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DESIGN AND SIMULATION OF THE MANUFACTURING PROCESS PLAY HINO TRUCK VEHICLE SHAFT USING THE MASTERCAM X5 TO GENERATE G-CODE

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Abstract
In its development, every manufacturing industry increasingly makes people think more creatively and are faced with new problems, especially in making new innovations. The purpose of these production issues is to achieve faster and more efficient production targets. The metal machining process is an important factor to support the quality of the final product, but there is one obstacle that must be faced.
The main shaft is a component on hino truck vehicles, to produce components that are precise in terms of size and good surfaces are used for machining processes using a CNC machine, to simplify the manufacturing process, it is assisted by the Cam X5 master program to produce the G Code program to be used on the machine CNC. The manufacturing process uses a CNC Turning Machine.
This research is an application of the CAD CAM course, the mastercam software application is very helpful in component manufacturing innovation. The main shaft is a form of a product resulting from the machining process, the material for the main shaft is made of AISI 1050 material.

Keywords: *Main Shaft, CNC Machined, Master Cam X5, AISI 1045 Steel, CAD CAM.*

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Introduction

Currently, the development of the industry has been very rapid with sophisticated technology. Every industry or company must always make innovations in the process of producing a product or goods in order to survive and be able to compete with other industries. Not only produce, but guaranteed product quality and efficient processing time are also a prerequisite. To support all of this, the need for technology and automation is inseparable. Automation can be defined as a technology based on the application of mechanical, electronic and computer systems. All of these require a reliable manufacturing data processing process. One that is often used or is already familiar is the CAD/CAM system.

The Manufacturing Industry is currently growing rapidly in line with the needs of service users or producers, Companies are required to innovate to develop technology to make it more effective and efficient. One of the manufacturing industries that is required to continuously innovate is an industry that is engaged in the manufacture of automotive components, Main Shaft is an automotive component that functions to continue rotation from the engine to the gear box, Main shaft functions as a transmission output as well as a place to install the main gear and hub set, between the main shaft to the main gear and the hub set are connected to the bearings. Seeing the working process of the Main shaft requires a precise geometry and precise tolerances, this can be achieved when using a CNC machine, because the fatigue level of a CNC machine is 1/1000 mm or 1 micron. The material used is AISI 1050 including medium carbon steel.

The process of making the main shaft is first carried out by a simulation using the Cam x5 master program to produce G Code which will later be transferred to a CNC machine which is then carried out by machining to make the main shaft. This process is carried out to increase the accuracy of the main shaft components that are made then the manufacturing process can be carried out in bulk with the same size and accuracy, because the manufacturing process is based on a simulated program.

Main Shaft

The main shaft is where the main gear and hub set are installed. This component is the transmission output, which is connected to the input shaft using a bearing so that it can rotate freely together with the input shaft.

Reverse Idler Gear Shaft

It takes a component called Reverse Idler Gear Shaft to connect the main reverse gear and counter gear. Its existence makes the rotation of the main reverse gear opposite the input shaft.

Interlock System

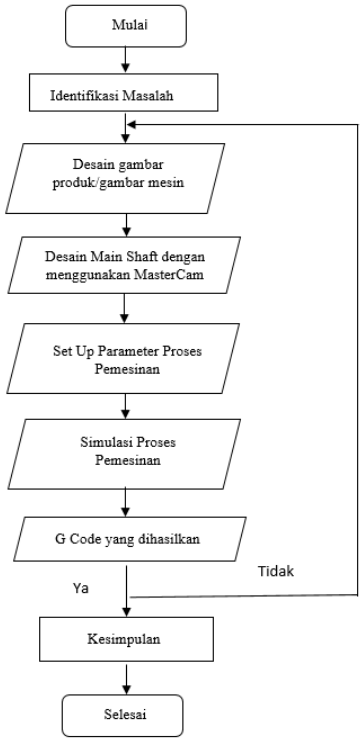
The interlock system functions to lock the transmission so that only one gear enters according to the speed level. This component is very important in the car transmission system.

