International Journal of Psychosocial Rehabilitation, Vol. 24, Issue 7, 2020
ISSN: 1475-7192

Preventive Maintenance CNC Machine DMC 210U

Ramadhani Prasetya,[1], Samsul Darul, , Nia Nuraeni Suryaman[4]Abdul Rohman Firdaus[3] Kopah[2]

Abstract *- Maintenance is an activity to maintain or maintain factory equipment and carry out repairs or adjustments and replacements needed so that there is a satisfactory state of production operation in accordance with what is planned. The purpose of maintenance: to keep the existing system running as it should and also to be able to control costs both for prevention and repairs in case of damage. The portal series type machine of DMC 210 U is a large, 5 axis / 5 axis machine that uses a stable bridge type structure to achieve high accuracy and dynamic performance. This model allows 5-axis / 5-axis machining with one arrangement, contributing to the increase in customer productivity, which is equipped with a high-speed pallet converter, which allows the operator to make arrangements for the next process during the production process. The methodology used in this study is to follow the stages of the process of preventive maintenance carried out on the DMC 210U CNC machine. Based on the results of handling including the Electronic and control systems, Axis, Spindles, APCs, ATCs, Hydrolic Units, Lube and Coolants, Cooling Systems, and Pneumatic Units, it can be concluded that the DMC 210 U CNC Machine is in good condition in the sense of not experiencing damage*

Keywords: *Maintenance, machining, CNC, DMC 210U*

I. INTRODUCTION

Any sophisticated machine that is used will have limitations in terms of accuracy, accuracy, and production capability, so to minimize this, the maintenance process is required.

The maintenance process consists of preventive maintenance, predictive maintenance, and corrective maintenance. In this research, the type of maintenance chosen by the author is preventive maintenance. The objectives of the study are:

1) Knowing preventive maintenance on DMC 210 U machines.
2) Know the standard operational procedures for preventive maintenance of DMC 210 U machines.

BASIC TEORY

Computer Numerical Control Machine, or what we often call a CNC MACHINE, is a machine tool automation system that is operated by abstract commands in the program system and stored in a data storage medium, in this process contrary to the previous system where the machine tool is controlled simply by hand rotation or automation using cam. The word NC itself is an abbreviation in English from the word Numerical Control which means "numerical control".

NC machines were first invented in the 1940s and 1950s, by modifying ordinary machine tools with the addition of a motor that would move the controller following the sign entered into the system by a paper recorder. This combination of servo motor and mechanical engine was changed to an analog system and then a digital computer,

[1] Department of Mechanical Engineering Widyatama University Bandung, Indonesia ramadhani.prasetya@widyatama.ac.id

Received: 10 Nov 2018 | Revised: 20 Dec 2018 | Accepted: 02 Jan 2019

and a modern machine tool called CNC (computer numerical control) was formed which later changed the design process.

Today CNC machines have a very close relationship with CAD programs in the modern manufacturing world. With a CNC machine, the accuracy of a product can be guaranteed up to 1/100 mm more, with mass production and exact results in a fast machining process.

1) Types of CNC Machines

The process of operating the CNC machine is divided into several types, including:

a) CNC Milling Machine.

Milling machine is a machining process where the cutting tool rotates on its spindle and workpiece with longitudinal and transverse movements in accordance with the desired cutting. Where the workpiece (material) is in a stationary position (fixed) and the cutter (tool) that eats the workpiece with movement that has been input in the G-Code

Fig.1 CNC Milling Machine

b) CNC Turning Machine.

CNC Turning Machine is a machining process where the work process occurs in reverse from a CNC Milling machine, with the cutting tool or cutting tool in a stationary position and while the workpiece is moving.

Fig.2 CNC Turning Machine

2) Main Parts of CNC Machines

The NC / CNC machine main part consists of six main parts:

a) Program

The machine program is a preliminary code or command and a helper command. Preliminary programs generally use the G-code command, and helper commands in the form of M-code. In addition to coding G and M,

Received: 10 Nov 2018 | Revised: 20 Dec 2018 | Accepted: 02 Jan 2019

from a number of command codes arranged in a combination of letters and numbers, where letters are N, T, S, F, H, I, J, K, R, D, X, Y, Z, and numbers from 0 to 9 are called addresses (banyuwiro, 2015)

Fig.3 System Program

b) Control unit or processor

The control unit or often referred to as the Machine Control Unit (MCU) functions as the memory for storing operational program data and supporting data used. The MCU reads the program data, and converts the data command into an electrical signal which is then issued into movement instructions for machine elements.

