. This high torque stationary 5C air collet closer is designed for use on milling, drilling and tapping operations. It can be utilized as single units, or mounted to a plate for multiple operations.

1.1 Objectives of project:

The main objectives of this project are:

1. Modeling of air collet using Unigraphics NX CAD software.
2. Manufacturing of air collet using NX CAM.
3. Generate NC program of manufacturing air collet.



LITERATURE REVIEW

Dunham Tool manufactures high quality air collet closers. The precision air collet closer and collet actuator are used with lathes, grinders, and CNC rotary tables, and are rated for up to 6000 RPM maximum. **Dunham** lathe collet closers are designed to increase production and reduce operator fatigue on any lathe by activating collet closer.

The **Royal** air collet closer enables collets to be used on any manual lathe or work head. This new model, based upon Royal's 65 years of collet closer experience, has been designed for heavy use under the most demanding manufacturing conditions. Fast opening/closing action makes the Royal pneumatic collet closer a great choice for high production applications.

MODELING OF AIR COLLET CLOSER

Input for air collet closer

A 2D drawing is used to design a 3D model for our component using Unigraphics NX 7.5 CAD software.

Below shows the 2D drawings of the air collet with all the required dimensions representations the suits the best for manufacturing the component without any errors.

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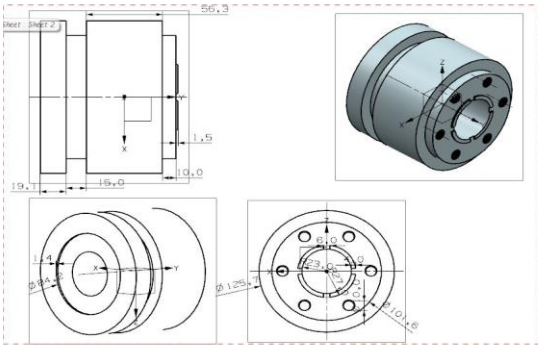


Fig: 2D drawing of air collet

3.2 DEVELOPMENT OF 3D MODELING

Below is the sketch required to obtain the 3D model of the air collet from the above 2D drawing input.

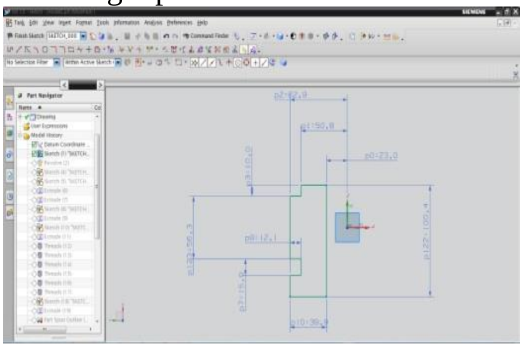


Fig: 2d sketch of air collet closer

Below image shows 2d sketch of air collet closer

Procedure to draw the above sketch

Insert → sketch in task environment → select plane → ok.

insert → curve → profile.

Below image shows revolving of air collet closer

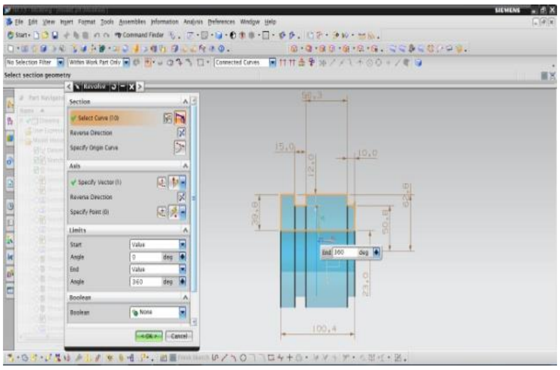


Fig: Revolving of air collet closer

Revolve option

Insert → design features → revolve.

Select curve → specify vector → Boolean operation (None) → ok.

Below image shows sketch on face of air collet closer

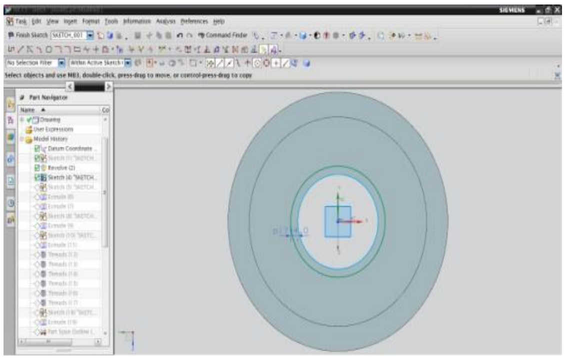


Fig: Sketch on face of air collet closer

SKETCH

Procedure to draw the above sketch

Insert → sketch in task environment → select plane → ok.

Insert → curve → profile.

Below image shows extrude of above sketch on air collect closer

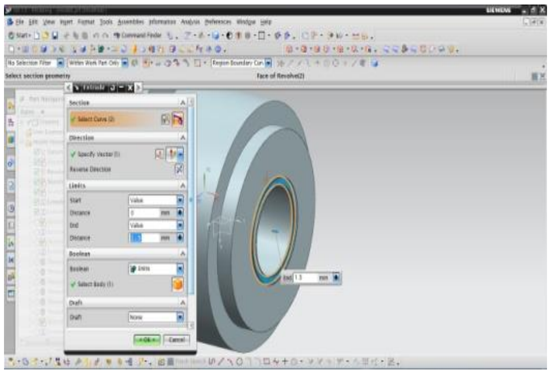


Fig: Extrude of above sketch on air collet closer

EXTRUDE

- Extrude command is used to create a body by sweeping a 2D or 3D section of curves, Edges, sketches in a specified Direction.

Insert → design features → extrude.

Select curve → specify vector → Boolean operation (unite) ok.

Insert → sketch in task environment → select plane → ok.

Insert → curve → profile.