The research done is creating

The planning stage, especially in the field of product design, currently has a lot of software that supports these activities, in this case, such as Cad software, Cam Software is very helpful in making it easier to make component designs so that it can minimize the occurrence of failures in the component manufacturing process. Several studies have been carried out by many researchers regarding the Machining Process using the Master Cam X5 program as has been carried out by several researchers. The research that the author will do here is to design the Main Shaft components and how to make them when processed on a CNC machine.

Research Method

To simplify the design process of the mold and the simulation process using MasterCam, a flow chart is made as follows.



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Main Shaft Design

The Main Shaft that will be made is a component used on Hino Truck vehicles as shown below:

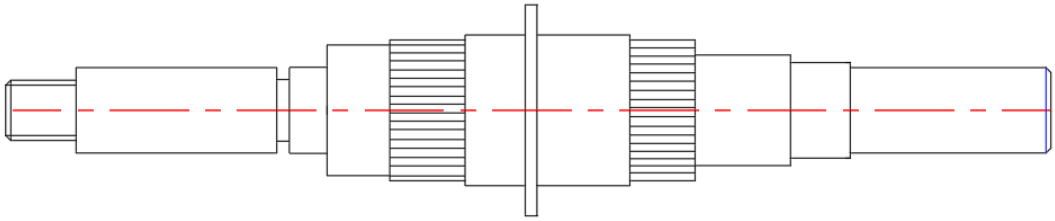

Figure 1. Main Shfat Design

Material Selection

In making and planning the design of a tool or machine, it is very necessary to calculate and choose the material to be used. Material is the main element in addition to other elements. We must know the materials produced in order to increase the value of the product. This will greatly affect the equipment because if the material is not in accordance with the functions and needs it will affect the condition of the equipment and the value of the product.

Selection of a very suitable material will greatly support the success of making the design and planning. The material to be processed must meet the requirements set out in the product design, alone the material properties will greatly determine the forming process.

Material Selection Factors

As for the things that need to be considered in the selection of materials in the manufacture of a tool are:

1. material strength material strength is the ability of the material used to withstand loads that have tensile strength and bending loads.
2. Ease of obtaining materials

In this planning it is necessary to consider whether the required material is available and easy to obtain. This is intended if damage occurs at any time, the damaged material can be replaced or made quickly so that the time for changing the tool is faster so that the tool can produce quickly too.

3. The function of the material

In making this equipment planning the planned components have different functions according to their shape. Therefore it is necessary to look for materials that match the components that are made.

4. Material prices are relatively cheap

To make the planned components, efforts are made to make the materials used for these components as cheap as possible without reducing or reducing the production costs of making these tools.

5. Efficiency of use

In the manufacture of machining components it is also necessary to pay attention to the use of materials that are as efficient as possible, where this does not reduce the function of the components to be made. In this way, the material to be used for the manufacture of components will not be wasted in vain thereby reducing production costs.

6. Ease of production process

Ease in the production process is very important in making a component because if the material is difficult to form, it will take a lot of time to produce the material, which will increase production costs.

Results and Discussion

Master Cam Setup Process

The Design Process for making the Main Shaft Component starts with the Drawing Process on the Cam X5 master program. Besides using Master Cam x5, you can also use AutoCAD, Inventor or directly on Master Cam software.

In this study, the drawing process was carried out in Auto CAD software with the aim of being easier to convert to Master Cam. The following is a picture of the results of the process with the Inventor software.