Fig.4 Modul Control Unit

c) Servo electric motor to drive the Liner movement control.

Servo electric motor is part of a closed loop system consisting of several parts, namely the control circuit, servo motor, potentiometer, drive gear, as a driver on the linear axis X and Z.

Received: 10 Nov 2018 | Revised: 20 Dec 2018 | Accepted: 02 Jan 2019

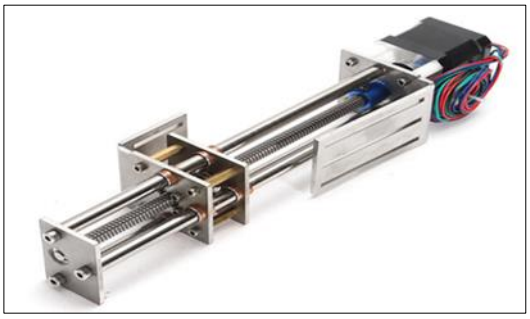

Fig.5 Axis Driving Motor

d) Electric motor for moving / turning the cutter

Servo electric motor is part of a closed loop system consisting of several parts, namely the control circuit, servo motor, potentiometer, drive rotor, and is often referred to as a spindle on a CNC machine, and as a mounting house on a cutting tool.

Fig.6 Spindle unit

e) Cutter

The cutting tool or cutter functions as a tool for cutting or cutting the workpiece in accordance with the demands of the shape and size of the workpiece design. In the turning process there are several types of cutting tools that are used including: flashlight drill / center drill, drill / drill, drill counter, reamer, kontersing, lathe cutting tool.

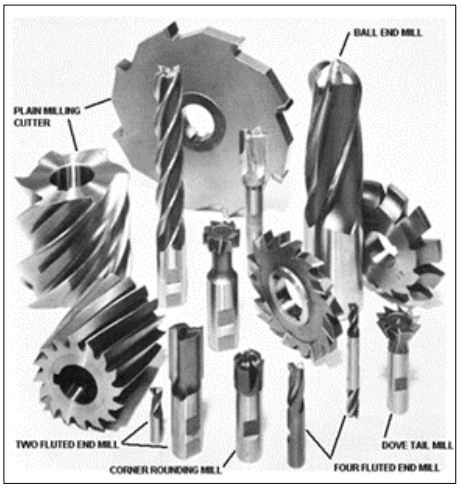

Fig.7 Cutting tools type

Received: 10 Nov 2018 | Revised: 20 Dec 2018 | Accepted: 02 Jan 2019

e) Holder

The holder and holder of the workpiece or often referred to as choking that is used to clamp the workpiece during the cutting process takes place. The main part are as follows:

• The house (cylinder) is choked

• Jaw (inside / outside)

• Plate / jaw drive plate

• Pinion teeth

• Fastening bolts

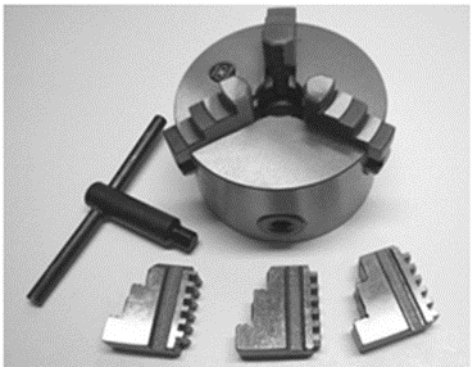

Fig.8 Tool holder

3) Maintenance

Maintenance is an activity to maintain or maintain factory equipment and carry out repairs or adjustments and replacements needed so that there is a satisfactory state of production operation in accordance with what is planned.

The purpose of maintenance: to keep the existing system running as it should and also to be able to control costs both for prevention and repairs in case of damage.

The types of treatment are divided into several stages:

- Corective maintenance

Corrective Maintenance is Maintenance carried out by identifying the cause of the damage and then repairing it so that the Production Machine or equipment can operate normally again. Corrective Maintenance is usually carried out on machines or production equipment that are operating abnormally (the machine can still operate but is not optimal).

- Preventive Maintenance

Preventive Maintenance is based on maintenance activities carried out scheduled, generally periodic, where a number of maintenance tasks such as infection, repair, replacement, cleaning, lubrication, and adjustments carried out. With the Preventive Maintenance, it is expected that all existing machines will guarantee the smooth working process so that no one is obstructed in the work process, so that no one is obstructed in the production process and always in optimal condition.