Below image shows extrude of above sketch on face of air collet closer

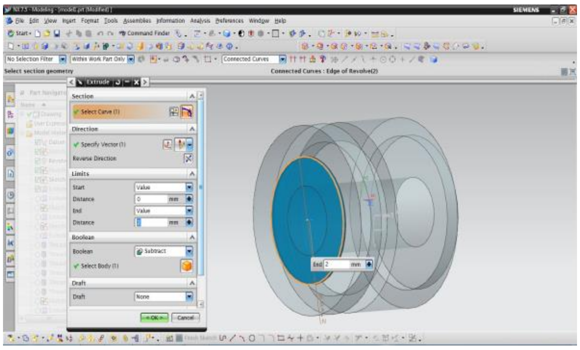


Fig: Extrude of above sketch on face of air collet closer

EXTRUDE

- Extrude command is used to create a body by sweeping a 2D or 3D section of curves, Edges, sketches in a specified Direction.

Insert → design features → extrude.

Select curve → specify vector → Boolean operation (subtract) ok.

Below image shows sketch on air collet closer

Below image shows sketch on face of air collet closer

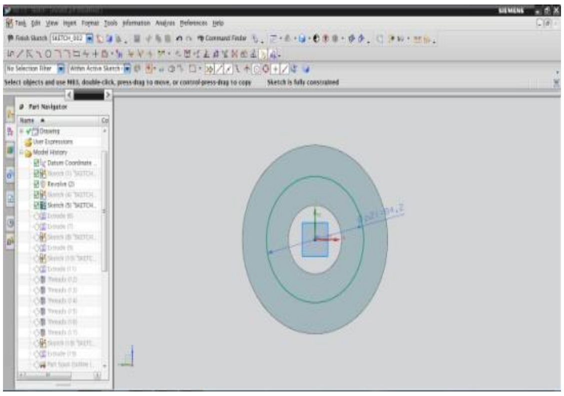


Fig: Sketch on face of air collet closer

SKETCH

Procedure to draw the above sketch

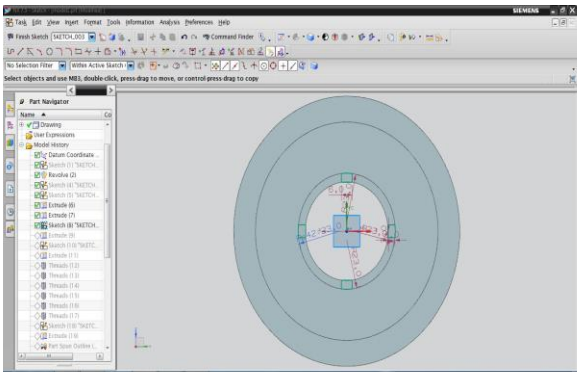


Fig: Sketch on air collet closer

Insert → sketch in task environment → select plane → ok.

Insert → curve → profile.

Below image shows subtract of above sketch on air collet closer

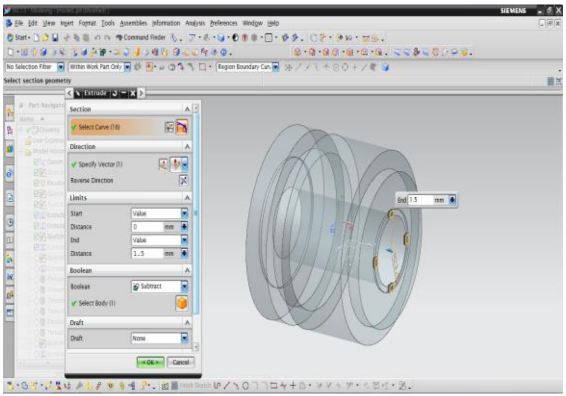


Fig: Subtract of above sketch on air collet closer

Insert → design features → extrude.

Select curve → specify vector → Boolean operation (subtract) → ok.

Below image shows sketch on face of air collet

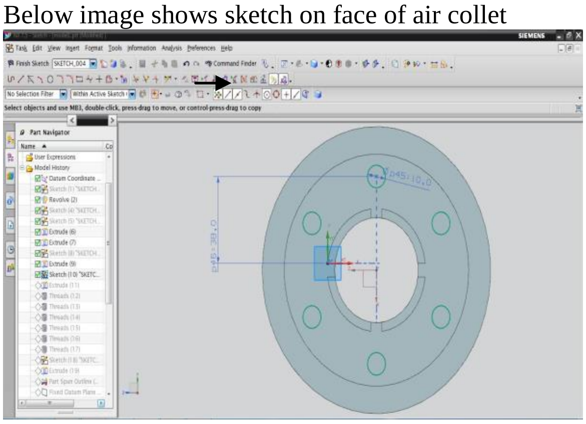


Fig: Sketch on face of air collet

Insert → sketch in task environment → select plane → ok.

Insert → curve → profile.

Below image shows subtract of above sketch on air collet

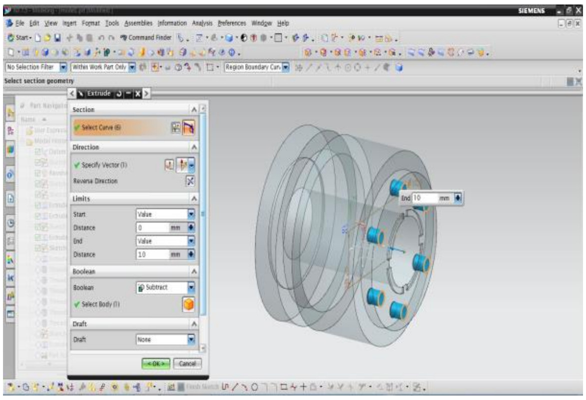


Fig: Subtract of above sketch on air collet

Insert → design features → extrude.

Select curve → specify vector → Boolean operation (subtract) → ok.

