SEMETS312

Inspecting components using co-ordinate measuring machines (CMM)

Overview

This standard identifies the competences you need to inspect components using manual and/or computer numerical control (CNC) co-ordinate measuring machines (CMM), in accordance with approved procedures. You will be required to prepare and set up the equipment in readiness for the inspection operations. This will involve obtaining and using the correct issue of drawings, job instructions and specifications including, where appropriate, downloading the correct CNC measuring program. You will be expected to set up the co-ordinate measuring machine, to position and secure the component/product in a suitable location, and to select and mount the correct inspection probes. In carrying out the inspection activities, you will be expected to check the components/product for both dimensional and geometrical accuracy, and this may be required to be undertaken at various stages of the engineering/manufacturing process, such as first-off inspection, during production and final inspection. Components to be inspected could include machined components, pressings, mouldings, extrusions, castings, forgings, patterns, assemblies and sub-assemblies, treated and coated components.

Your responsibilities will require you to comply with organisational policy and procedures for the setting-up and operating activities undertaken, and to report any problems with the equipment, tooling, programs or setting-up activities that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You will be expected to work with a minimum of supervision, taking personal responsibility for your own actions and for the quality and accuracy of the work that you carry out.

Your underpinning knowledge will provide a good understanding of your work and will provide an informed approach to the quality control procedures used. You will understand the co-ordinate measuring equipment being used, and its application, and will know about the inspection probes, setting-up and operating procedures, in adequate depth to provide a sound basis for using the equipment effectively, identifying faults and ensuring that the inspection activities are carried out to the required specification.

You will understand the safety precautions required when working with the machine and its associated equipment. You will be required to demonstrate safe working practices throughout and will understand the responsibility you owe to yourself and

others in the workplace.

Performance criteria

You must be able to:

1. work safely at all times complying with health and safety legislation and other relevant regulations, directives and guidelines
2. follow the correct specification for the product or equipment being inspected
3. use the correct equipment to carry out the inspection activities
4. identify and confirm the inspection checks to be made and acceptance criteria to be used
5. carry out all required inspections as specified
6. identify any defects or variations from the specification
7. record the results, and complete inspection documentation in the appropriate format
8. deal promptly and effectively with problems within your control and report those that cannot be solved

Knowledge and understanding

You need to know and understand:

1. the specific health and safety precautions to be taken when inspecting components/products (such as specific legislation or regulations governing the activities or work area, safe working practices and procedures to be adopted, general workshop safety practice)
2. Regulations with regard to the substances used in the inspection process
3. the hazards associated with inspecting components/products, and how they can be minimised
4. the appropriate personal protective equipment and clothing (PPE) to be worn during the inspection activities
5. how and where to obtain the required drawings and/or CNC operating program and related specifications
6. the importance of checking that all inspection documentation, programs and specifications are current and complete
7. how to extract information from engineering drawings and or CNC operating programs and related specifications (to include codes, symbols and conventions to appropriate BS or ISO standards) in relation to the inspection work being undertaken
8. how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing
9. the use of relevant standards in determining if components and products are fit for purpose
10. the general principles of quality assurance systems and procedures
11. preparations to be undertaken before the component/product is inspected
12. the application of different co-ordinate measuring machines (such as vertical, horizontal and gantry/bridge)
13. the function keys and operating system used on co-ordinate measuring machines
14. the application of the different types of inspection probes that are available
15. the importance of ensuring that equipment is set up correctly and is in a safe and useable condition
16. the systems of measurement that are used on co-ordinate measuring machines
17. how to ensure that inspection probes are correctly calibrated before

undertaking the inspection activities

18. how to deal with equipment and/or program error messages

19. the effects that the environment may have on the measurements taken, particularly where precision measurements are required

20. the need to select and use set datum points, and the effects of taking readings from different datums (such as accumulation of limits, leading to errors)

21. why sampling is used, and when it is an effective means of quality assurance

22. the typical defects and variations that can be found on components/products, and how to identify them

23. the procedure to be followed when inspected products are out of specification (including obtaining concessions, where appropriate)

24.
the importance of completing inspection documentation, what needs to be recorded and where records are kept

25.
the extent of your own responsibility and whom you should report to if you have problems that you cannot resolve

Scope/range

1.

Carry out all of the following during the inspecting activities:

1.1 obtain and use the correct issue of drawings, job instructions and specifications
1.2 follow specified and appropriate inspection procedures
1.3 identify and record any out-of-tolerance dimensions/features, in the appropriate format
1.4 investigate and obtain concessions for out-of-specification products (where appropriate)
1.5 place products in the correct location on completion of the inspection activities (compliant and non-compliant specifications)
1.6 shut down the equipment using the correct procedure
1.7 leave the work area in a safe and tidy condition on completion of the inspection activities

2.

Use one of the following types manual and/or CNC co-ordinate measuring machines:

2.1 vertical
2.2 gantry/bridge
2.3 horizontal
2.4 other specific type

3.

Inspect one of the following types of engineering components/equipment:

3.1 machined components
3.2 castings
3.3 mechanical assemblies/sub-assemblies
3.4 forgings
3.5 pressings
3.6 overhauled components/products
3.7 mouldings
3.8 extrusions
3.9 patterns
3.10 other specific components/products

4.

Mount the workpiece in a suitable position, using two of the following:

4.1 directly to the machine table
4.2 on parallels
4.3 on angle plates
4.4 on vee blocks
4.5 in special jigs
4.6 other mounting methods

5.

Carry out two of the following inspection procedures:

5.1 first/one-off
5.2 in-process sample inspection
5.3 one hundred percent final inspection of components or products
5.4 statistical quality control

6.

Check all of the following, as applicable to the machine type:

6.1 check that datums for each machine axis are set in relation to equipment, components and probes selected
6.2 where applicable, download the CNC program into the controller, safely and correctly
6.3 select and mount suitable inspection probes for the different features to be checked
6.4 calibrate the inspection probe (where applicable)
6.5 enter the probe information correctly into the machine controller/operating system
6.6 ensure that probe changes are carried out safely and clear from obstructions
6.7 check that all inspection operations and probe movements are executed safely and correctly
6.8 ensure that any alterations to programs are communicated fully to the appropriate personnel (where applicable)

7.

Inspect components/products that have a range of different features and cover twelve of the following:

7.1 diameters
7.2 threads
7.3 recesses
7.4 internal diameters/bores
7.5 eccentric features
7.6 slots
7.7 tapered diameters
7.8 angular faces
7.9 holes or slots on linear/angular pitch
7.10 tapered bores
7.11 internal profiles/forms/surfaces
7.12 holes or slots on pitch circles
7.13 shoulders and steps
7.14 external profiles/forms/surfaces
7.15 counterbored/countersunk holes
7.16 linear dimensions (lengths)
7.17 grooves/undercuts
7.18 special forms (such as gear, spline, serrations)
7.19 depths

8.

Check four of the following geometric features:

8.1 flatness
8.2 straightness
8.3 parallelism
8.4 alignment
8.5 position/location
8.6 geometry
8.7 squareness
8.8 concentricity
8.9 distortion
8.10 ovality/lobing
8.11 eccentricity
8.12 surface finish

9.

Complete inspection documentation to include one from the following and pass to the appropriate people:

9.1 inspection report
9.2 concession report
9.3 job card
9.4 customer specific documentation

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