- Predictive maintenance.

Predictive Maintenance is maintenance carried out to anticipate failures before total damage occurs. This Predictive Maintenance will predict when damage will occur to certain components of the machine by analyzing the behavior of the machine / work equipment.

II. METHODOLOGY

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The methodology used in this study is to follow the stages of the process of preventive maintenance carried out on the DMC 210U CNC machine.

The portal series type machine of DMC 210 U is a large, 5 axis / 5 axis machine that uses a stable bridge type structure to achieve high accuracy and dynamic performance. This model allows 5-axis / 5-axis machining with one arrangement, contributing to the increase in customer productivity which is equipped with a high-speed pallet converter, which allows the operator to make arrangements for the next process during the production process. The model can produce a large and efficient workpiece production process. The following stages are the maintenance process:

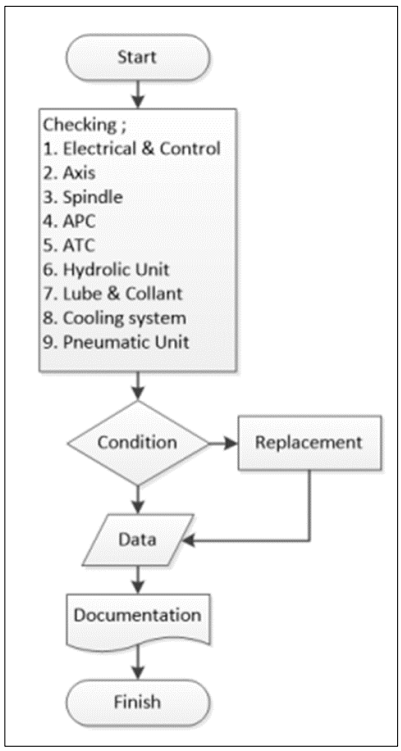

Fig.9 Flow Chart Maintenance

III. RESULT AND DISCUSSION

The 201U DMC CNC machine has a maximum rotation speed of 30,000 rpm with support capabilities on the worktable up to 6,000 kg. This machine is very suitable in making aircraft parts.

Machine spesification:

- Machine length : 13,842 mm
- Machine height : 12,320 mm
- Machine width : 5,100 mm
- Spindle motor : 68 KW
- Max. movement in the X-axis is 2,100 mm
- Max. movement in the Y axis direction is 2100 mm
- Max. movement in the Z axis direction is 1,250 mm

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Maintenance system can be carried out on a tool / machine by carrying out the process of work in the form of an inspection of the system and components that include its parts. In each system there are different ways of handling according to their respective functions. At this stage the handling process will be carried out at 2000 hours periodic maintenance.

The periodic maintenance process includes steps that must be taken in the process of treatment, including the following points:

Sub System	Action
Electrical & Control	CC
Axis	CC
Spindel	CC
APC	CC & SA
ATC	CC & SA
Hydrolic Unit	CC & RP
Lube & Coolant	CC & RP
Cooling System	CC
Pneumatic	CC & SA

Note: CC (Check & Clean)
RP (Replace / Refill)
SA (Set/Adjust)

The maintenance process is carried out through the steps of preventive maintenance 2000 hours CNC DMC 210 U machine, as follows:

1) Checking electrical & control systems

Received: 10 Nov 2018 | Revised: 20 Dec 2018 | Accepted: 02 Jan 2019

Fig.10 Controller

The CNC machine control system contains buttons and switches and is equipped with a monitor to display program commands. The control system is directly related to the operator in the process.

Maintenance Process:

- Check in the control system whether a system error has appeared on the display or monitor display.
- Check whether each part of the button is functioning properly.

After the control system has been checked, the next step is to handle the electrical system. One example of the electrical system that is carried out by the maintenance process is the laser measuring section.

Fig.11 Laser Measuring

2) Checking Axis

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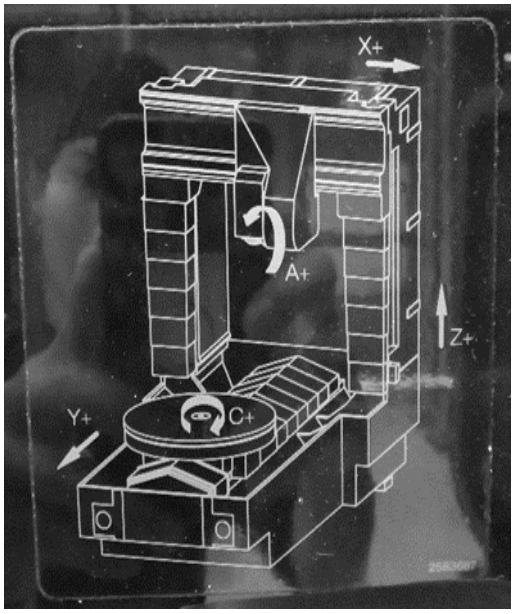