Below image shows creation of threads in existing holes on air collet closer

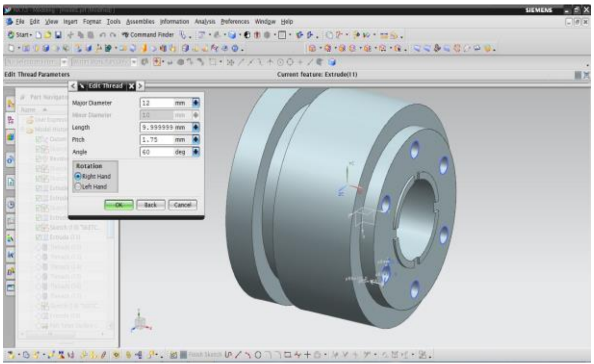


Fig: Creation of threads in existing holes on air collet closer

Below image shows final 3D model of air collet

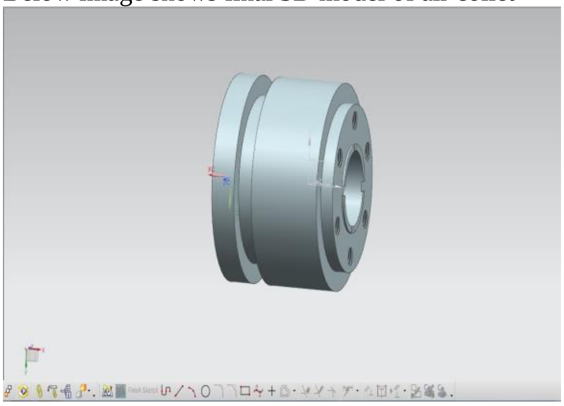


Fig: Final 3D model of air collet

COMPUTER AIDED MANUFACTURING OF AIR COLLET CLOSER

The generation of tool path on 3D model of air collet closer will be done using NX-CAM software. By generating tool path NC program will be generated. This NC program is given input to the CNC machine to run operations.

The main objective of the project is to obtain to reduce machining errors and collision of tools and rotary table by developing virtual kit.

Methodology of manufacturing Steering knuckle

- Identify suitable machine.
- Selecting suitable tools for manufacturing Steering knuckle component.
- Selection of fixture.
- Listing down the Sequence of operation performed on Steering knuckle component.
  - Generating tool path at specified cutting speed.
- Retrieving virtual machine in NX-CAM and simulating machine.
- Verification of machining process in virtual machine simulation.

Generating NC program using NX-CAM software.

4.1 Selection of machine:

MORI SEIKI 4-AXIS CNC turning machine is used for machining missile piston. MORI SEIKI offers the industry's best lineup of high-performance lathes with better precision and rigidity, greater multi-axis compatibility and smaller footprints.

High rigidity with Integrated Turning Spindle. Spindle is directly coupled with motor. Rigid Turret with BIM (Built In Motor) Technology. Directly coupled Integrated driven tools. Is a patent technology. Y-axis machining, Up to 100mm (+/- 50). 4-axes simultaneous machining, C-axis with 360 deg and Y-axis, Machine accuracies, Positional Accuracy +/- 0.005mm, Repeatability +/- 0.003mm. In 4-axis turning machine, Axis represents as work piece rotation and spindle movement in x, y, z directions.

Fig: 4-axis CNC MORI SIEKI turning machine

4.2 SELECTION OF TOOLS

Selection of tools plays an important role in manufacturing any component. Proper tools must be selected otherwise in manufacturing process improper tools results in damage of work piece or damage to the tools, tool holders. Suitable tools for manufacturing missile piston are listed below

OD_80_L facing

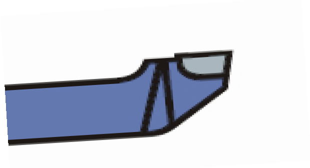
Facing in the context of turning work involves moving the cutting tool at right angles to the axis of rotation of the rotating work piece. This can be performed by the operation of the cross-slide, if one is fitted, as distinct from the longitudinal feed (turning). It is frequently the first operation performed in the production of the work piece

OD_80_L rough

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

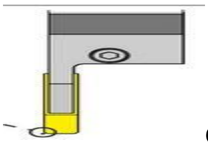
OD_55_L finish

Finish tool remove the left over stock after roughing process. It is the last process which gives surface finish.

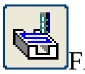


ID_80_L rough

Grooving tool remove the stock on v-shape of material.



Groove_OD



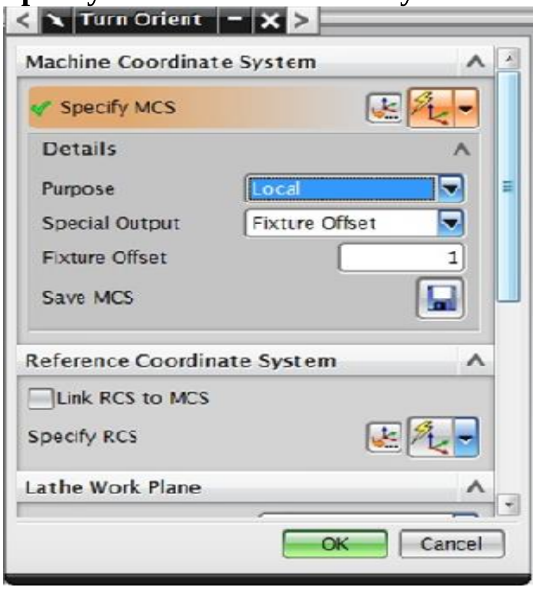
FACE_MILLING tool

FACE_MILLING is the main Face Milling operation subtype. A milling cutter that cuts metal with its face. Face milling creates large flat surfaces.

