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PRECISION OPTICS TECHNICIANS SKILL STANDARDS

CRITICAL WORK FUNCTIONS and TASKS

- 1. Identify, inspect, and qualify bulk materials for manufacturing high tolerance optical components.**
 - a. Review incoming material certification sheets to match print specifications.
 - b. Inspect and evaluate materials for defects like inclusions, bubbles, striae, scratches, bulk stress, scattering, fractures, and impurities.
 - c. Ensure physical safety in handling the material by following prescribed procedures.
 - d. Follow material handling procedures to avoid contamination.
 - e. Initiate documentation of the job jacket.

- 2. Plan and upgrade high tolerance optical fabrication processes.**
 - a. Use design specifications and technical drawings to meet specified tolerances.
 - b. Understand basic processing techniques for producing aspheric components.
 - c. Assist in the selection of the fabrication process.
 - d. Recommend process changes to increase quality and efficiency.
 - e. Identify standard operating and safety procedures of the optics shop and equipment required in the process.
 - f. Where applicable define rapid prototyping process.

- 3. Shape and finish bulk materials to generate high tolerance optical components.**
 - a. Determine and perform procedures for tooling, blocking, generating, shaping, beveling, grinding, polishing and centering.
 - b. Observe accepted procedures for handling optical materials.
 - c. Apply appropriate procedures for processing a variety of optical materials like glass, crystals, glass ceramics, and plastics.
 - d. Monitor dimensionality to ensure adherence to specifications and tolerances.
 - e. Retrieve, clean, store, and secure the finished optical components to ensure their integrity.

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- 4. Operate, maintain, and calibrate high tolerance optics manufacturing equipment.**
 - a. Use proper procedures to operate CNC machines.
 - b. Apply accepted standards to maintain work area cleanliness such as lean manufacturing principals. (Suggest adding components of Lean manufacturing throughout the program)
 - c. Inspect the performance of equipment to ensure optimal use and productivity.
 - d. Using the work instruction template, verify set points in the control screens.
 - e. Perform standard maintenance as prescribed by the equipment manufacturer.

- 5. Conduct optical metrology measurements and inspections for final distribution.**
 - a. Interface with quality assurance inspectors to assess compliance to print / design specifications.
 - b. Test finished components by test plate or interferometric techniques to ensure compliance with design specifications.
 - c. Use autocollimators to measure dimensional and angular deviations in finished components.
 - d. Basic use of collimator or interferometer to measure focal length and on-axis aberrations.
 - e. Inspect surface quality of finished product using ANSI scratch and dig standards.
 - f. Measure surface roughness using white light interferometry or other optical means.
 - g. Measure forms using profilometer or coordinate measuring device
 - h. Determine and select appropriate packaging of optics for protection, storage and shipping
 - i. Document final inspection results to close out job jacket.
 - j. Be acquainted with the functions of a quality assurance department and its role in the manufacturing process.
 - k. Follow statistical process control guidelines for sampling finished components.

- 6. Assembly of Achromats, components and optical systems**
 - a. Interpret assembly drawings.
 - b. Apply proper clean room and air-flow work bench procedures.
 - c. Use proper alignment techniques to assemble achromats.
 - d. Work with various optical adhesives and epoxies (UV, etc.), demonstrating full understanding of selection and use of each.
 - e. Mount optical components in mechanical assemblies.
 - f. Actively align and pot elements in cells.
 - g. Measure conformance and performance via mechanical and/or optical means.

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7. Coating of optical components

- a. Interpret drawings for coating specifications.
- b. Clean optics for coating, exhibiting full understanding of proper cleaning and inspection techniques.
- c. Load and operate coating equipment to apply thin film coatings to proper prescription demonstrating an understanding of thin film theory.
- d. Operate spectrometer to test coating performance on witness samples.

We haven't included anything on thin film coatings or the testing of optical assemblies. These are a couple of topics that should be included. There may be others.

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TECHNICAL SKILLS

1. Determine optical, chemical, thermal, and mechanical properties of selected materials from handbooks, supplier specification sheets , and internet sources
2. Apply chemical safety procedures
3. Evaluate physical properties of materials for hardness, cleavage, fracturing, and chemical stability.
4. Use a loupe to identify bulk material defects such as inclusions, bubbles, striae, scratches, and fractures.
5. Use polarization measurement techniques to identify internal stress.
6. Basic knowledge of hardness testing procedures/equipment such as Mohs scratch and Knopp Hardness Instrument. Optimax adds - This is not a common procedure in our operation, but is useful knowledge.
7. Knowledge of basic optical principles like Snell's Law, Fresnel reflection, refractive dispersion, total internal reflection and Brewster's Angle.
8. Follow material handling procedures for personal safety, to prevent material damage and avoid contamination.
9. Read and interpret technical drawings and specifications.
10. Operate common machine shop equipment for metals such as lathe, band saw, drill press, and milling machines.
11. Be able to select appropriate abrasives including grit size and composition to achieve design tolerances and specifications for specific materials.
12. Optimize fabrication tools and parameters to increase efficiency and quality
13. Prepare the fixtures for mounting starting material for fabrication process.
14. Determine the interaction between various materials used in high tolerance optics fabrication like hot pitch and acetone.
15. Operate cutoff and wire saws, abrasive grinding machines and coring machines to shape optical materials to specifications.
16. Operate special grinding and polishing machines to generate cylindrical and toric optics.
17. Evaluate finished product per company specifications.
18. Maintain and prepare conduits and pumps for cooling and slurry delivery to work surface.
19. Align physical and optical centers per specifications.
20. Use calipers, micrometers, depth gauges and spherometers.
21. Clean optics to appropriate specification level.
22. Store optics in appropriate containers with environmental control.
23. Measure deviations from specifications in dimensionality and surface quality.
24. Program CNC Controllers according to specifications.
25. Assess CNC performance against specifications.

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26. Apply maintenance instructions from manufacturer's equipment manual
27. Follow instructions for entering and operating in a clean room.
28. Analyze and evaluate interferometric fringe patterns
29. Measure optical properties using an autocollimator.
30. Measure surface quality using a scratch-and-dig inspection box.
31. Measure surface roughness with white light interferometry or laser surface profiler
32. Measure shapes using profilometer or coordinate measuring device
33. Evaluate shipping conditions for finished optical components to determine appropriate packaging.
34. Use basic mathematics concepts to include fractions, decimals, ratio, proportion, powers, algebra, units and conversion, angle measurements, geometry, scientific notation and trigonometry.
35. Use decibel and metric/English units.
36. Be able to identify the functions and shapes of various optics components
37. Use quality assurance criteria to determine deficiencies in design specifications.

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EMPLOYABILITY SKILLS

1. Reads instructions and follows company procedures.
2. Present technical information clearly and concisely in written and oral form.
3. Manage time schedules for fabrication runs.
4. Use materials and resources efficiently.
5. Use proficiently hand calculators and computers.
6. Maintain effective tracking data on parts and support materials-distribution systems
7. Establish effective working relationships with others involved in processing and fabrication of materials and parts.
8. Identify and assimilate information from prior shifts to determine process status on parts.
9. Perform problem solving and trouble-shooting strategies.
10. Work responsibly with minimum supervision.
11. Work cooperatively with others.
12. Follow laboratory safety rules and regulations.
13. Exercise good judgment in quickly and accurately reporting accidents to supervisors.
14. Navigate the internet to gather information.
15. Be punctual for work days, assignments, and tasks.
16. Be able to evaluate graphical and tabular data.
17. Maintain daily laboratory notebooks.
18. Create and implement system-schedule maintenance plan.