1. Image of Main Shaft Components

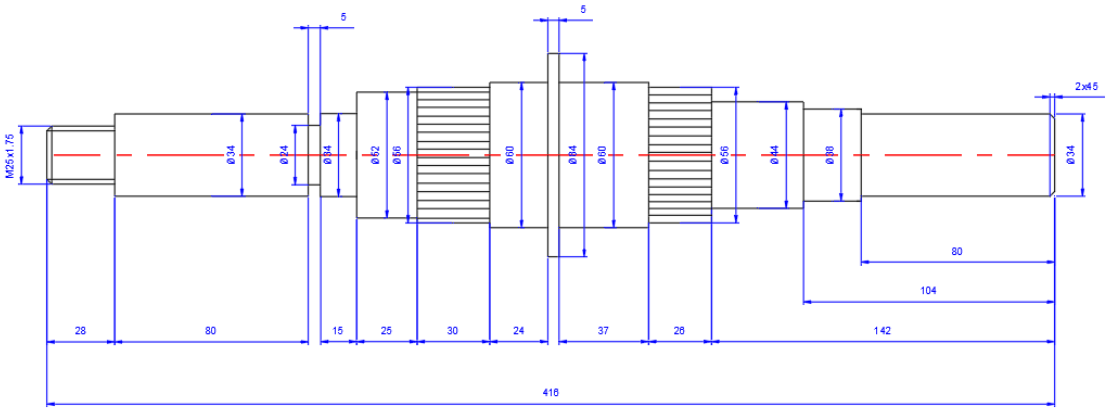

Figure 2. Main Shaft Component Design

The next process is to make the size of the main shaft on the master cam by selecting the stock setup button, then filling in the size of the components according to the X, Y,
The main shaft component manufacturing process is divided into two parts because of its long size. Like the picture below.

1. Front

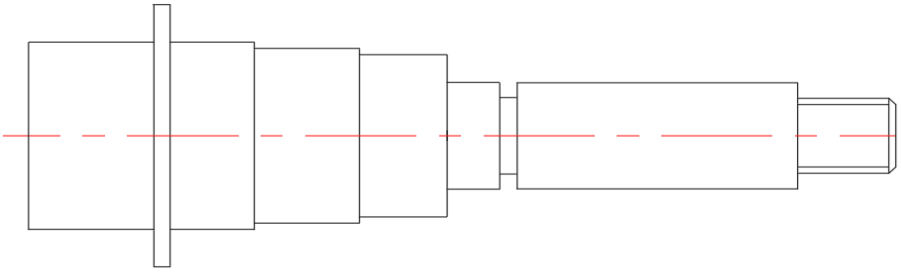

Figure 3. Front main shaft components

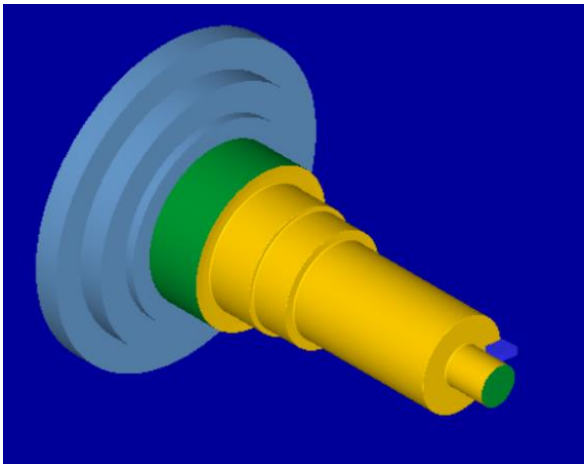

Figure 4. Image Process Master Cam X5 results

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G97 S850 M03
G0 G54 X103. Z-.01
G50 S3600
G96 S275
G99 G1 X-1.6 F.25
G0 Z1.99
X83.15
Z4.5
G1 Z2.5
Z-181.8
X87.
X89.828 Z-180.386
G0 Z4.5
X79.3
G1 Z2.5
Z-181.8
X83.55
X86.378 Z-180.386
G0 Z4.5
X75.45
G1 Z2.5
Z-151.8
G18 G3 X77.4 Z-152.8 I-.025 K-1.
G1 Z-181.8
X79.7
X82.528 Z-180.386
G0 Z4.5
X71.6
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G1 Z2.5
Z-27.8
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Z-27.8
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X36.95
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Z-27.8
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X33.1
G1 Z2.5
Z-27.8
X37.35
X40.178 Z-26.386
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X29.25
G1 Z2.5
Z-27.8
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X36.328 Z-26.386
G0 Z4.5
X25.4
G1 Z2.5
Z-27.8
X29.65
X32.478 Z-26.386
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T0100
M01
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(OD GROOVE RIGHT - NARROW INSERT - N151.2-185-20-5G)
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G18
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Z-111.8
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X62.6
G1 X58.2 F.05
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G1 X58.2 F.1
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Z-110.05
G1 X58.2
X58.375 Z-
110.138
G0 X62.6
Z-110.925
X62.2
G1 X57.8 F.05
G0 X62.2
Z-111.8
G1 X57.8 F.1
X57.975 Z-
111.713
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Z-110.05
G1 X57.8
X57.975 Z-
110.138
G0 X62.2
Z-110.925
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Z-111.8
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X57.575 Z-
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G1 X57.4
X57.575 Z-
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Z-110.925
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Z-111.8
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Z-110.05
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X57.175 Z-
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X52.2
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G0 X56.6
G1 Z-110.05
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G0 X56.6
Z-110.925
X56.2
G1 X51.8 F.05
G0 X56.2
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F.1
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111.713
G0 X56.2
G1 Z-110.05
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X51.975 Z-
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X55.8
G1 X51.4 F.05
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G1 Z-111.8
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G0 X55.8
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Z-110.925
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G0 X54.2
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F.1
X49.8
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G1 X59.4 Z-
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Z-111.5
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W0. M05
T0300
M01
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INSERT -
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16MM01-100)
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M05
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G76 P010029
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2. Back

