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- ASC Exterior Technologies
- ASQ China
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- Division
- Dixie Aerospace LLC
- Doncasters Blaenavon
- Eaton Corp.
- EGAP and NAFCO
- EKK Eagle Industry Co., Ltd.
- Elbit Systems of America
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- Henkel Corporation, Aerospace Group
- Hitchiner Manufacturing Co.
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- Howmet Dover Casting
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- Hypertherm Inc.
- IHI Corporation Japan
- IMP Aerospace & Defense
- Industrial Neotex S.A.
- ITP Ingenieria Y Fabricacion
- ITP Tubes
- ITT Industries Inc.
- Jet Propulsion Laboratory
- Kessington LLC
- L&E Engineering
- Labinal
- Lewis Engineering Inc.
- LG Silicon Valley Lab
- Lockheed Martin
- Materion Brush Inc.
- MBS fabrication, Inc.
- Messier-Dowty Inc.
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- Miba Gleitlager Austria GmbH
- Moeller Mfg. Co.
- Morgan Advanced Materials, Wesgo Metals
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- Nemak
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- Northwire Inc.
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- Oerlikon Eldim (NL) B.V.
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WHY PROFESSIONAL DEVELOPMENT?

Your organization’s success depends on the knowledge and experience of your people.

Professional development or continued education and training, fosters a culture of improvement and achievement. Encouraging a lifetime of learning builds a team that strives for accomplishment and sets goals and standards for themselves and the organization.

A high-achieving technical team is knowledgeable and informed. Professional development fills the knowledge gaps, supplies information tools, and develops a team that performs and excels. When your workforce succeeds, your organization succeeds.
WHY SAE INTERNATIONAL FOR PROFESSIONAL DEVELOPMENT?

SAE is your industry’s trusted training resource.

Engineers and technical professionals in the ground vehicle and aerospace industries look to SAE as their trusted information resource and have done so for over 110-years. The Professional Development portfolio from SAE offers you access to 300+ live online, in-classroom, and on-demand learning programs. Programs in the technology areas shaping the automotive and aerospace industries. Courses designed to meet your specific needs with the right content to solve your specific challenges.

Thousands of professionals train through SAE’s portfolio to keep their organizations on the leading edge of technical and business subjects.

Contact Corporate Learning Solutions to schedule your next on-site training or to learn more about our programs.

Corporate Learning Solutions
+1.724.772.8529
corplearn@sae.org
training.sae.org/corplearning

Explore State Resources for Training Dollars

Often states and local economic development groups have grant dollars available for training. Contact your state’s Department of Labor or other groups in your area to research funds available for your organization.

For example, Michigan residents can visit michiganworks.org and enter their zip code to find local offices and Michigan Works! contacts in the area.
WHAT IS SAE CORPORATE LEARNING SOLUTIONS?

Professional development and training programs designed to meet your specific business need.

For 8 to 100+ employees, SAE works with you to design and deliver exactly the training you need at your site and to your team.

THROUGH SAE CORPORATE LEARNING SOLUTIONS YOU CAN:

• Select an existing instructor-led course for delivery at your site
• Order an on-demand course for one or many employees
• Purchase a corporate subscription for access to predefined course “bundles” and multiple titles
• Customize a learning experience to address your specific business needs
WHY SAE CORPORATE LEARNING SOLUTIONS?

SAE Corporate Learning Solutions offers:

**VARIETY**
Choose from over 300 titles in 22+ technology areas. The most extensive catalog of industry-relevant training among top training providers means we can meet your specific need.

**CUSTOMIZATION**
Select from our catalog or let SAE customize a training program. We can also integrate online learning for a “blended solution.” The right course material and the best learning platforms.

**INDUSTRY RELEVANCE**
Course instructors are leading academic and industry professionals. Plus, objective industry experts review and approve all SAE courses—assuring course content is relevant and accurate and taught by knowledgeable, experienced professionals.

**GUARANTEED QUALITY**
We award the IACET CEU—the original Continuing Education Unit (CEU). This accreditation requires us to meet a stringent standard of high-quality instruction guaranteeing a quality of professional development you won’t find elsewhere.

**CONVENIENCE**
We schedule the instructor, supply the course materials, learning assessments, and post-course evaluation forms and coordinate administrative details like instructor travel and accommodation or online connections. You simply arrange the space and forward supplied instructions to the learners. We strive to make arranging the training as easy as possible.

