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Personal Instruction. Real-time interaction.

Effective, focused, and efficient training chosen specifically for optical manufacturing professionals. Take advantage of the unique opportunity to learn from some of the most experienced and accomplished minds in industry and research, and interact with peers who share similar challenges.

• 2 New Courses: The Proper Care of Optics and Fundamentals of Optical Engineering

• Suite of Standards Training Courses: Scratch and Dig, Optics Surface Inspection Hands-on Workshop, and Modern Optical Drawings

• 3.5 hour course on optics fundamentals great for exhibitors, sales reps, marketers, and managers!

MONEY-BACK GUARANTEE
We are confident that once you experience an SPIE course for yourself you will look to us for your future education needs. However, if for any reason you are dissatisfied, we will gladly refund your money. We just ask that you tell us what you did not like; suggestions for improvement are always welcome.

CONTINUING EDUCATION UNITS
SPIE is accredited by the International Association for Continuing Education and Training (IACET) and is authorized to issue the IACET CEU.
Fastening Optical Elements with Adhesives

SC015 • Course Level: Intermediate • CEU: 0.4
$300 Members • $355 Non-Members USD
SPIE Student Members: $172
Monday 8:30 am to 12:30 pm

Optomechanical systems require secure mounting of optical elements. Adhesives are commonly used, but rarely addressed in the literature. This course has compiled an overview of these adhesives, their properties, and how to test them. How to use them is addressed in detail with guidelines and examples provided. A summary of common adhesives is presented with justification for their use. Consideration and analysis of adhesive strength, reliability, and stability are included. Different design approaches to optimize the application are presented and discussed. Many examples are described as well as lessons learned from past experience. Discussions are encouraged to address current problems of course attendees.

LEARNING OUTCOMES
This course will enable you to:
• describe and classify adhesives and how they work (epoxy, urethane, silicone, acrylic, RTV, VO-cure, etc.)
• obtain guidance in: adhesive selection, surface preparation, application, and curing
• develop a basis for analysis of stress and thermal effects
• recognize contamination/outgassing and how to avoid it
• review design options
• create and use an adhesive check list

INTENDED AUDIENCE
This course is for engineers, managers, and technicians. This course provides a foundation for the correct design for successful optical mounting; an understanding of the best options to employ for each application, and the selection and approach conducive to production. A bound course outline (that is a good reference text) is provided, including summaries of popular adhesives and their properties.

INSTRUCTOR
John Daly has 35 years of experience in lasers and optomechanics. Over this period, he has worked optical bonding problems since his thesis projects, as an employee of several major corporations, and now as a consultant. His academic background in mechanical engineering and applied physics complements this discipline. His work experience has been diverse covering areas such as: military lasers, medical lasers, spectroscopy, point and standoff detection, and EO systems. His roles over these years have included analysis, design, development, and production. He is an SPIE member, with numerous publications, and is a committee member of the SPIE Optomechanical Engineering Program.

Attendee testimonial:
That was an amazing amount of material!! Possibly the most applicable & easy to apply short course I've ever taken.

Optical Scatter Metrology for Industry

SC1003 • Course Level: Intermediate • CEU: 0.4
$370 Members • $425 Non-Members USD
SPIE Student Members: $200
Tuesday 1:30 pm to 5:30 pm

The course emphasizes quantifying, measuring and understanding scatter. A scatterometer will be used during the class to illustrate these issues and students are encouraged to bring samples to the course. Optical scatter, originally used almost exclusively to characterize the stray light generated by optically smooth surfaces, is now being used as a fast, economical way to monitor the surface texture requirements in a variety of industries. For example, as the lighting industry moves to LED’s scatter from a huge number of components is being measured for analysis in stray radiation codes. Texture is an important requirement for the metal producing industry and it changes with roll wear. The appearance of every day appliances (from door hinges to computer cases) varies dramatically with texture. The quality of flat panel displays depends on the scatter characteristics of the screen and components behind it. SEMI and ASTM have responded to the new applications with “scatter standards” to help communication between manufacturers, vendors and customers. The course starts with easier to analyze optical applications and then explores the transition to rougher industry surfaces, where the measurements are easier. Between a good optical mirror and a concrete sidewalk there are thousands of industry surfaces that can be monitored with scatter metrology. There are two key points for these “in-between” surfaces: (1) If the texture changes — the scatter changes and (2) these changes (and product function) cannot be adequately monitored by a single variable - such as RMS Roughness, Haze or Gloss. Students are asked to share as much as they can of their scatter metrology issues.