SEQUENCE OF OPERATIONS PERFORMED ON AIR COLLET CLOSER

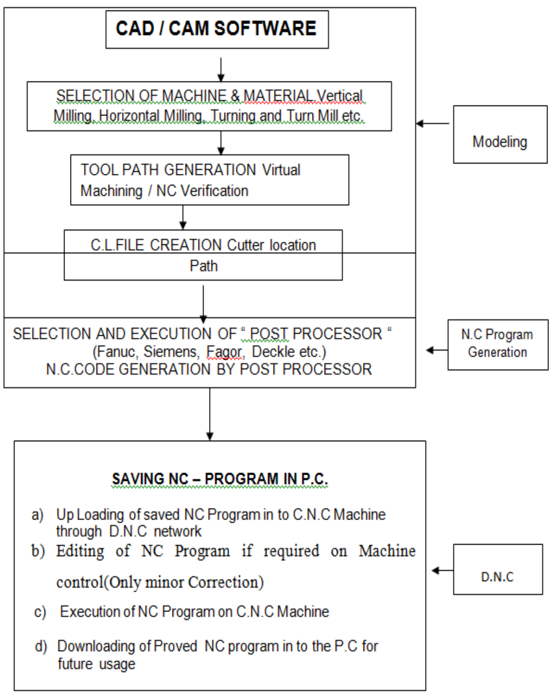
TURNING OPERATIONS
Face_Turn_OD
Face_Turn_OD_1
Rough_Turn_OD
Centerline_Drilling
Face_Turn_OD_2
Groove_OD
Rough_BORE_ID
MILLING OPERATIONS
Face_Milling_Area
Mill_Drilling
Thread_Milling

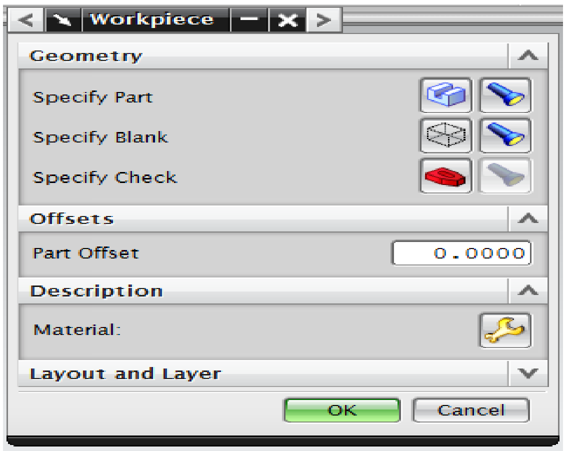
Specify machine coordinate system



Specify part and blank

Part: The final component to be obtained
Blank: Initial raw material to be machined





