Mid-Process Inspection

Abbie Rodgers – Precision Engineering BEng

Abbie.rodgers8@gmail.com

Aim of the Project

The aim of this project is to explore and inspect a part using the CMM. Evaluating manufacturing operations, focusing on accuracy, efficiency, and the impact on production accuracy.

Objectives

Develop CAM program for optimized machining of workpiece and fixture.

Develop and execute CMM inspections post-machining for previously machined operation one.

Machine fixture and operation two with CAM programmed toolpaths.

Develop and execute CMM inspections post-machining for the newly programmed and machined operation two.

Analyse and compare CMM vs. Hexagon Arm measurements for workpiece.

Photo of: Received Part

Background

Inspection Equipment

•Coordinate Measuring Machines (CMMs): Utilized for precise geometrical measurements.

Photo of: Hexagon CMM

•Optical Systems: Employed for non-contact assessments of complex parts.

•Traditional Callipers and Micrometres: Essential for accurate dimensional checks.

•Importance: These tools are crucial for ensuring product quality and strict adherence to specifications.

Machine-Integrated Inspection Systems

•Automation of Quality Assurance: Utilizes advanced sensors and algorithms.

•Precision Measurements: Capable of performing highly accurate assessments.

•Reduction of Manual Errors: Minimizes human mistakes in quality control processes.

•Manufacturing Efficiency: Enhances overall productivity by streamlining quality assurance steps.

Literature Review

The literature on mid-process inspection using CMMs highlights the importance of addressing data capture challenges, using advancements in CAIP, integrating digital twins, applying free-form surface inspection techniques, and considering statistical issues. These areas are critical for improving the efficiency, accuracy, and reliability of CMM inspections in manufacturing. Projects that aim to improve mid-process inspection processes can improve from the knowledge provided by these studies, suggesting a varied approach that combines technological improvements and addresses existing challenges.

Machining Tolerances

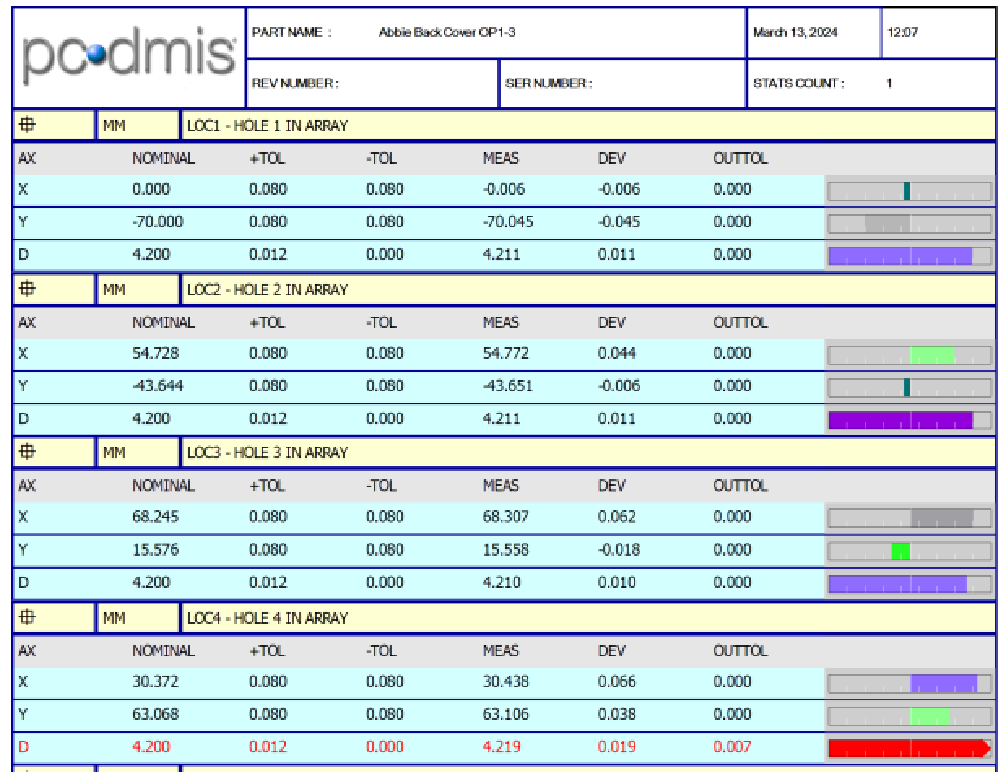
Tolerances for turning operations on the Mazak Quick Turn Nexus 250-II MSY are typically within ±0.005 mm.

Milling operations with live tooling may have broader tolerances of ±0.010 mm.

Several factors influence these tolerances:

- The machine's mechanical precision.
- The material being machined.
- The specific type of operation.
- Wear on the tools used.
- The skill level of the operator and the programming quality.

CMM OP1 Results



pc-dmis

PART NAME : Abbie Back Cover OP1-3 | March 13, 2024 | 12:07

REV NUMBER : | SER NUMBER : | STATS COUNT : 1

AX	NOMINAL	+TOL	-TOL	MEAS	DEV	OUTTOL
MM	LOC1 - HOLE 1 IN ARRAY					
X	0.000	0.080	0.080	-0.006	-0.006	0.000
Y	-70.000	0.080	0.080	-70.045	-0.045	0.000
D	4.200	0.012	0.000	4.211	0.011	0.000
MM	LOC2 - HOLE 2 IN ARRAY					
X	54.728	0.080	0.080	54.772	0.044	0.000
Y	-43.644	0.080	0.080	-43.651	-0.006	0.000
D	4.200	0.012	0.000	4.211	0.011	0.000
MM	LOC3 - HOLE 3 IN ARRAY					
X	68.245	0.080	0.080	68.307	0.062	0.000
Y	15.576	0.080	0.080	15.558	-0.018	0.000
D	4.200	0.012	0.000	4.210	0.010	0.000
MM	LOC4 - HOLE 4 IN ARRAY					
X	30.372	0.080	0.080	30.438	0.066	0.000
Y	63.068	0.080	0.080	63.106	0.038	0.000
D	4.200	0.012	0.000	4.219	0.019	0.007

Photo of: PCDMIS Results

Future Developments

The integration of robotics with precision measurement tools like CMM will further automate the inspection process, reducing human error and increasing quality. Robots equipped with CMM sensors can perform complex inspections on a variety of parts and assemblies, ensuring consistent quality across the production cycle.

Future CMMs are expected to use AI and machine learning algorithms to improve their predictive capabilities. By analysing historical data, these intelligent systems can predict tool wear, anticipate potential defects, and recommend or take corrective actions, hence automating quality control and improving manufacturing precision.