LEARNING OUTCOMES
This course will enable you to:
• quantify and analyze scatter in terms of BRDF, ARS, TIS, Haze and DSC units
• explain the instrumentation for obtaining scatter data and evaluate system calibration
• describe and overcome the various difficulties in comparing roughness statistics found from profilometers and scatterometers for both isotropic and non-isotropic samples
• convert scatter to roughness statistics if possible and understand when it is not possible
• evaluate the use of scatter measurements for specific applications such as: stray system radiation, surface micro-roughness, particulate sizing and background sensor noise
• explain the use of polystyrene latex sphere depositions as an optical scattering standard
• review scattering standards for the semiconductor and photo-voltaic industries

INTENDED AUDIENCE
Engineers, scientists, and managers who need to understand and apply the basic concepts of scatter metrology to laboratory research and industrial process control. Some knowledge of calculus is helpful, but the course does not require that the student
Courses

follow mathematical derivations. The instructor has worked with Thomas Germer (SC492 instructor) to avoid overlap between the two courses.

INSTRUCTOR

John Stover is President of The Scatter Works, Inc., a Tucson firm concentrating on scatter based metrology standards, consulting, instruments and measurements as they apply to diverse industries. He has researched light scatter related problems for over 40 years and led teams of engineers who developed state-of-the-art scatterometers, verified theoretical relationship between surface roughness and scatter and characterized surface defects to improve wafer metrology. He has been involved with international standards organizations for over 20 years, is an SPIE Fellow, and has been active as an author, conference chairman, and editor, and has over one hundred publications including the following book.


Understanding Scratch and Dig Specifications

SC700 • Course Level: Introductory • CEU: 0.4 $400 Members • $455 Non-Members USD SPIE Student Members: $212 Monday 8:30 am to 12:30 pm

Surface imperfection specifications (i.e. Scratch-Dig) are among the most misunderstood, misinterpreted, and ambiguous of all optics component specifications. This course provides attendees with an understanding of the source of ambiguity in surface imperfection specifications, and provides the context needed to properly specify surface imperfections using a variety of specification standards, and to evaluate a given optic to a particular level of surface imperfection specification. The course will focus on the differences and application of the Mil-PRF-13830, ISO 10110-7, and BSR/OP1.002. Many practical and useful specification examples are included throughout, as well as a hands-on demonstration on visual comparison evaluation techniques.

The course is followed by SC1017 Optics Surface Inspection Workshop, which provides hands-on experience conducting inspections using the specification information provided in this course.

LEARNING OUTCOMES

This course will enable you to:
• describe the various surface imperfection specifications that exist today
• compose a meaningful surface imperfection specification for cosmetic imperfections using ISO, ANSI, or Mil standards
• identify the different illumination methods and comparison standards for evaluation
• demonstrate a surface imperfection visual inspection
• understand the options available for controlling surface imperfections in a vendor/supplier relationship

INTENDED AUDIENCE

This material is intended for anyone who needs specify, quote, or evaluate optics for surface imperfections. Those who either design their own optics or who are responsible for optics quality control will find this course valuable.

INSTRUCTOR

David Aikens a.k.a “the scratch guy”, is among the foremost experts on surface imperfection standards and inspection. Dave is President and founder of Savvy Optics Corp., is the head of the American delegation to ISO TC 172 SC1, and is currently the Executive Director of the Optics and Electro-Optics Standards Council, OEOSC.

COURSE PRICE INCLUDES a copy of the latest ANSI approved surface imperfections specification standard.

Optics Surface Inspection Workshop

SC1017 • Course Level: Introductory • CEU: 0.4 $400 Members • $455 Non-Members USD SPIE Student Members: $212 Monday 1:30 pm to 5:30 pm

Due to the hands-on nature of this course, class size is limited to 12 participants. Early registration is recommended.

Understanding the correct way to inspect optical surfaces is one of the most important skills anyone working with or around optics can have, including technicians, material handlers, engineers, managers, and buyers. While understanding the specifications is the first step, learning how to actually perform the inspection is just as important. This hands-on workshop will allow attendees to learn the “Best Practice” for cleaning and inspecting optical surfaces. The course has many demonstrations and labs and gives attendees practice handling and inspecting optics to develop a high level of proficiency.

This course was designed to bring photonics personnel up to an immediate working knowledge on the correct methods to conduct a surface inspection in accordance with MIL, ANSI, and ISO standards. It is designed to complement SC700 Understanding Scratch and Dig Specifications and provide hands-on experience applying the specification and inspection parameters covered in that course.