4.6 Manufacturing process planning

Below image shows blank and part of air collet closer

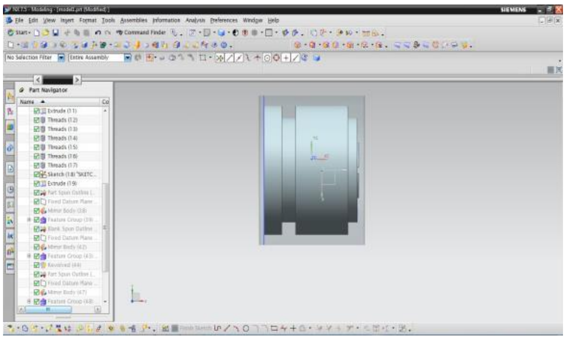


Fig: Blank and part of air collet closer

Below image shows coordinate system given to blank

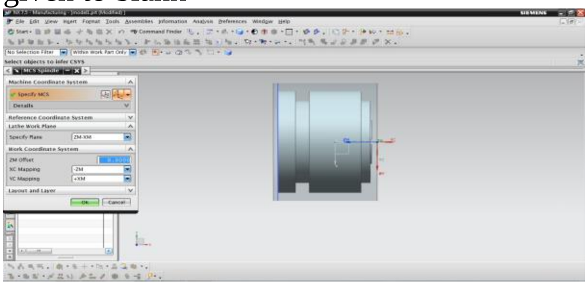


Fig: Coordinate system given to blank

Below image shows selection of blank and part for turning operation

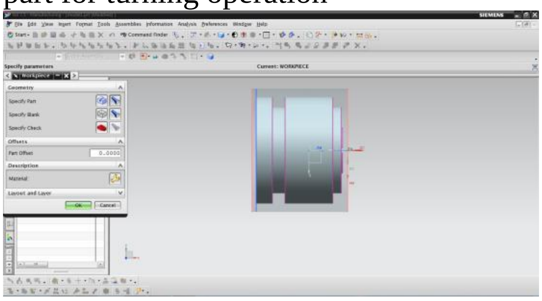


Fig: Selection of blank and part for turning operation

Below image shows generation of spun for turning operation

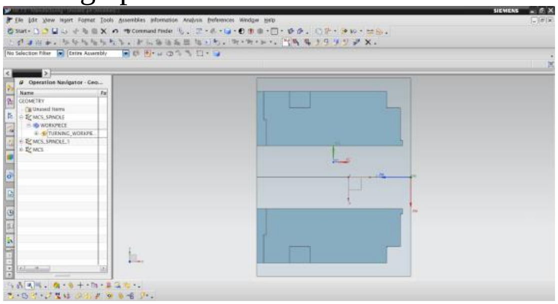


Fig: Generation of spun for turning operation

Below image shows given outer avoidance for turning operation

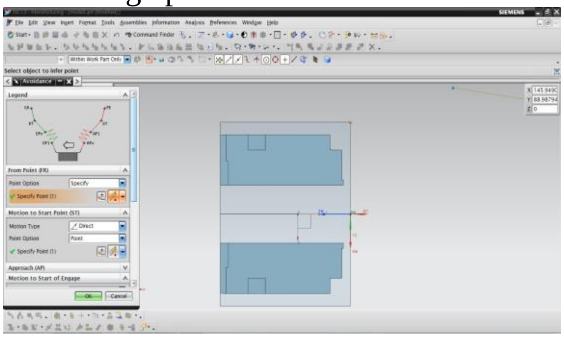


Fig: Outer avoidance for turning operation

Below image shows given outer containment for turning operation

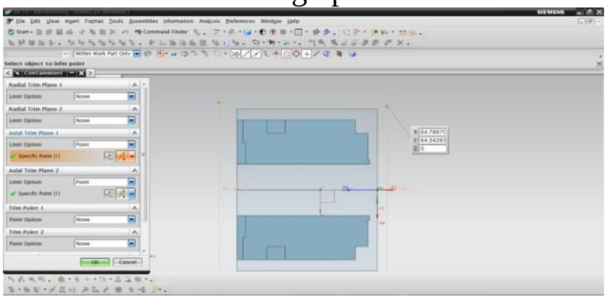


Fig: Outer containment for turning operation

Below image shows tool path visualization of facing operation

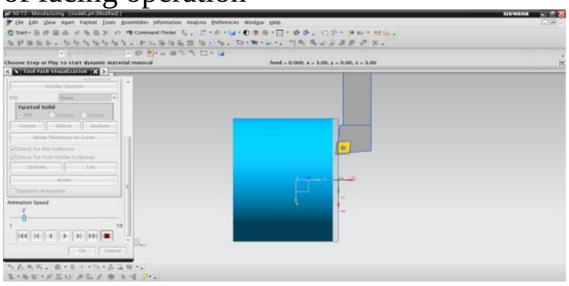


Fig: Tool path visualization of facing operation

Below image shows tool path visualization of facing operation

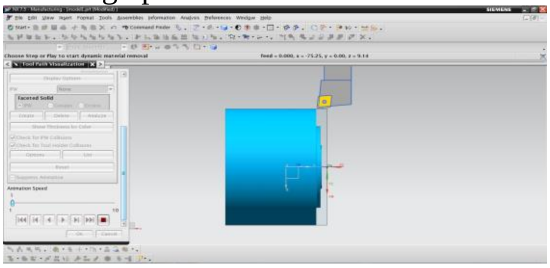


Fig: Tool path visualization of facing operation

Below image shows tool path visualization of roughing operation

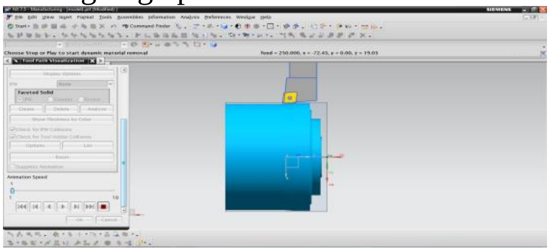


Fig: Tool path visualization of roughing operation

Below image shows given inner avoidance for turning operation

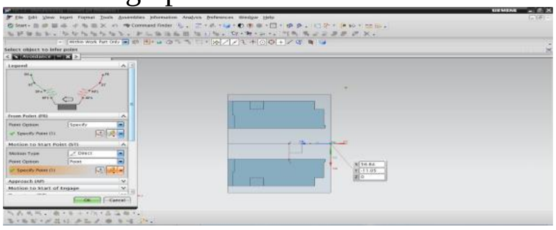


Fig: Inner avoidance for turning operation

Below image shows given inner containment for turning operation

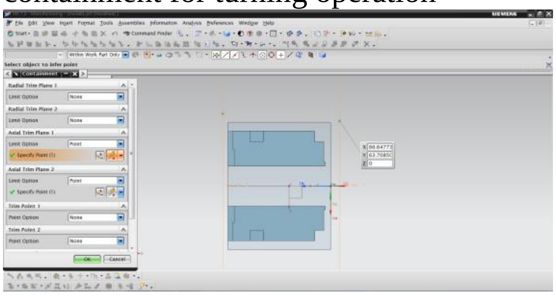


Fig: Inner containment for turning operation

Below image shows tool path visualization of drilling operation