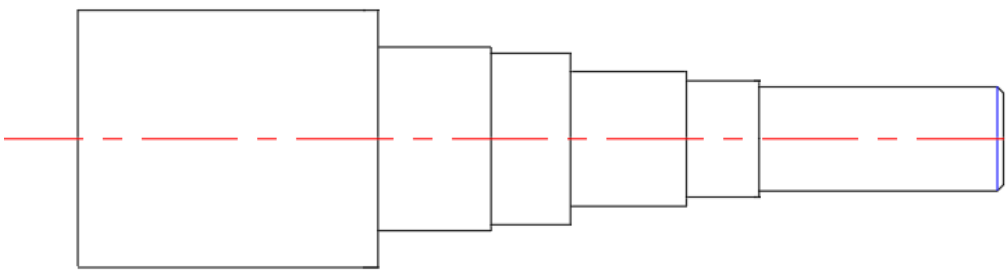
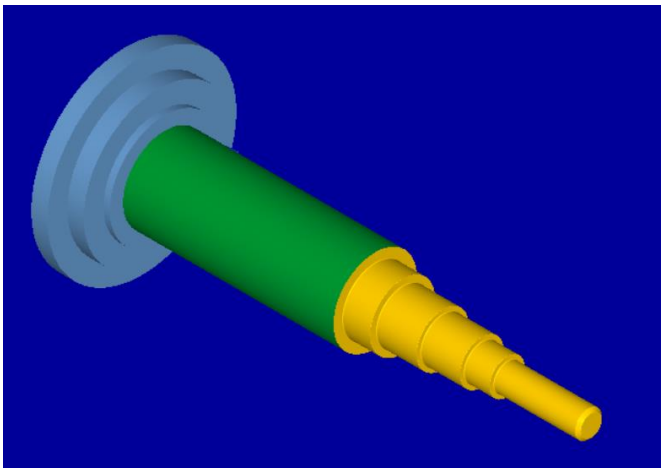