LEARNING OUTCOMES

This course will enable you to:
• perform a visual review of the surface
• create a surface map
• safely clean the surface using air only, and the drag method
• assess when magnification or high-intensity light is allowed or required
• conduct a visual inspection according to MIL-PRF-13830B
• conduct a visual inspection according to ANSI OP1.002
• conduct a visual inspection according to ISO 10110-7 and ISO 14997 standards
• acquire and apply the accumulation rules
• review the tools available for microscope-based inspection to ANSI and ISO standards
• evaluate a surface and determine if a surface passes or fails
INTENDED AUDIENCE
This course is designed for all optical practitioners who need to handle and evaluate optics or optical assemblies. Other suggested attendees include mechanical engineers, purchasing agents, quality assurance personnel and other persons working with or around optical components. <b>SC700 Understanding Scratch and Dig Specifications is a pre-requisite for the course.</b>

INSTRUCTOR
David Aikens a.k.a “the scratch guy”, is among the foremost experts on surface imperfection standards and inspection. Dave is President and founder of Savvy Optics Corp., is the head of the American delegation to ISO TC 172 SC1, and is currently the Executive Director of the Optics and Electro-Optics Standards Council, OEOSC.

COURSE PRICE includes a copy of the OP1.002 the American National Standard for surface imperfections on optics, if desired.

ATTENDEE TESTIMONIAL:
Wonderful! I've learned many skills that I can use every day.

Geometric Dimensioning and Tolerancing
SC1040 • Course Level: Introductory • CEU: 0.7
$525 Members • $635 Non-Members USD
SPIE Student Members: $284
Thursday 8:30 am to 5:30 pm

Costly errors are made when Geometric Dimensioning concepts and tolerance characteristics are not fully understood. This course is designed to familiarize personnel responsible for interpreting a technical drawing to estimate, inspect, and manufacture a part or assembly with symbology, principles, and concepts, associated with Geometric Dimensioning and Tolerancing ASME Y14.5-2009. This course will cover all topics related to GD&T, but will focus on Geometric Dimensioning and verification concepts as they apply to the Optics Industry.

LEARNING OUTCOMES
This course will enable you to:
• obtain an overview of the different used optical and mechanical standards
• become familiar with Geometric Dimensioning and Tolerancing ASME Y14.5-2009 standards
• define Terminology and Symbology
• review new symbols in the 2009 Standard
• utilize Rules and Concepts
• calculate Material Conditions
• interpret Tolerance Zones for GD&T Applications
• interpret Geometric applications as they relate to the optics industry
• list Inspection Requirements

INTENDED AUDIENCE
Estimators, Engineering, Inspectors, and Operators responsible for print interpretation.

INSTRUCTOR
Walt Prystaj is the director of PEN Associates LLC, a training and consulting firm, and adjunct faculty at Rochester Institute of Technology, as well as a trainer for Finger Lakes Community College, Monroe Community College, Genesee Community College, and other educational institutions. He is a graduate of the University of Oswego, completed a Tool and Die Apprenticeship at Eastman Kodak, and is a former tool and die company owner. Walt has been training Geometric Dimensioning and Tolerancing in industry for over twenty-five years at more than 150 companies.

Introduction to Modern Optical Drawings – the ISO 10110 Standard
SC863 • Course Level: Introductory • CEU: 0.4
$300 Members • $355 Non-Members USD
SPIE Student Members: $2172
Wednesday 8:30 am to 12:30 pm

Since the late 1990’s, the optics community has gradually been converting optics drawings from a free-form, notes-based method to a standardized, international pictographic method. In 2013, the United States will join the international community by adopting a version of ISO 10110 as the American National Standard for optics drawings. This new method is a great boon for an industry in need of standardization, but can be very confusing to the uninitiated.

This course provides attendees with an introduction to ISO-10110, the international standard for optics drawing notations. The course concentrates on the fundamentals of the drawing layout and how to read the notations required for typical optics, such as glass parameters, radius, wave-front, surface imperfections and roughness. Attendees are also informed about how the American version is going to differ from the current international standard. Practical and useful examples are included throughout.

LEARNING OUTCOMES
• read and interpret an optical drawing prepared to ISO 10110
• identify the meaning of the symbology and specifications of ISO 10110 for materials imperfections, surface form, wedge, surface imperfections, and surface texture
• describe which symbol corresponds to each of the fundamental optical parameters
• compose and interpret an ISO 10110-compliant optical element drawing

INTENDED AUDIENCE
This material is intended for anyone who has a basic understanding of optics, and encounters or generates optical drawings in the course of their work. Those who either design their own optics, work with optical designers, work with optical suppliers, or manufacture optics will find this course valuable.