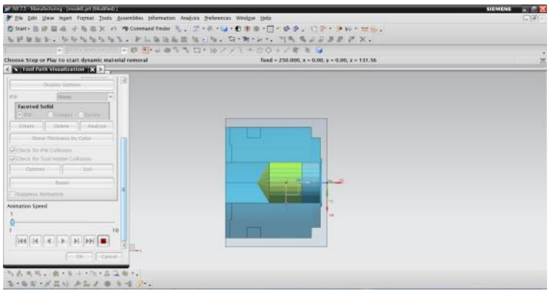


Fig: Tool path visualization of drilling operation

Below image shows coordinate system given to remaining blank

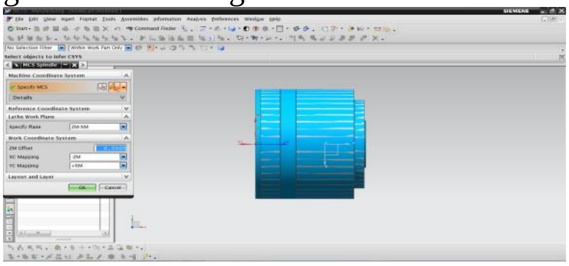


Fig: Coordinate system given to remaining blank

Below image shows selection of blank and part for turning operation

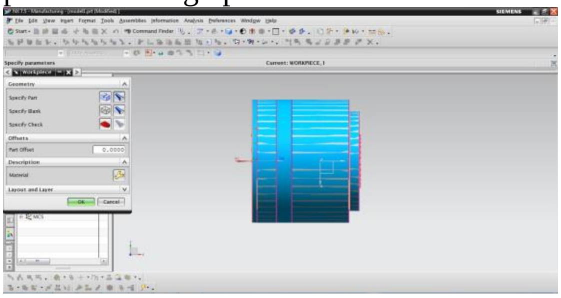


Fig: Selection of blank and part for turning operation

Below image shows generation of spun for turning operation

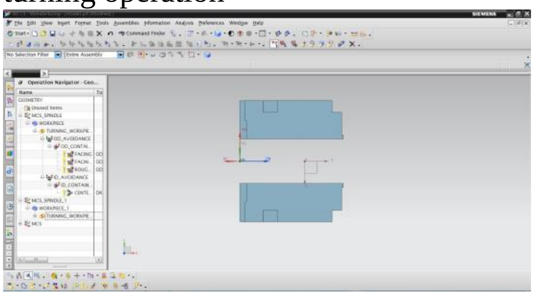


Fig: Generation of spun for turning operation

Below image shows given outer avoidance for turning operation

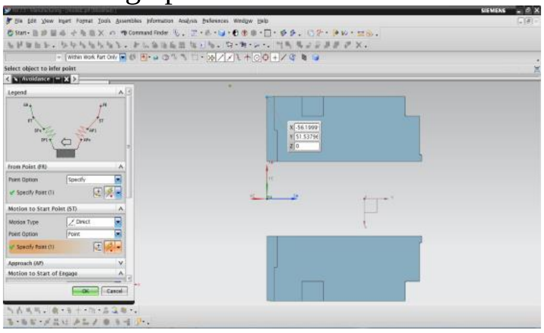


Fig: Outer avoidance for turning operation

Below image shows given outer containment for turning operation

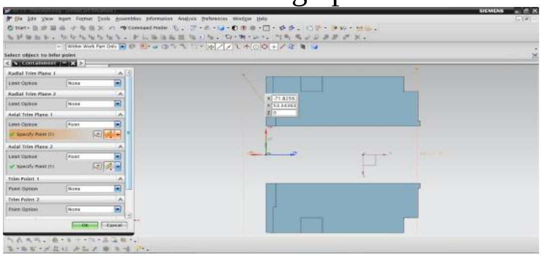


Fig: Outer containment for turning operation

Below image shows tool path visualization for facing operation

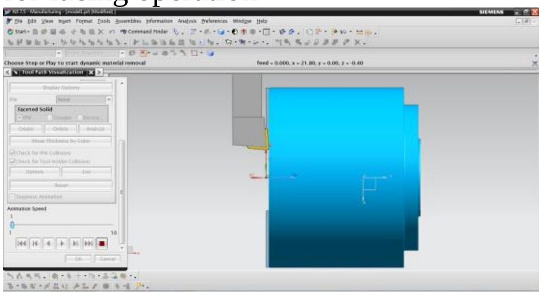


Fig: Tool path visualization for facing operation

Below image shows tool path verification for grooving operation

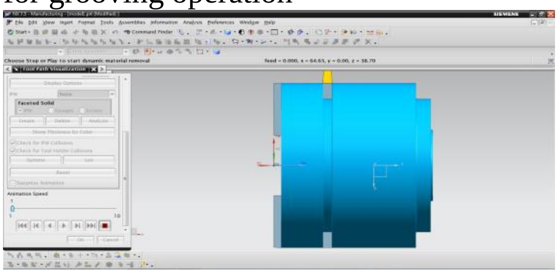


Fig: Tool path verification for grooving operation

Below image shows given inner avoidance for turning operation

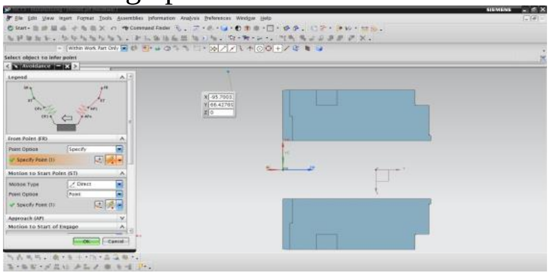


Fig: Inner avoidance for turning operation

Below image shows given inner containment for turning operation

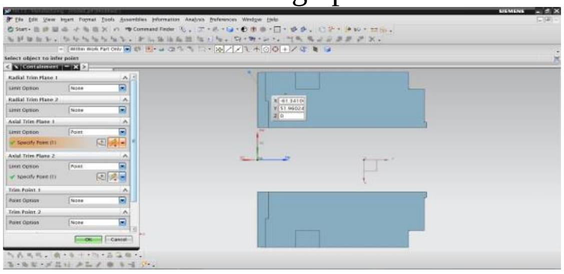


Fig: Inner containment for turning operation

Below image shows tool path visualization of inner roughing operation

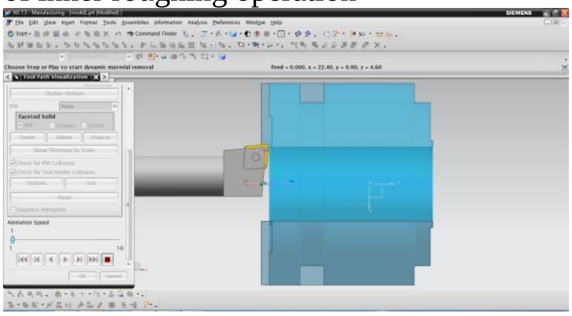


Fig: Tool path visualization of inner roughing operation

Below image shows coordinate system given to remaining blank for milling operation