Figure 5. Back main shaft components



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M03
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G96 S275
G99 G1 X-1.6 F.25
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X82.002
Z4.5
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G18 G3 X82.4 Z-209.8 I-.801 K-.599
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G0 Z4.5
X81.603
G1 Z2.5
Z-209.001
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G1 X85.228
Z-208.386
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G1 Z2.5
Z-208.885
G3 X82.003
Z-209.202
I-.402 K-.916
G1 X84.832
Z-207.788
G0 Z4.5
X80.806
G1 Z2.5
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G3 X81.605
Z-209.002
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G3 X80.808
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K-1.
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X77.221
G1 Z2.5
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X76.823
G1 Z2.5
Z-208.8
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Z-208.8
X77.223
X80.051 Z-
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G0 Z4.5
X76.026
G1 Z2.5
Z-208.8
X76.824
X79.653 Z-
207.386
G0 Z4.5
X75.628
G1 Z2.5
Z-208.8
X76.426
X79.254 Z-
207.386
G0 Z4.5
X75.229
G1 Z2.5
Z-208.8
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X76.028
X78.856 Z-
207.386
G0 Z4.5
X74.831
G1 Z2.5
Z-208.8
X75.629
X78.458 Z-
207.386
G0 Z4.5
X74.432
G1 Z2.5
Z-208.8
X75.231
X78.059 Z-
207.386
G0 Z4.5
X74.034
G1 Z2.5
Z-208.8
X74.832
X77.661 Z-
207.386
G0 Z4.5
X73.636
G1 Z2.5
Z-208.8
X74.434
X77.263 Z-
207.386
G0 Z4.5
X73.237
G1 Z2.5
Z-208.8
X74.036
X76.864 Z-
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G0 Z4.5
X72.839
G1 Z2.5
Z-208.8
X73.637
X76.466 Z-
207.386
G0 Z4.5
X72.441
G1 Z2.5
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Z-208.8
X73.239
X76.067 Z-
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G0 Z4.5
X72.042
G1 Z2.5
Z-208.8
X72.841
X75.669 Z-
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X71.644
G1 Z2.5
Z-208.8
X72.442
X75.271 Z-
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G0 Z4.5
X71.245
G1 Z2.5
Z-208.8
X72.044
X74.872 Z-
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G0 Z4.5
X70.847
G1 Z2.5
Z-208.8
X71.645
X74.474 Z-
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G1 Z2.5
Z-208.8
X71.247
X74.075 Z-
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X70.05
G1 Z2.5
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G3 X70.4 Z-
172.8 I-
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G1 Z-208.8
X70.849
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G0 Z4.5
X69.652
G1 Z2.5
Z-172.02
G3 X70.4 Z-
172.8 I-
.626 K-.78
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X70.45
X73.279 Z-
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X69.254
G1 Z2.5
Z-171.896
G3 X70.052
Z-172.237
I-.427 K-
.905
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Z-170.822
G0 Z4.5
X68.855
G1 Z2.5
Z-171.826
G3 X69.654
Z-172.021
I-.227 K-
.974
G1 X72.482
Z-170.607
G0 Z4.5
X68.457
G1 Z2.5
Z-171.8
G3 X69.255
Z-171.896
I-.028 K-1.
G1 X72.084
Z-170.482
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X68.058
G1 Z2.5
Z-171.8
X68.4
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G1 X71.685 Z-170.412
G0 Z4.5
X67.66
G1 Z2.5
Z-171.8
X68.4
X68.458
X71.287 Z-170.386
G0 Z4.5
X67.262
G1 Z2.5
Z-171.8
X68.06
X70.888 Z-170.386
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X66.863
G1 Z2.5
Z-171.8
X67.662
X70.49 Z-170.386
G0 Z4.5
X66.465
G1 Z2.5
Z-171.8
X67.263
X70.092 Z-170.386
G0 Z4.5
X66.067
G1 Z2.5
Z-171.8
X66.865
X69.693 Z-170.386
G0 Z4.5
X65.668
G1 Z2.5
Z-171.8
X66.467
X69.295 Z-170.386
G0 Z4.5
X65.27
G1 Z2.5
Z-171.8
X66.068
X68.897 Z-170.386
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X64.871
G1 Z2.5
Z-171.8
X65.67
X68.498 Z-170.386
G0 Z4.5
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G1 Z2.5
Z-171.8
X65.271
X68.1 Z-170.386
G0 Z4.5
X64.075
G1 Z2.5
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G1 Z2.5
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X64.475
X67.303 Z-170.386
G0 Z4.5
X63.278
G1 Z2.5
Z-141.901
G3 X64.076 Z-142.255
I-.439 K-.899
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G0 Z4.5
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G1 Z2.5
Z-141.829
G3 X63.678 Z-142.031
I-.24 K-.971
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G3 X63.28 Z-141.902
I-.041 K-.999
G1 X66.108 Z-140.488
G0 Z4.5
X62.083
G1 Z2.5
Z-141.8
X62.4
G3 X62.881 Z-141.83 K-1.
G1 X65.71 Z-140.415
G0 Z4.5
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G1 Z2.5
Z-141.8
X62.4
G3 X62.483 Z-141.801 K-1.
G1 X65.311 Z-140.387
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X61.286
G1 Z2.5
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X59.294