INSTRUCTOR
David Aikens is President and founder of Savvy Optics Corp., and has been involved in optics drawings and specifications for over 20 years. He is the head of the American delegation to ISO TC 172 SC1, and is the Executive Director of the Optics and Electro-Optics Standards Council. He is also chairman of the project to adopt ISO 10110 as the American National Standard for optics drawings.
Courses

The Proper Care of Optics: Cleaning, Handling, Storage and Shipping

SC1114 • Course Level: Introductory • CEU: 0.4 $345 Members • $400 Non-Members USD SPIE Student Members: $190 Tuesday 1:30 pm to 5:30 pm

This course is also available in online format.

There are many ways to clean optics; some are learned from experience and/or failure. This course explains the proper cleaning methods for optics that are used by professional optical technicians and engineers.

How to clean optics has always been a challenging and controversial subject. Searching the Internet will yield hundreds of articles and videos that claim to know the best methods. This course will explain the simple steps used in cleaning optics. It will also describe the proper handling, storage and shipping of optical components. The course is designed for a diverse audience, from a first-time optical cleaner to an engineer searching for methods of handling and packaging optics. An in-class demonstration on inspecting and cleaning optics will be presented.

LEARNING OUTCOMES

This course will enable you to:

• identify proper cleaning tools and their use
• explain safety guidelines, personal protection equipment and basic worktable layout
• compare lighting types required for inspection and cleaning
• identify solvents and cleaning liquids used for removing contaminates
• describe hand techniques used for applicators, wipes, and how to fold wipes
• explain inspection methods for optical surfaces
• list the types of contaminants and describe a short history of scratch and dig
• describe visual methods used: unaided eye, eye loupe, microscope (light and digital)
• describe types of optical coatings
• explain proper cleaning of small, large and infrared optics
• describe special cleaning techniques
• explain techniques used for instrument inspection, disassembly, assembly, and cleaning
• describe various instrument types
• describe the tricks of the trade: edge cleaning, protection, black paint and removing glue
• describe handling of optics using tweezers, cups, trays, storage and protection methods
• summarize shipping containment methods
• explain outdoor field cleaning

INTENDED AUDIENCE

Technicians, engineers, scientists and managers who wish to learn the methods of cleaning, handling, storage and shipping of optics. High school to graduate degree.

INSTRUCTOR

Robert Schalck is an Optical Engineer with over 40 years experience in the optical industry, and author of the text “The Proper Care of Optics” (SPIE Press, 2013) as well as an SPIE Online Course of the same title. He presented his first paper on cleaning optics at the OSA OF&T workshop in 1975. In 1989, he delivered a paper on Classical Optical Cleaning at the OSA “How to Conference.” Over several decades, he has given presentations on how to clean optics to groups and organizations. He is a Senior Member of OSA and SPIE.

Optical Manufacturing Fundamentals

SC1169 • Course Level: Introductory • CEU: 0.7 $555 Members • $665 Non-Members USD SPIE Student Members: $296 Monday 8:30 am to 5:30 pm

This course provides a familiarity with precision optical manufacturing and metrology; and an introduction to the materials, machinery, tooling, methods, processes, metrology, and production flow used to fabricate precision optical elements. The optical, thermal, and working properties of common optical materials will be compared. The processes and machinery involved in shaping, finishing, measuring, cleaning, and coating optical components will be described. Strengths and limitations of metrology instruments and methods will be discussed. An overview of the ISO drawing indications will be presented.

This course serves as both successor and tribute to Bob Novak’s long-running SC350 Optical Manufacturing Overview course that has been a staple at the Optifab event.

LEARNING OUTCOMES

This course will enable you to:

• describe the normal process flow in the manufacturing of spherical optical components
• explain blank preparation, curve generating, grinding, polishing, and centering processes
• classify the metrology needed for each step in the manufacturing process cycles
• compare the applicability of various optical fabrication techniques and equipment
• judge the relative difficulty of fabricating different materials in various configurations
• relate optical performance to tolerances and tolerances to manufacturing processes
• compute optimal lot quantity breaks
• facilitate clear communication between engineers, sales, and opticians

INTENDED AUDIENCE

The course brings mutual understanding to a dual audience: Optical fabrication technicians who seek to gain greater depth and broader context for their specialties; and engineers, sales people, and buyers who require an awareness of current optical fabrication methodology as well as “lead times” associated with low volume production.