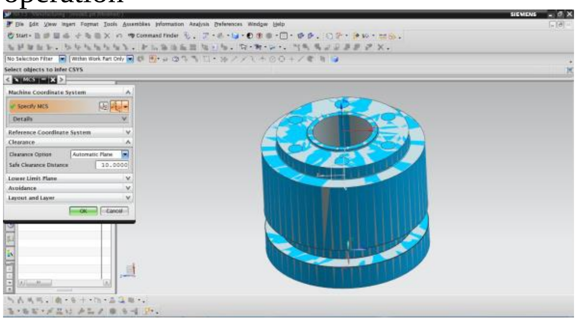


Fig: Coordinate system given to remaining blank for milling operation

Below image shows selection of blank and part for milling operation

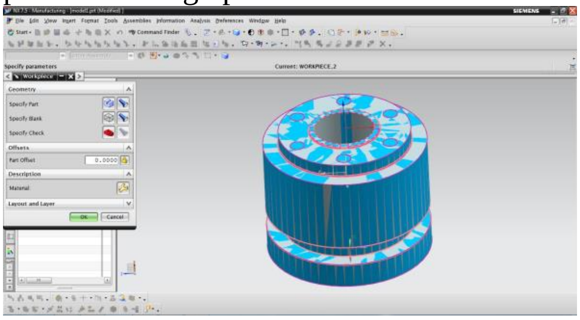


Fig: Selection of blank and part for milling operation

Below image shows tool path visualization of face milling operation

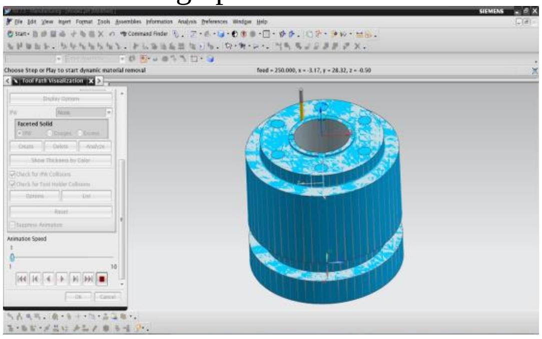


Fig: Tool path visualization of face milling operation

Below image shows tool path visualization of drilling operation

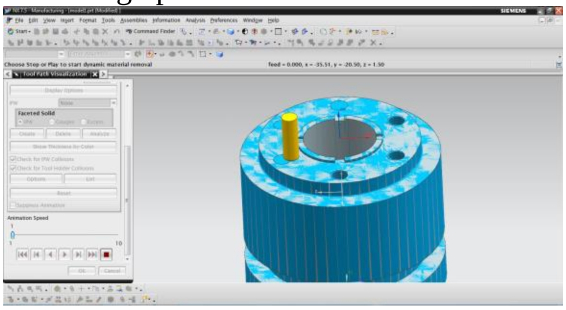


Fig: Tool path visualization of drilling operation

4.4 FLOW CHART FOR GENERATION OF NC PART PROGRAMS

OPERATION LIST BY PROGRAM

PROGRAM NAME: TURNING

TOOL NAME	DESCRIPTION	NOSE RAD	TOOL ORIENT	ADJ REG
OD_80_L	Turning Tool-Standard	0.3000	5.0025	0
OD_GROOVE_L	Grooving Tool-Standard	0.3000	90.0456	0
OD_55_L	Turning Tool-Standard	0.3000	17.5089	0
ID_80_L	Turning Tool-Standard	0.3000	275.1395	0
ID_GROOVE_L	Grooving Tool-Standard	0.3000	270.1369	0

4.8 CONVERT TO NC CODE

Using the post processor we have to convert CL file data into machine specified NC part program

1. In the Project Manager, select the first operation on the Operations page, then hold down the Shift key and select the last operation. All the cutting operations are selected.
2. Press the right mouse button and select NC Code from the menu.
3. Select a Machine Format file from the pull down list (3-Axis/5-Axis).
4. Select Apply.

RESULTS

RESULTS:

1. 3D model of air collet closer is done using NX-CAD software by considering tolerances given in 2D input.
2. Generated 3D model is drafted and cross checked with 2D inputs for verification.
3. Tool path is generated on 3D model of air collet closer using NX-CAM software
4. NC program is generated for air collet closer component and this program is given to 4-axis TURN-MILL CNC machine through DNC line

NC PROGRAM

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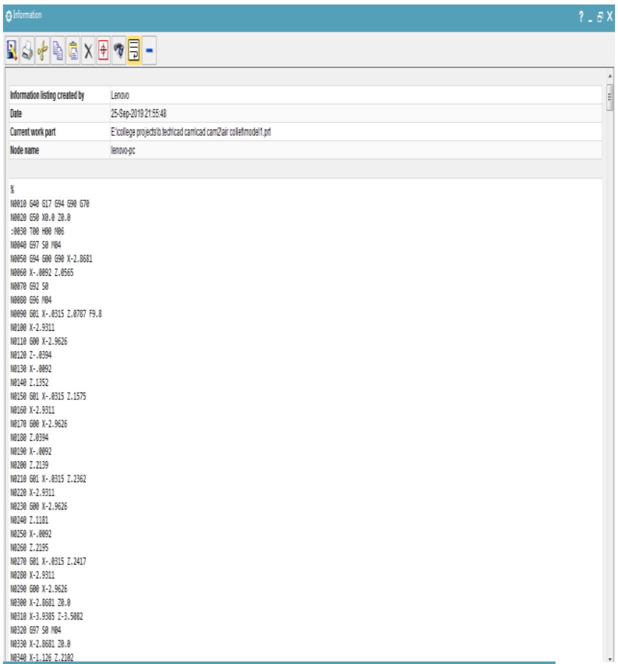

Information listing created by	Lenovo
Date	25-Sep-2019 21:55:48
Current work part	E:\college projects\b.tech\cad cam\cad cam2\air collet\model1.prt
Node name	lenovo-pc

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N0020 G50 X0.0 Z0.0
:0030 T00 H00 M06
N0040 G97 S0 M04
N0050 G94 G00 G90 X-2.8681
N0060 X-.0092 Z.0565
N0070 G92 S0
N0080 G96 M04
N0090 G01 X-.0315 Z.0787 F9.8
N0100 X-2.9311
N0110 G00 X-2.9626
N0120 Z-.0394
N0130 X-.0092
N0140 Z.1352
N0150 G01 X-.0315 Z.1575
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N0240 Z.1181
N0250 X-.0092
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N0270 G01 X-.0315 Z.2417
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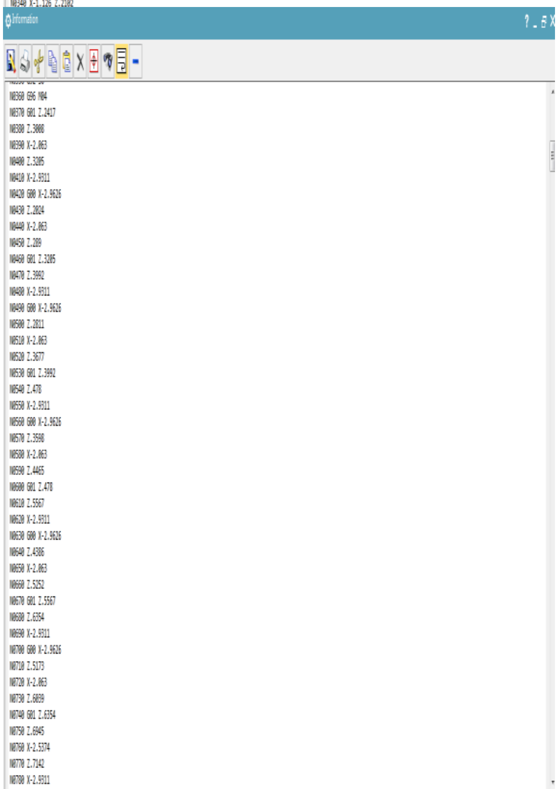