Fig.12 Axis Movement Section

These five axes are the most complex because they work using 5 driving axes, namely the X, Y, Z and A and C axes. For the X, Y, Z axes the same as for the 3 Axis machines, the A axis for vertical rotating movements and the C axis as movers rotate horizontally. With the most complex drive axes, this axis can make workpieces in the form of flat, cylindrical and overall media.

Work step:

- Clean the chips that stick to each axis path so that the movement functions normally using a brush.
- Lubricate every axis movement.
- Check the movement of the axis on the control system whether the system is functioning normally.
- Measuring the Z axis ratio between the left and right sides upright, make sure the height is the same, if there is a deviation of 0.002 millimeters it can be calibrated through a command in the control system, but if it exceeds the detail it requires special handling of disassembly and re-calibration adjustments on the driving rotor.
- In the movement of Axis, A, X, C, and Y the adjustment point "0" (zero) parameter is done on the controller command system.

3) Checking Spindle

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Fig.13 Spindle

The High-Speed CNC machine spindle controls the rotation and movement of the cutter mounted on the Z axis and can rotate with the direction of rotation horizontally on the movement of the A axis.

Maintenance step:

- Cover the spindle of the attached chip using a brush.
- Lubricate the rotating parts of the spindle.
- Checking fastening bolts to prevent more fatal damage from loose bolts.
- Spindle checking when gripping / locking the cutter tool, make sure the grip does not experience any shifting or aberration to avoid the result of misalignment of the tool's position.
- Check the rotation of the spindle rotation on the control system, whether or not there is data error that appears on the screen.
- Check the "0" (zero) parameter.

4) Checking APC (Automatic Pallet Changer)

The process of changing worktable / pallet that can be exchanged automatically between the main table and the second table is known as the Automatic Pallet Changer (APC).

Fig.14 APC

Maintenance step:

- Clean the chips and dirt that is attached to the Pallet lane.
- Ensure that there is no damage in the form of cracks, breaks or scratches on the pallet movement path that can interfere with pallet shifting.
- Lubricate the pallet path.
- Clean the chips found in the Set Up using compressed air, and make sure to clean using safety glasses.
- Check the movements of the main pallet and the second pallet, make sure the position of the main pallet is inside the machine and the second pallet is outside the machine.
- Cleaning the remaining chips is discarded using a chip conveyor system

5) Checking ATC (Automatic Tool Changer)

ATC is a place that functions as a rotating tool storage with tool replacement on the spindle. The tools used are automatically selected by the machine control unit (MCU). Components contained in ATC such as gripper, electric motor and pneumatic, are controlled automatically on the controller

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Fig.15 ATC

Maintenace steps:

- Inspection of the cutter, in the form of checking the diameter and length does not change in shape such as: bent, cracked or there is a fracture on the cutter.
- Check the cutter replacement cycle accordingly.
- Check the drive lever on the gripper, make sure in the center position with the spindle, if you experience a shift, adjust the lever according to the value of the shift from the center point to avoid collisions between the spindle and the tool due to the deviation.
- Check the controller system if the tool placement matches the cutter serial number.

Fig.16 Cutter serial number

6) Checking Hydraulic Unit

Received: 10 Nov 2018 | Revised: 20 Dec 2018 | Accepted: 02 Jan 2019

Fig.17 Hydraulic

The oil pump serves to send hydraulic oil to the integrated cartridge valve block, the hydraulic oil will be distributed to the upper or lower chamber through one-way valves and relief valves, cylinders. will move under the action of high-pressure oil.

Maintenance step:

- Check the height of the fluid oil reserve tank.
- Check the pressure of the fluid when the closed valve is channeled, the spindle, axis and so on, do not experience a pressure drop.
- Check the control system again for the open or closed valve

7) Checking Lub & Coolant

Coolant lubrication is needed for, cooling and lubricating the surface rubbing against the tool and the workpiece. In the process there are coolant liquid chip chips that carry over from the remaining cuts. Before the coolant liquid can be re-used, filtering is needed in the Filter Unit

Fig.18 Filter unit

Maintenance step:

- Check the height of the coolant water parameters, making sure it does not exceed the minimum and maximum limits of the storage tank.
- Replacement of the filter with 2000-hour replacement time.
- Check that the coolant is sure to continue circulating under 24 hours so that the bacterial content contained in the coolant liquid is not damaged.
- Check the coolant duct on the engine to prevent clogging.
- Check cooling work on the control system.

