Tool identification

Problem

With any manufacturing process that requires manual intervention, there is an opportunity for human error; a CNC process is no exception. Two failure modes associated with the cutting tools being used can cause variation in the manufacturing process, or in some cases, a crash on the machine tool.

- **Incorrect tool assembly loaded into the CNC machine tool**

  When setting up a CNC machine to produce a new part or when replacing a tool due to wear, failure or tool life expiry, there exists the potential risk that an incorrect tool will be loaded to the machine. If this tool differs significantly from the expected tool in terms of tool type and geometry, the subsequent machining operation will not be executed as expected. There is a significant chance that this mistake would result in damage to the part, fixturing or machine.

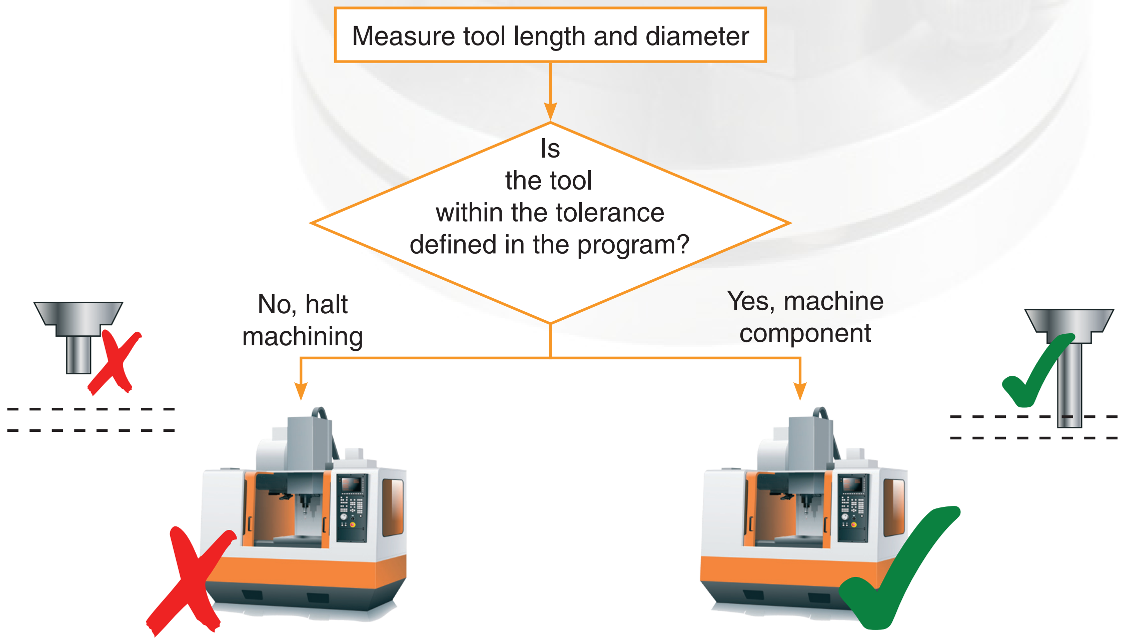
- **Tool not assembled as instructed**

  The construction of a tool assembly requires a level of process control; the design of the manufacturing process has inferred that a specific tool build will perform the machining process and give a certain level of capability. If tool construction is uncontrolled and deviates significantly, the process performance will vary. For example, if a tool projection is increased, the rigidity of the tool assembly is reduced and therefore cutter ‘push-off’ can increase, causing a degradation in the final accuracy of the component being produced.

  Additionally, tool projection can be critical to ensure adequate clearance from other features on the component or fixturing elements on the machine. Incorrect tool construction can lead to collisions between the tool holder and component or fixture.

Solution

An on-machine tool setting system is used to establish tool length and diameter offsets when replacing tools. As a safety check, the measured values are compared against reference dimensions with a tolerance applied: if the tool length or diameter deviation is greater than the allowed tolerance, the process will stop safely before any machining takes place or any damage can occur.



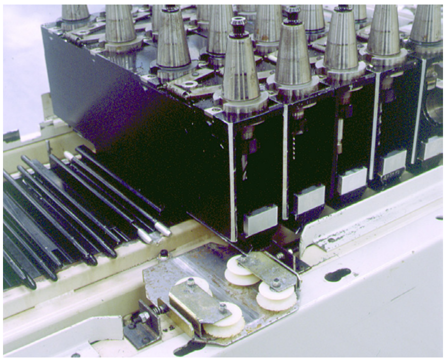
Benefits

- Fail safe capture of manual error before incorrect machining or damage can occur
- This process does not incur additional machining time as the check is incorporated into standard tool measurement cycles

Case study 1

Cutting tools used within an automated production process are loaded into tooling racks by an operator at a remote loading station.

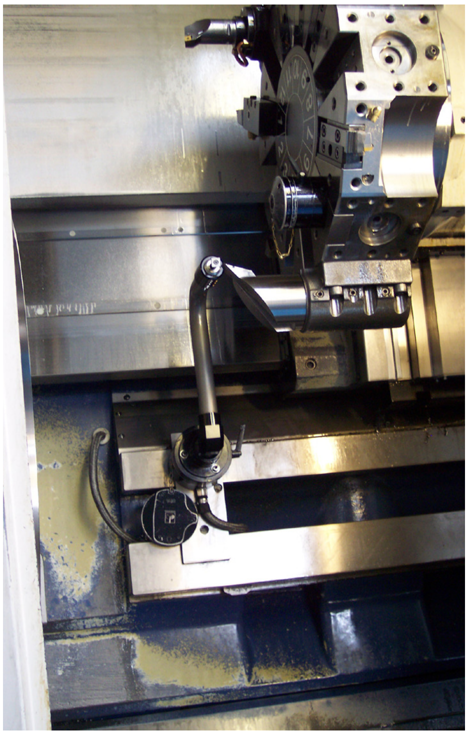
Although graphical and written instructions have been produced, there remains the potential for mis-loading or incorrect construction of the tool assembly.



