Case brief

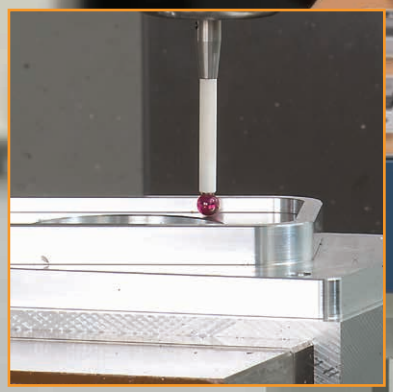
RENISHAW
apply innovation™

High-volume manufacturing: increasing the yield of precision machined components

Improve accuracy

Enhance capability

Reduce scrap



Overview

Companies that manufacture precision components and products in very high volumes, increasingly prefer to CNC machine them from castings or solid materials. Although this process can deliver precise parts with desired cosmetic appearance, high volume CNC precision machining requires process controls to deliver consistently high quality products that meet design requirements.

Typical process

High-volume machining requires large machine tool populations, arranged in cells, which carry out specific operations.	Parts are moved between machines until all machining operations are completed. Machine selection is non specific. See figure 1.	Where machining variance cannot be eliminated, graded parts are binned for selective assembly.

Challenge

1 **Eliminate setting errors and reduce scrap**

In order to achieve the high tolerances required, CNC machine tool operations are initially qualified and maintained by skilled engineers, often one engineer to a cell of machines. Machine operators are employed to load components, typically locating them using bespoke fixtures.

The quality of finished parts depends upon a number of variables including: fixture quality; operator skill; positioning errors; input material condition; and thermal effects – all of which can lead to variable machined parts, high scrap and low yield rates.

Parts that are incorrectly machined at one operation can continue through the process having errors added at each subsequent operation, resulting in scrap parts and a net yield that reduces with each operation.

Figure 1 below shows an example of three operations carried out in a multiple machine cell without probing. Note how the yield reduces following each operation.

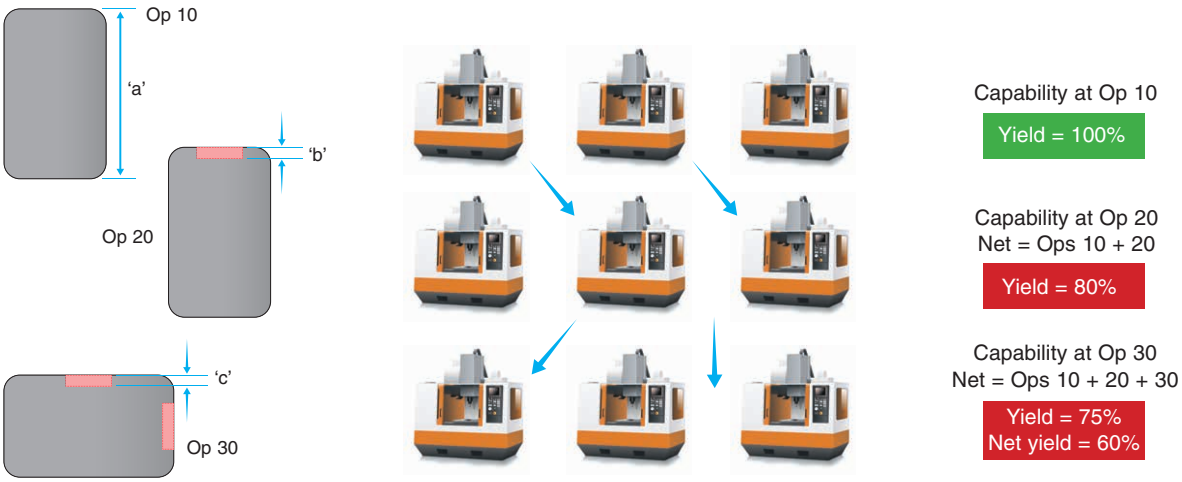
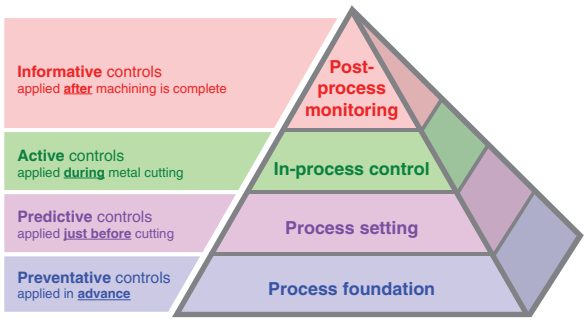


Figure 1

Process considerations

Renishaw engineers considered key elements within a customer's process and production stages of manufacturing using Renishaw's ***Productive Process Pyramid™***. This framework is used to identify and control the variations that can occur at key stages of the machining process.