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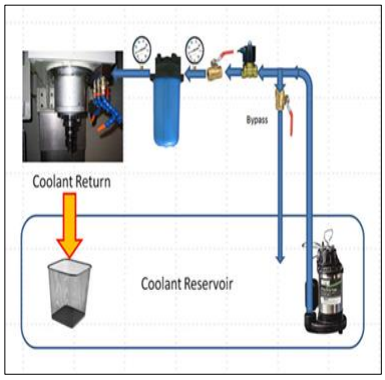

Fig.19 Coolant Circulation

8) Checking Cooling System

The cooling system serves to keep the engine temperature in ideal conditions, both on the engine and on the workpiece.

Maintenace step:

- Check the compressor system for leaks
- Check the air flow from the compressor with a pressure of at least 65 bar, make sure the emergency tap is in the closed position and the tap to the air dryer is open.
- Air dryer In the light position wait - / + 20 seconds to ensure that the air is completely dry before it is flowed into the cnc machine.
- The air is used to cool coolants, tools and parts that require pneumatic pressure

On the CNC machine there is also an external air filtering system in the form of foam, to cool the electrical system with a minimum temperature of 25 degrees and a maximum of 35 degrees.

Fig.20 Filter System

9) Checking Pneumatic System

Inspection in the pneumatic system unit, through the following stages:

- Air compressor

Hold air pressure (compressed air) as a source of power from the pneumatic system.

- Aftercooler

Cool the hot air from the compressor

Dispose of mostly moist (condensate), oil (oil), dust (dust).

Received: 10 Nov 2018 | Revised: 20 Dec 2018 | Accepted: 02 Jan 2019

- Main Line Air Filter

Filter out fine dust

Discard the remaining moisture and oil

- Refrigerated Air Dryer

Make the air dry.

After passing through tools 2, 3 and 4, the air becomes cool, clean and dry which is needed by the next equipment for perfect operation of the pneumatic system.

- Air Filter

Filter the dirt contained in the pipe

Dispose of damp (drain).

- Air Pressure Reducing Valve

Reducing the main pressure (main) as needed.

- Air Lubricators

Flush clean oil as a lubricant cylinder so that it doesn't get thirsty quickly.

- Cylinder Air

Sound dampening from exhaust air (exhaust).

Keep the outside dirt from entering the valve hole.

- Air Flow Change Solenoid Valve

Electricity regulators for the course of air-driven (solenoid) air.

- Speed Control Valve

Set cylinder speed

- Air Cylinder / Reservoir

A device where compressed air is used to make linear or rotational movements

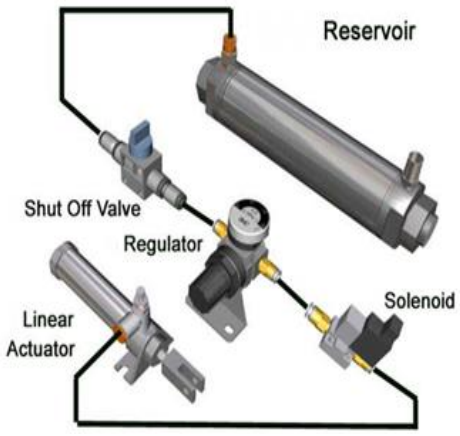

Fig.21 Pneumatic unit

Maintenance step:

- Check the reservoir / reservoir tube to make sure it doesn't leak.
- Checks on the shut off valve, solenoid, liner actuator function properly, if there is air seepage then further action is needed.
- Measuring pressure parameters on the regulator part.

Received: 10 Nov 2018 | Revised: 20 Dec 2018 | Accepted: 02 Jan 2019

- Return to the control unit system in the system control check

IV. CONCLUSION

Based on the results of handling including the Electronic and control systems, Axis, Spindles, APCs, ATCs, Hydrolic Units, Lube and Coolants, Cooling Systems, and Pneumatic Units, it can be concluded that the DMC 210 U CNC Machine is in good condition in the sense of not experiencing damage. However, it is often found that many chips are carried along to the Coolant channel section

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