Overview

This standard identifies the competences you need to carry out the machining of aspheric glass and diamond turned components, using Computer Numerical Control (CNC) machines or CNC machining centres, in accordance with approved procedures. You will confirm with the machine setter that the machine is ready for the operations to be performed and that all the required components, materials and consumables are available. You will be required to produce a range of aspheric components of various infra-red and/or visible materials, which combine a range of different features, such as aspheric form, power, surface roughness, cap height. You will also be required to check and verify the finished components, using a variety of equipment, to ensure they meet the required specifications.

You will be required to operate the machine in line with safe working practices and approved procedures, to continuously monitor the machining operations and, where necessary make minor adjustments or seek the help of the machine setter to make the adjustments, in order to ensure that the work output is to the required quality and accuracy. Meeting production targets will be an important issue, and your production records must show consistent and satisfactory performance.

Your responsibilities will require you to comply with organisational policy and procedures for the CNC optical machining activities undertaken, and to report any problems with the machining activities, materials or equipment used that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You will be expected to work to instructions, with a minimum of supervision, taking personal responsibility for your own actions and for the quality and accuracy of the work that you produce.

Your underpinning knowledge will be sufficient to provide a sound basis for your work, and will enable you to adopt an informed approach to applying CNC optical machining procedures. You will have an understanding of the CNC aspheric glass and diamond turning processes used, and their application, and will know about the equipment, materials and consumables, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

You will understand the safety precautions required when working with the machine, its associated tools and 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.

Setting up of the machine, its tooling and associated workholding devices, is the subject of another standard and is the responsibility of the machine-tool setter.
Performance criteria

You must be able to:

1. work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines
2. confirm that the machining equipment is set up and ready for operation
3. follow the defined procedures for starting and running the operating system
4. deal promptly and effectively with error messages or equipment faults that are within your control and report those that cannot be solved
5. produce optical components
6. check the computer process and ensure that the production output is to the required specification
7. complete the required production documentation
8. shut down the equipment to a safe condition on conclusion of the activities
Knowledge and understanding

You need to know and understand:

1. the safe working practices and procedures to be followed while operating CNC aspheric lens generating, and polishing equipment and diamond turning equipment
2. the safety mechanisms on the machine, and the procedure for checking that they function correctly
3. the operation of the machine controls in both set-up and run modes, and how to stop the machine in an emergency
4. the personal protective equipment (PPE) to be worn, and where this can be obtained
5. the hazards associated with carrying out aspheric lens process operations, and how to minimise them and reduce any risk
6. the importance of keeping the work area clean and tidy
7. how to extract and use information from optical engineering drawings and related specifications (to include symbols and conventions to appropriate BS, ISO or BSEN standards) in relation to work undertaken
8. how to use imperial and metric systems of measurement and system of tolerancing
9. the process methods of aspheric manufacture, and the use of a variety of tools (such as diamond tip tools, diamond abrasive wheels and polishing tools)
10. the lens mounting methods used to set up the workpiece prior to operation, to minimise wedge error, concentricity and astigmatism
11. how to handle and store all cutting tools and kit required, safe and correctly
12. factors which affect the selection of cutting feeds, pressures and speeds required, and the depth of cut that can be taken (such as workpiece rigidity, machine condition, types of tooling, material, finish and tolerance required)
13. how tool wear affects surface finish and dimensional accuracy
14. how the various types of material will affect the way the operation is performed
15. the application of cutting fluids with regard to the range of material being produced
16. how to recognise machine faults, and how to identify when tooling needs refurbishment
17. the problems that can occur with CNC optical lens infra-red and
Operating CNC aspheric optical and diamond turning machines

special material machining activities, and how they can be overcome
18. the quality control procedures used, inspection checks to be carried out, and the equipment used
19. the extent of your own responsibility and to whom you should report if you have problems that you cannot resolve
1. Apply **all** of the following during the machining activities:
   1. obtain and use the appropriate documentation (such as job instructions, drawings, quality control documentation)
   2. adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
   3. confirm with the machine setter that the machine is ready for production
   4. where appropriate, seek any necessary instruction/training on the operation of the machine
   5. ensure that machine guards are in place and are correctly adjusted
   6. hold components securely, without damage or distortion
   7. maintain the cutting tools in a suitable condition
   8. ensure that the operating program is at the correct start point before starting the machine
   9. ensure that the workpiece is clear of the machine spindle
   10. ensure that safe working practices and start-up procedures are observed
   11. ensure that machine settings are adjusted as and when required (either by yourself or the setter) to maintain the required accuracy
   12. ensure that the components produced meet the required specification for quality and accuracy
   13. leave the work area and machine in a safe and appropriate condition on completion of the activities

2. Operate **one** of the following aspheric lens processes:
   1. glass aspheric generating process
   2. diamond turning aspheric process
   3. glass aspheric polishing process
   4. diamond turning diffractive/hybrid process

3. Produce machined optical components that combine different operations and cover **four** of the following:
   1. centre thickness
   2. lens cap height
   3. lens surface roughness
   4. lens cosmetic defects
Operating CNC aspheric optical and diamond turning machines

5. lens diameter/step feature, angle
6. lens power analysis/radius
7. lens concentricity
8. lens aspheric form analysis
9. lens diffractive step height

4. Machine **three** different types of material from the following:
   1. zinc selenide
   2. zinc sulphide
   3. optical silicon
   4. optical cleartran
   5. optical infra-red glass 4
   6. optical infra-red glass 5
   7. optical infra-red glass 6
   8. gallium arsenide
   9. acrylic
   10. optical glass
   11. optical grade germanium
   12. optical thallium ideobromide
   13. aluminium
   14. other appropriate optical material

5. Carry out the necessary checks for accuracy during production of **four** of the following:
   1. lens chamfers
   2. lens diameter
   3. lens centre thickness
   4. lens surface power error
   5. lens surface finish
   6. lens cap height
   7. lens power error

6. Produce components with dimensional accuracy, form and surface quality, which comply to **one** of the following:
   1. BS, ISO or BSEN standards and procedures
   2. customer (contractual) standards and requirements
   3. company standards and procedures
   4. other accepted international standards
Operating CNC aspheric optical and diamond turning machines

<table>
<thead>
<tr>
<th>Developed by</th>
<th>Semta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Version Number</td>
<td>2</td>
</tr>
<tr>
<td>Date Approved</td>
<td>February 2016</td>
</tr>
<tr>
<td>Indicative Review Date</td>
<td>March 2019</td>
</tr>
<tr>
<td>Validity</td>
<td>Current</td>
</tr>
<tr>
<td>Status</td>
<td>Original</td>
</tr>
<tr>
<td>Originating Organisation</td>
<td>Semta</td>
</tr>
<tr>
<td>Original URN</td>
<td>SEMMME2-45</td>
</tr>
<tr>
<td>Relevant Occupations</td>
<td>Engineering; Engineering and manufacturing technologies; Engineering Technicians</td>
</tr>
<tr>
<td>Suite</td>
<td>Mechanical Manufacturing Engineering Suite 2</td>
</tr>
<tr>
<td>Keywords</td>
<td>engineering; manufacturing; mechanical; machining; aspheric glass; diamond turning; CNC machine; CNC machine centre; polishing; diffractive process; operating</td>
</tr>
</tbody>
</table>