**COST EFFECTIVENESS**
Whether in-person or online, the instructor comes to you! No staff travel means no time out of the office and no travel expenses. Plus our extensive course catalog makes pricing extremely competitive! Meet your training AND budget obligations.

**TIMELINESS**
As the world’s leader in mobility engineering knowledge, our programs are developed and refined to stay ahead of industry trends; we offer only the most up-to-date and knowledgeable instructors supplying timely and relevant information and tools in a highly interactive learning environment.

**CURRICULUM CERTIFICATES**
Need a directed learning plan to meet a specific technology or business goal? SAE multi-course, curriculum certificates offer a directed map of training in a specific technology area. Choose an established certificate program for your group or work with a Corporate Learning program developer to plot out a program for your business or technical need.

---

**What determines the cost of Corporate Learning Solutions?**
- The length of the program (number of days or hours of learning contact time) or quantity of courses
- The learning materials—some courses include textbooks, learning materials, and other job aids
- The number of participants
- Any customization required
- The instructor’s travel expenses or connection fees

These variables are used to calculate a base fee (typically based on 10 participants). The fee increases as more participants are added.
NO OTHER TRAINING PROVIDER OFFERS THE BREADTH AND DEPTH OF TECHNICAL AND BUSINESS TOPICS TAILORED TO YOUR INDUSTRY

SAE’S PORTFOLIO OFFERS YOU AN EXTENSIVE RANGE OF COURSE TITLES FOR NEARLY EVERY LEVEL OF LEARNER.

Introductory and core technical courses offer knowledge development for the new or newly hired professional—course work that imparts the tools and training an engineering degree might not.

Intermediate and advanced coursework keep the experienced engineer up-to-speed and agile in his or her focus area.

Titles developed to address burgeoning or emerging technology, prepare your team for what’s changing in the industry.
COURSE TITLES COVER TECHNICAL TOPICS IN:

- Additive Manufacturing
- Aerospace Regulations and Standards
- Aerospace Supplier Quality
- Aircraft Systems
- Chassis/Vehicle Dynamics
- Cybersecurity
- Connected Vehicle Technology
- Electronics/Electronics Systems
- Engineering Tools and Methods
- Management and Leadership
- Managing Product Development
- Materials and Manufacturing
- Noise, Vibration, and Harshness
- Powertrain
- Propulsion
- Safety and Accident Reconstruction
- Geometric Dimensioning and Tolerancing

courses including introductory, intermediate and advanced coursework:

- Applications of GD&T
- Engineering Drawing Requirements
- Fundamentals of GD&T
- GD&T for Manufacturing
- Critical concepts of Tolerance Stacks

This is only a snapshot of the SAE Professional Development portfolio and the options available to you through SAE Corporate Learning Solutions. Work with a Corporate Learning Developer today to determine the best options to meet YOUR specific training challenge and to develop solutions to fit your budget and schedule.

ACCREDITATIONS

The IACET CEU

SAE International is recognized as an Accredited Provider by the International Association for Continuing Education and Training (IACET). All SAE Professional Development seminars, e-Seminars, web seminars, and engineering academies meet eligibility requirements for IACET Continuing Education Units (CEUs) according to the ANSI/IACET 1-2013 Standard. To receive CEUs, attendees are required to be engaged in the entire course and demonstrate mastery of the learning objectives by successfully completing a knowledge assessment.

Many organizations offer some form of continuing education credit, but only the IACET CEU is held to the strict, research-based IACET Criteria and Guidelines for Continuing Education and Training. Only IACET Authorized Providers, who undergo a strict application and site-review process, can award the IACET CEU. IACET Authorized Providers are required to re-apply and be reauthorized every five (5) years.

The Continuing Education Unit (CEU) was created by IACET as a measurement of continuing education. One (1) IACET CEU is equal to ten (10) contact hours of participation in an organized continuing education experience under responsible sponsorship, capable direction, and qualified instruction. Under IACET’s care, the IACET CEU has evolved from a quantitative measure to a hallmark of quality training and instruction. For more information on IACET, visit iacet.org.

To obtain official transcripts, please contact SAE Customer Service at +1.877.606.7323 (U.S. and Canada only) or +1.724.776.4970 (outside U.S. and Canada)
Explore classroom, live and online, or on-demand courses. Many courses are offered in multiple formats so be sure to watch for the icons that identify the format for each course.

Classroom offerings available as similar live, online Web Seminars will feature both icons and the course description for the Web Seminar will be listed immediately following the classroom title.

Live, online or classroom courses that have a similar course offered on-demand will include both icons – watch for those descriptions or notes on where to get additional information.