G1 Z2.5
Z-141.8
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X58.497
G1 Z2.5
Z-141.8
X59.296
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X62.124 Z-
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G0 Z4.5
X58.099
G1 Z2.5
Z-141.8
X58.897
X61.726 Z-
140.386
G0 Z4.5
X57.701
G1 Z2.5
Z-141.8
X58.499
X61.327 Z-
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G0 Z4.5
X57.302
G1 Z2.5
Z-141.8
X58.101
X60.929 Z-
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X56.904
G1 Z2.5
Z-141.8
X57.702
X60.531 Z-
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X56.505
G1 Z2.5
Z-141.8
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X60.132 Z-
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G0 Z4.5
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X59.336 Z-
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G1 Z2.5
Z-141.8
X56.109
X58.937 Z-
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Z-141.8
X55.71
X58.539 Z-
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Z-141.8
X54.515
X57.344 Z-
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G0 Z4.5
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Z-141.8
X54.117
X56.945 Z-
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G1 Z2.5
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X53.718
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Z-141.8
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Z-141.8
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X55.75 Z-
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G0 Z4.5
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Z-141.8
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Z-141.8
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X54.555 Z-
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G1 Z2.5
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G3 X50.4 Z-
104.8 I-
.866 K-.501
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G1 Z2.5
Z-104.055
G3 X50.4 Z-
104.8 I-
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X53.36 Z-
140.386
G0 Z4.5
X49.335
G1 Z2.5
Z-103.916
G3 X50.133
Z-104.301
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.884
G1 X52.961
Z-102.887
G0 Z4.5
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G1 Z2.5
Z-103.837
G3 X49.735
Z-104.055
I-.268 K-
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G1 X52.563
Z-102.641
G0 Z4.5
X48.538
G1 Z2.5
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G3 X49.336
Z-103.917
I-.069 K-
.998
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G1 X52.165
Z-102.502
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Z-103.8
X48.4
G3 X48.938
Z-103.837
K-1.
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Z-102.423
G0 Z4.5
X47.741
G1 Z2.5
Z-103.8
X48.4
G3 X48.54
Z-103.802
K-1.
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Z-102.388
G0 Z4.5
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G1 Z2.5
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X48.141
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G1 Z2.5
Z-103.8
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X46.546
G1 Z2.5
Z-103.8
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X46.148
G1 Z2.5
Z-103.8
X46.946
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X49.774 Z-
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X45.749
G1 Z2.5
Z-103.8
X46.548
X49.376 Z-
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G1 Z2.5
Z-103.8
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Z-103.8
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Z-103.8
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X48.181 Z-
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G1 Z2.5
Z-103.8
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X47.384 Z-
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X43.359
G1 Z2.5
Z-103.8
X44.157
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Z-103.8
X43.759
X46.587 Z-
102.386
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X42.562
G1 Z2.5
Z-103.8
X43.361
X46.189 Z-
102.386
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X42.164
G1 Z2.5
Z-103.8
X42.962
X45.791 Z-
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X41.766
G1 Z2.5
Z-103.8
X42.564
X45.392 Z-
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G0 Z4.5
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Z-103.8
X42.166
X44.994 Z-
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G0 Z4.5
X40.969
G1 Z2.5
Z-103.8
X41.767
X44.596 Z-
102.386
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X40.57
G1 Z2.5
Z-103.8
X41.369
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X44.197 Z-
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G0 Z4.5
X40.172
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Z-103.8