For more information, please visit the **When do I probe?** section of the Renishaw website:
www.renishaw.com/en/whendoiprobe



Productive Process Pyramid

Solutions

Manufacturing process focus: process setting

Focusing on process setting, Renishaw engineers have helped introduce measures to increase part accuracy and reduce the need for intervention by skilled engineers. These have successfully been applied to part setting in high-volume industries.

Automated on-machine measurement of actual component position and alignment has been introduced using Renishaw probing systems.

Figures 2 to 4 show that it is possible to check the actual Z surface height and update the work offset for every part, despite input material variation. The results are impressive:

- **Reduced rejections as a result of fewer machining errors**
- **Increased good part yield**

Figure 2 shows the possible effects of machining a slot where the primary Z height is unknown.

Figure 3 shows the slot machined correctly where a probe has been used to establish the Z position.

Figure 4 below shows the positive result, following the introduction of a simple part setting cycle using probes.

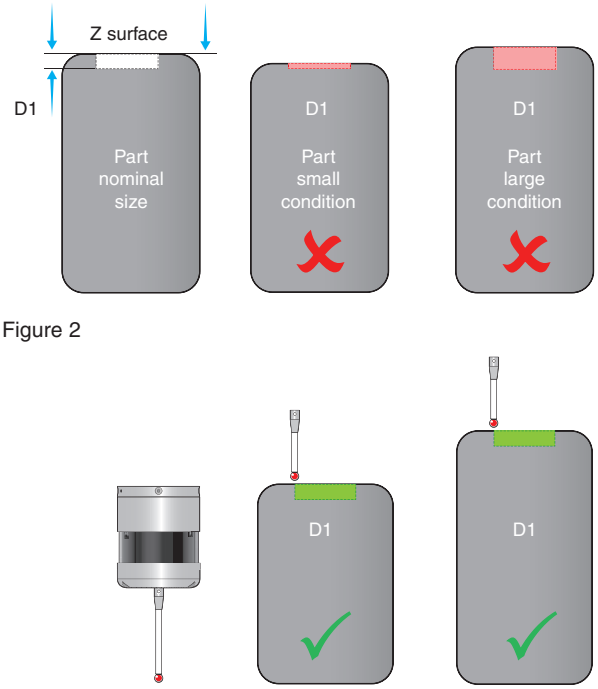


Figure 2

Figure 3

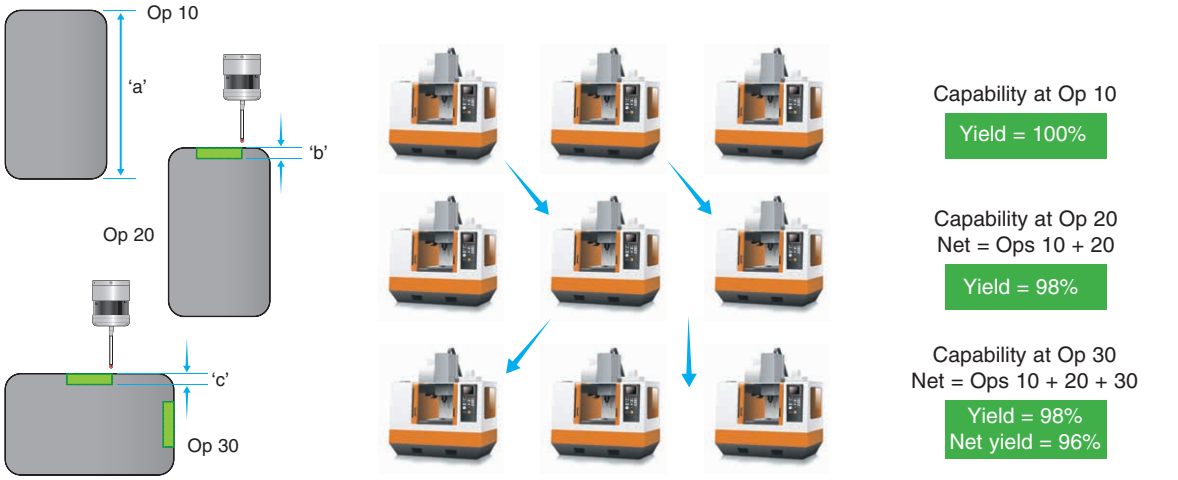


Figure 4

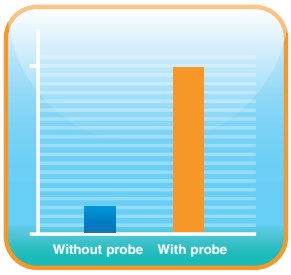
Typical results

These charts provide a value illustration for this industry application where probing has been introduced. Whilst the high scrap rate illustrated is not necessarily typical of all applications, it is based on actual field experience and illustrates the cumulative effect of production variables as parts pass through multiple operations.

Reduced scrap and increased yield

	Without probing	With probing	Gain
Sample volume	10,000	10,000	
Scrap rate	40%	4%	Scrap significantly reduced
Scrap volume	4,000	400	3,600 additional good parts
Yield – good parts	6,000	9,600	60%

Improved performance



	Without probing	With probing	
Feature accuracy	±0.1 mm	±0.025 mm	
Skill level	High	Low	

Increased savings and profits

	Without probing	With probing	Saving
Part cost US$	5	5	
Bad parts	4,000	400	3,600
Cost of scrap US$	20,000	2,000	18,000

RENISHAW
apply innovation™

Summary

Manufacturers of high-volume precision machined parts continually strive to deliver an ever higher yield of good parts. Despite using advanced CNC machines, some manufacturers have achieved unacceptably low yield rates of good parts.

The wider adoption of Renishaw probe systems within machining processes in this industry sector has now transformed manufacturers' capabilities.