A LEARNING FORMAT TO FIT EVERY NEED

Accommodate diverse learning styles and needs with SAE’s variety of learning formats.

SEMINARS

SAE International offers over 200 seminar and classroom titles in 100+ separate technology and business skill topics. These courses range from one-to three-days and are led by highly-qualified, industry or academic experts. SAE live, classroom courses are interactive and encourage skill-development and problem solving. Each course includes comprehensive course materials to assist the learner in implementing the knowledge gained in the course.

Additionally, we offer courses throughout the year at the SAE International Office in Troy, Michigan; or at sights across the US and the world including at SAE International Engineering Events. View the public enrollment schedule on page 179 or at training.sae.org/calendar/.
SAE E-LEARNING

Learners can take advantage of the convenience and cost effectiveness offered by e-Learning from SAE. SAE maintains a growing menu of instructor-led, live online and SAE-produced on-demand courses; as well as courses from other training providers that have been reviewed and vetted by industry subject matter experts. These programs are listed throughout the catalog. Look for the icons that denote live online or on-demand.

Live, Online Courses

Informative and content-rich, SAE live, online courses are instructor-led programs delivered via WebEx® Training Center. Schedules and budgets can make it difficult to attend a classroom offering so SAE has developed a web seminar format to deliver technical courses directly. Delivered in one or a series of 90- to 120-minute sessions, Web Seminars feature audio delivered by telephone or VoIP, web-based presentations, interactive question-and-answer, and course-specific online forums for posting of supplemental materials, networking and course activities. Comprehensive course materials are also provided in PDF format. CEUs are awarded when course requirements have been met. Look for the live, online icon throughout the catalog.

On Demand Courses

Avoid travel expenses and time out of the office, and make learning fit into your schedule. Access SAE On Demand Courses right from your desktop, laptop or tablet device*. Many of our on-demand offerings are based on classroom seminars or are replays of our most popular SAE Web Seminars. We also provide short-courses designed to bring team members quickly up-to-speed on a specific subject. Look for the symbol in the course description to identify those titles that are delivered on-demand. Browse our growing library of individual and bundled technology and tools courses.

View the current on-demand course offerings in the On Demand Courses Resource Guide on pages 97-139.

*There are varying equipment requirements for the different online or on-demand options. Visit the webpage for each course to determine if your system meets the course equipment requirements.

On Demand Courses INCLUDE:
• Quick, short-duration courses on targeted topics
• Full length, self-paced courses based on our most popular instructor-led seminars
• Replays of recorded web seminars
• Courses on international standards, including ISO 9001, ISO 14001, ISO/TS 16949, and ISO 19011
• Course portfolios and bundles that focus on vehicle electrification, powertrain, quality, leadership, engineering tools and methods, metallurgy, additive manufacturing and more

Your company can subscribe to one title or multiple titles for just a few employees or the entire organization. Please contact the Corporate Learning Solutions hotline, +1.724.772.8529 for additional information or to get a proposal.

CATALOG KEY

You will see the following icons alongside the course descriptions. These icons indicate:
• delivery formats available for the ...... course
• the course is part of an SAE certificate
• that it is an ACTAR approved course

Many courses are available in multiple formats. See page X to get more information on the learning formats offered by SAE. In addition to finding courses that fit your technology need, look for courses with icons that fit the way you want to learn.

Classroom – indicates the course is an instructor-led seminar or workshop offered in a classroom setting

Live, Online – indicates the course is an instructor-led web seminar offered live and online via two-way audio and internet connection

On Demand – indicates the course is available online anytime the participant has internet access and the time to learn

Certificate – indicates the course is part of an SAE International curriculum-based, multi-course certificate. See a list of the multi-course certificates on page XII
SAE CREDENTIALING - ELEVATING KNOWLEDGE

Show the industry the depth of your organization’s expertise. SAE offers focused topic-specific credentialing programs for engineers and other professionals in ground vehicle and aerospace. Shine a light on their knowledge and expertise through SAE Credentialing.

Your team can earn an SAE Certification by passing industry-created and vetted exams. Get more information at training.sae.org/credentialing

How does it work?
• **Complete** established eligibility requirements (typically educational background and work experience)
• **Pass** an industry-developed, vetted, and proctored exam that tests mastery of an industry-defined body of knowledge
• **Earn** your industry recognized credential endorsing your experience and knowledge of the technology, and establishing a solid foundation on which to build a successful career.

Certifications must be maintained over 3-year period of time by fulfilling established maintenance requirements.