Within the automated system, the tools are transferred into a CNC machine tool. Prior to any metal cutting, the tool is measured using a contact tool setting system. This tool measurement is used primarily to establish accurate tool offsets, however, the measured result is also compared to reference data that is ‘hard written’ into the CNC program. If the measured value deviation exceeds the allowable tolerance, the process will stop safely with an alarm to notify the operator.

Case study 2

The machining of a high value, rotative aerospace part is undertaken on a large mill-turning machine. The number of cutting tools required to undertake the machining process exceeds the physical tool stations available on the machine. As a result, there is a process stop during the machining operation to allow an operator to change a cutting insert. The geometry of this cutting insert is critical to achieving the final part accuracy. Failure to change or loading an incorrect insert will result in the high value part being scrapped.



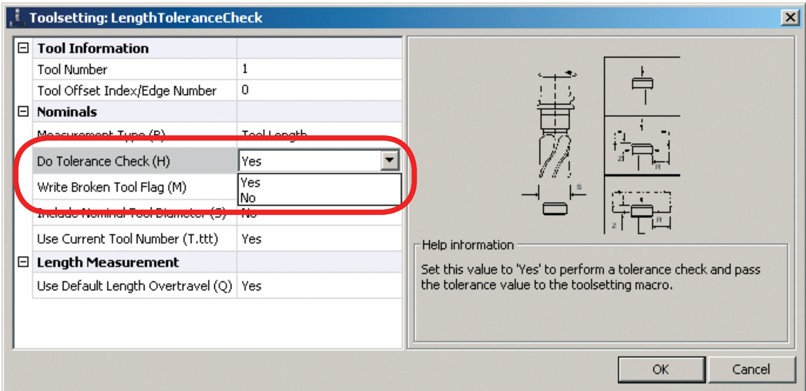
Following the process stop, the new tool is measured and compared to the reference (expected) size: the process is stopped safely if the tool is incorrect.

Example: tool length and diameter tolerance check

Sample Productivity+™ probe software program

Tool reference length and diameter written to available variables.

Tool dimensions checked against allowable tolerance values (see dialog below).



Sample Inspection Plus software program

Tool data:

- 6 mm slot drill, tool position 1, length offset 1, diameter offset 31
- Reference length 150 mm
- Allowable length deviation 1 mm
- Reference diameter 6 mm
- Allowable deviation 0.5 mm

#2001 = 150.0	Write reference length to tool offset 1
G65 P9857 B1. T1. H1.	Measure tool 1, length offset 1, tolerance 1 mm
#2031 = 6.0	Write reference diameter to offset 31
G65 P9857 B2. D6. E31. H0.5	Measure tool 1, diameter offset 31, tolerance 0.5 mm
N70	Continue

SAMPLE PRODUCTIVITY+™ PROGRAMS ASSUME THE USE OF ACTIVE EDITOR PRO 1.70.20
SAMPLE INSPECTION PLUS PROGRAMS ASSUME USE WITH FANUC TYPE CONTROLS

This page is intentionally left blank

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:

- **Dental CAD/CAM scanning and milling systems.**
- **Encoder systems for high accuracy linear, angle and rotary position feedback.**
- **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 (co-ordinate measuring machines).**
- **Styli for CMM and machine tool probe applications.**

Renishaw worldwide

Australia
T +61 3 9521 0922
E australia@renishaw.com

Austria
T +43 2236 379790
E austria@renishaw.com

Brazil
T +55 11 4195 2866
E brazil@renishaw.com

Canada
T +1 905 828 0104
E canada@renishaw.com

The People's Republic of China
T +86 21 6180 6416
E china@renishaw.com

Czech Republic
T +420 548 216 553
E czech@renishaw.com

France
T +33 1 64 61 84 84
E france@renishaw.com

Germany
T +49 7127 9810
E germany@renishaw.com

Hong Kong
T +852 2753 0638
E hongkong@renishaw.com

Hungary
T +36 23 502 183
E hungary@renishaw.com

India
T +91 80 6623 6000
E india@renishaw.com

Indonesia
T +62 21 2550 2467
E indonesia@renishaw.com

Israel
T +972 4 953 6595
E israel@renishaw.com

Italy
T +39 011 966 10 52
E italy@renishaw.com

Japan
T +81 3 5366 5316
E japan@renishaw.com

Malaysia
T +60 3 5631 4420
E malaysia@renishaw.com

The Netherlands
T +31 76 543 11 00
E benelux@renishaw.com

Poland
T +48 22 577 11 80
E poland@renishaw.com

Russia
T +7 495 231 16 77
E russia@renishaw.com

Singapore
T +65 6897 5466
E singapore@renishaw.com

Slovenia
T +386 1 527 2100
E mail@rls.si

South Korea
T +82 2 2108 2830
E southkorea@renishaw.com

Spain
T +34 93 663 34 20
E spain@renishaw.com

Sweden
T +46 8 584 90 880
E sweden@renishaw.com

Switzerland
T +41 55 415 50 60
E switzerland@renishaw.com

Taiwan
T +886 4 2473 3177
E taiwan@renishaw.com

Thailand
T +66 2 746 9811
E thailand@renishaw.com

Turkey
T +90 216 380 92 40
E turkiye@renishaw.com

UK (Head Office)
T +44 1453 524524
E uk@renishaw.com

USA
T +1 847 286 9953
E usa@renishaw.com

For all other countries
T +44 1453 524524
E international@renishaw.com

H-5650-4009-01

Issued 1111 Part no. H-5650-4009-01-C