Renishaw probes used for component setting will help eliminate part variation due to:

- **Fixturing and feature location**
- **Input material condition**
- **Thermal growth of the part or machine**

As a result, yield, and therefore productivity, will increase.

Contact

To find out how you could benefit from our process control solutions, contact us today – find your local office at **www.renishaw.com/contacts**

Customer comment

> The Renishaw team has been fantastic, especially with regard to set-up and training. Their engineers spent hours with us, making sure we knew what we were doing. We looked at other suppliers, but we weren't convinced they could support us as well as Renishaw could.

Best practice

Productive Process Patterns™ from Renishaw provide guidance on best practice and the implementation of a wide range of probing solutions.

For more information regarding job set-up and other applications, visit **www.renishaw.com/processcontrol**

Renishaw plc

New Mills, Wotton-under-Edge
Gloucestershire, GL12 8JR
United Kingdom

T +44 (0) 1453 524524
F +44 (0) 1453 524901
E uk@renishaw.com

www.renishaw.com

RENISHAW
apply innovation™

About Renishaw

Renishaw is an established world leader in engineering technologies, with a strong history of innovation in product development and manufacturing. Since its formation in 1973, the company has supplied leading-edge products that increase process productivity, improve product quality and deliver cost-effective automation solutions.

A worldwide network of subsidiary companies and distributors provides exceptional service and support for its customers.

Products include:

- Additive manufacturing and vacuum casting technologies for design, prototyping, and production applications
- Dental CAD/CAM scanning systems and supply of dental structures
- Encoder systems for high-accuracy linear, angle and rotary position feedback
- Fixturing for CMMs (co-ordinate measuring machines) and gauging systems
- Gauging systems for comparative measurement of machined parts
- High-speed laser measurement and surveying systems for use in extreme environments
- Laser and ballbar systems for performance measurement and calibration of machines
- Medical devices for neurosurgical applications
- Probe systems and software for job set-up, tool setting and inspection on CNC machine tools
- Raman spectroscopy systems for non-destructive material analysis
- Sensor systems and software for measurement on CMMs
- Styli for CMM and machine tool probe applications

For worldwide contact details, visit www.renishaw.com/contact

H-2000-3803-01

Part no.: H-2000-3803-01-A
Issued: 08.2015