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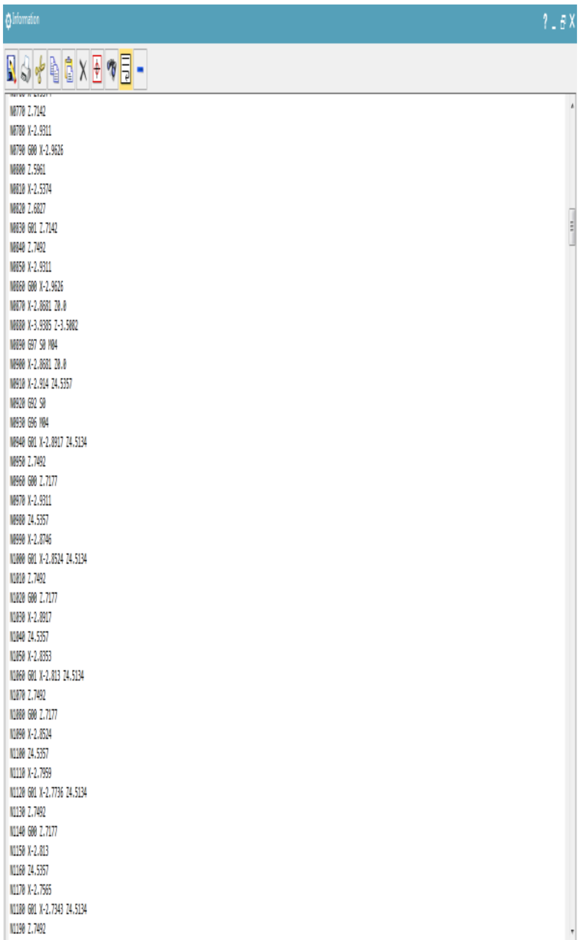

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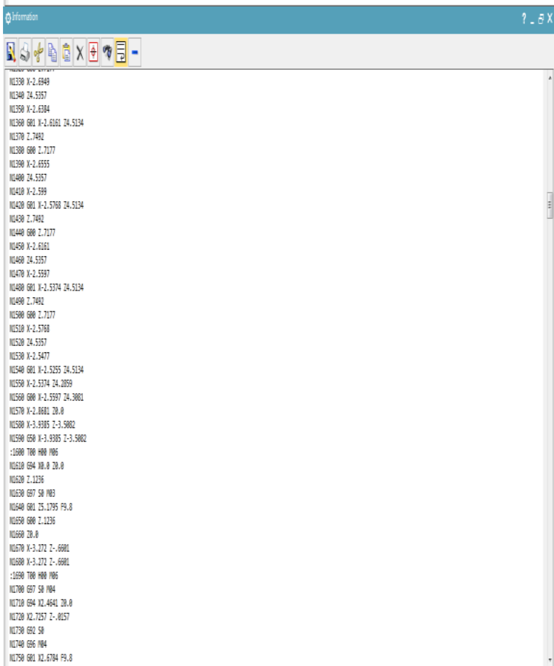

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N1400 Z4.5357
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N1430 Z.7492
N1440 G00 Z.7177
N1450 X-2.6161
N1460 Z4.5357
N1470 X-2.5597
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N1490 Z.7492
N1500 G00 Z.7177
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N1520 Z4.5357
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N1560 G00 X-2.5597 Z4.3081
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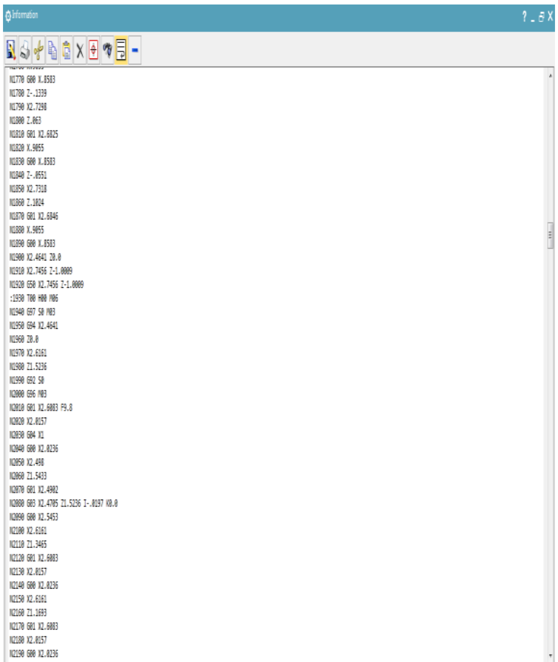

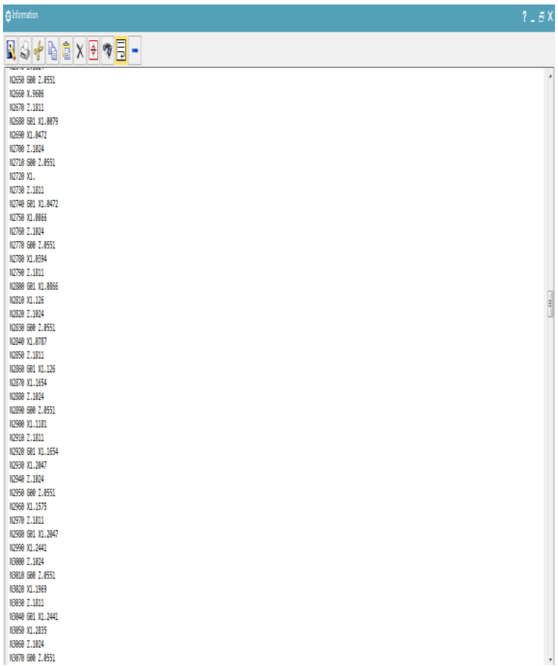

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