INSTRUCTOR

Ray Williamson has a 45-year career in precision optics. He holds a BS in Physics with a concentration in optics. He has been a hands-on optician on components ranging from micro to massive; a process engineer developing fabrication and testing methods, tooling, and sequences; an engineering manager responsible for staffing, documentation,
methods, budgets, and customer technical contact; and a quality assurance manager creating and administering a quality and calibration system. He has provided courses to several hundred opticians. He works with ANSI/OEOSC as an American delegate to ISO on drawing standards. His consulting work at Ray Williamson Consulting concentrates on manufacturing, and qualifying optical components, training technicians, and technical writing. He is a Senior Member of both SPIE and OSA, and the author of the Field Guide to Optical Fabrication.


Seeing, Analyzing and Controlling Mid-Spatial Frequency (MSF) and Surface Roughness Errors on Optical Surfaces

SC1171 • Course Level: Introductory • CEU: 0.4
$300 Members • $355 Non-Members USD
SPIE Student Members: $172
Thursday 8:30 am to 12:30 pm
This course is designed to reinforce the fundamentals of seeing, measuring and analyzing surface roughness and mid-spatial frequency (MSF) errors. After reviewing these fundamentals this course will cover how MSF errors are created, controlled and/or minimized using a variety of conventional and state of the art CNC optical manufacturing methods.

LEARNING OUTCOMES
This course will enable you to:
• differentiate between surface roughness and mid-spatial frequency errors
• describe how MSF errors are formed or controlled on optical surfaces
• identify causes of MSF errors in the manufacturing process
• communicate with others regarding MSF tolerances

INTENDED AUDIENCE
This is an introductory course intended for individuals that design, fabricate or measure optical surfaces who wish to learn more about mid-spatial frequency errors. Undergraduate training in engineering or science is assumed.

INSTRUCTOR
Jessica DeGroote Nelson is the Director of Technology and Strategy at Optimax Systems, Inc. She specializes in optical materials and fabrication processes. She is an adjunct faculty member at The Institute of Optics at the University of Rochester teaching an undergraduate and graduate course on Optical Fabrication and Testing, and has given several guest lectures on optical metrology methods. She earned a Ph.D. in Optics at The Institute of Optics at the University of Rochester. Dr. Nelson is a member of both OSA and SPIE.

Fundamentals of Optical Engineering

SC1224 • Course Level: Introductory • CEU: 0.4
$300 Members • $355 Non-Members USD
SPIE Student Members: $172
Wednesday 1:30 pm to 5:30 pm
This course explains fundamental principles and applications of optics. The basic characteristics and the design of optical components and systems will be discussed. For perspective, general topics such as the history of optics and the presence of optical phenomenon in our everyday lives will be included. All information will be presented in a conversational format, with no requirement for dealing with complex theories or mathematics. This course will include hands-on demonstrations of optics phenomena.

LEARNING OUTCOMES
This course will enable you to:
• explain fundamental concepts of optics
• identify basic optical components
• describe basic optical systems
• compare relative optical performance
• describe how concepts in optics play a role in applications or devices found in modern society
• explain the functioning of the human visual system

INTENDED AUDIENCE
Engineers, technicians, sales professionals, and support staff interested in learning more about optics. Attendance will enhance the understanding and specification of basic optical principles, components, and systems.

INSTRUCTOR
Alexis Vogt Ph.D. is Endowed Chair and Associate Professor of Optics at Monroe Community College. In addition to teaching responsibilities, Dr. Vogt was appointed to her role at MCC in September 2015 to strengthen and grow the optics and photonics program – the nation’s oldest two-year degree program for training technicians to work in the optics and photonics industry. Dr. Vogt received her B.S. as well as her Ph.D. in Optics from the University of Rochester Institute of Optics where her research focused on polarization engineering, coherence theory, and microscopy. Prior to joining MCC, Dr. Vogt was the Applications & Business Development Manager at Melles Griot and previous to that, designed contact lenses and intraocular lenses for Bausch + Lomb. In addition to her industry experience, Dr. Vogt holds three patents and has authored numerous papers, presentations, and publications in the field, including the definitions of “light” and “polarization” for The World Book Encyclopedia.
“The instructor was skilled and clear in his presentation. In contrast to some other courses I have taken there is value in using the higher definition of the videos where the video is available as the presenter actually gestures and contributes to the presentation.”

– Online course taker on Mounting of Optical Components

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