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102.386
G0 Z4.5
X39.774
G1 Z2.5
Z-103.8
X40.572
X43.4 Z-
102.386
G0 Z4.5
X39.375
G1 Z2.5
Z-103.8
X40.174
X43.002 Z-
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Z-103.8
X39.775
X42.604 Z-
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G0 Z4.5
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Z-103.8
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G0 Z4.5
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80.8 I-.89
K-.456
G1 Z-103.8
X38.979
X41.807 Z-
102.386
G0 Z4.5
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X37.782
G1 Z2.5
Z-80.077
G3 X38.4 Z-
80.8 I-.691
K-.723
G1 Z-103.8
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102.386
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Z-79.929
G3 X38.182
Z-80.346 I-
.492 K-.871
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G0 Z4.5
X36.985
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G3 X37.783
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G1 Z2.5
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G1 X39.815
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Z-79.8
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G1 X39.417
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Z-79.8
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X38.62 Z-
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G0 Z4.5
X34.595
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Z-79.8
X35.393
X38.222 Z-
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G0 Z4.5
X34.196
G1 Z2.5
Z-2.36
G3 X34.4 Z-
2.8 I-.898
K-.439
G1 Z-79.8
X34.995
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78.386
G0 Z4.5
X33.798
G1 Z2.5
Z-2.085
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2.093
G3 X34.4 Z-
2.8 I-.707
K-.707
G1 Z-79.8
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78.386
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X33.4
G1 Z2.5
Z-1.886
X33.814 Z-
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G3 X34.198
Z-2.362 I-
.707 K-.707
G1 X37.026
Z-.948
G0 Z4.5
X33.001
G1 Z2.5
Z-1.686
X33.8 Z-
2.086
X36.628 Z-
.671
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X32.603
G1 Z2.5
Z-1.487
X33.401 Z-
1.886
X36.23 Z-
.472
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G1 Z2.5
Z-1.288
X33.003 Z-
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X35.831 Z-
.273
G0 Z4.5
X31.806
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X32.604 Z-
1.488
X35.433 Z-
.074
G0 Z4.5
X31.408
G1 Z2.5
Z-.89
X32.206 Z-
1.289
X35.035
Z.125
G0 Z4.5
X31.009
G1 Z2.5
Z-.69
X31.808 Z-
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Z.325
G0 Z4.5
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G1 Z2.5
Z-.491
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X34.238
Z.524
G0 Z4.5
X30.213
G1 Z2.5
Z-.292
X31.011 Z-
.691
X33.839
Z.723
G0 Z4.5
X29.814
G1 Z2.5
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.492
X33.441
Z.922
G28 U0. V0.
W0. M05
T0100
M01
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(OD RIGHT 55 DEG INSERT - DNMG 15 06 08)
G0 T1212
G18
G97 S3600 M03
G0 G54 X-3.2 Z2.
G50 S3600
G96 S550
G1 Z0. F.5
X28.4
G18 G3 X29.39 Z-.205 K-.7
G1 X33.39 Z-2.205
X36.218 Z-.791
G0 Z0.
X33.8
G1 Z-2.
Z-80.
X34.8
X37.628 Z-78.586
G0 X37.8
Z-78.
G1 Z-80.
Z-104.
X46.8
X49.628 Z-102.586
G0 X49.8
Z-102.
G1 Z-104.
Z-142.
X60.8
X63.628 Z-140.586
G0 X63.8
Z-140.
G1 Z-142.
Z-172.
X66.8
X69.628 Z-170.586
G0 X69.8
Z-170.
G1 Z-172.
Z-209.
X78.8
X81.628 Z-207.586
G0 X81.8
Z-207.
G1 Z-209.
Z-212.9
X84.628 Z-211.486
G28 U0. V0. W0. M05
T1200
M30
%
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Conclusion

The main shaft is one of the components of an automotive vehicle which functions to continue rotation from the engine to the transmission system made of AISI 1050. At this time a component that has high accuracy is needed to get a performance from the vehicle, one of which is by using a CNC machine. Prior to the machining process with a CNC machine, currently Manufacturing companies carry out a machining process simulation by carrying out the Cad Cam process with the aim of minimizing the occurrence of errors during the manufacturing process on a CNC machine. From the results of this simulation we get a G code (G-code) which functions to make workpieces on a real CNC machine, using the resulting program we can make a large number of main shaft components with the same size because the manufacturing process is based on the program. . In this machining process, 5 types of chisels are used according to the stages of the machining process, namely chisels for facing, roughing, finishing, chisels for screwing and chisels for making grooves.

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