Or, expand their knowledge and build your organization’s reputation as an expert through industry-advised Certificate of Competency programs.

How does it work?
• **Complete** a course in a focused content area
• **Pass** an industry-vetted exam that verifies your understanding of the material
• **Earn** a Certificate of Competency or Certificate of Mastery

SAE Certification or Certificate of Competency – how does it benefit the ENGINEER?
• Validates their mastery of industry-driven training and learning objectives or confirms mastery of an industry-generated body of knowledge
• Imparts international recognition of experience and skills
• Provides a portable credential that is recognized across industry
• Demonstrates their commitment to continued growth and improvement

What is the value to the ORGANIZATION?
• Recognizes the capabilities of your people and enhances your company’s credibility with the industry as a supplier OR OE through an independent assessment
• Contributes to the hiring and promotion process – quickly illustrates the capabilities and experience of potential new hires or those you’d like to advance
• Encourages employee commitment to growth and opportunity
• Supports the promotion of professional competence

SAE currently offers the following Credentialing Programs:
The **Connected Vehicle Professional™ Program**: designed for all engineering, technical, and industry professionals who touch the “connected vehicle”, the multi-course program provides the understanding of vehicle and infrastructure connectivity necessary to operate within the rapidly advancing field of automated and connected vehicles.
EARN A CURRICULUM-BASED, MULTI-COURSE CERTIFICATE IN A SPECIFIC TECHNICAL AREA.

Need a directed learning plan to meet a specific technology or business goal? SAE multi-course, curriculum certificates offer a directed map of training in a specific technology area. Choose an established certificate program for your group or work with a Corporate Learning program developer to plot out a program for your business or technical need.

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Watch for the certificate icon to indicate course titles that are part of an SAE multi-course certificate.

**Accident Reconstruction Certificate Program**

Professionals become more proficient in the practice of vehicle crash/accident reconstruction by successfully completing this certificate program from SAE. Required courses guide one through crash reconstruction methods, vehicle dynamics, and event data recorder (EDR) technology then completion of three elective courses suit the individual’s specific technical interest area.

The following are required courses:

- **Vehicle Crash Reconstruction: Principles and Technology** (I.D.# C1728)
- **Vehicle Dynamics for Passenger Cars and Light Trucks** (classroom - 99020; or on-demand option) OR **Applied Vehicle Dynamics** (I.D.# C0414)
- **Applying Automotive EDR Data to Traffic Crash Reconstruction** (I.D.# C1210) OR **Accessing and Interpreting Heavy Vehicle Event Data Recorders** (I.D.# C1022)

Choose three electives:

- **Advanced Vehicle Dynamics for Passenger Cars and Light Trucks** (I.D.# C0415)
- **Photogrammetry and Analysis of Digital Media** (I.D.# C1728)
- **Hydraulic Brake Systems for Passenger Cars and Light Trucks** (I.D.# C0509)
- **High-Performance Brake Systems** (I.D.# C0718)
- **Introduction to Brake Control Systems: ABS, TCS, and ESC** (classroom - I.D.# C0315; or on-demand option)
- **Basic Tire Mechanics and Inspection** (I.D.# C1423)
- **Tire Forensic Analysis** (I.D.# C1424)
- **Tire and Wheel Safety Issues** (I.D.# C0102)
- **The Tire as a Vehicle Component** (I.D.# C0101)
- **Injuries, Anatomy, Biomechanics & Federal Regulation** (I.D.# 85049)
- **Commercial Vehicle Braking Systems** (I.D.# C0233)
- **Fundamentals of Automotive All-Wheel Drive Systems** (I.D.# C0305)
- **Reconstruction and Analysis of Motorcycle Crashes** (I.D.# C1502)
- **Reconstruction and Analysis of Rollover Crashes of Light Vehicles** (I.D.# C1506)
- **Applying Automotive EDR Data to Traffic Crash Reconstruction** (if not taken as a required course – I.D.# C1210)
- **Accessing and Interpreting Heavy Vehicle Event Data Recorders** (if not taken as a required course – I.D.# C1022)

**Diesel Technology Certificate Program**

This certificate equips engineers with a solid understanding of diesel engines, emissions and aftertreatment strategies, and related components including fuel injection and air management. The program requires completion of courses that address these areas and offers further depth through a menu of electives.

The required courses are:

- **Diesel Engine Technology** (classroom - I.D.# 93014; or on-demand option)
- **Common Rail Diesel Fuel Injection** (I.D.# C0920)
- **Turbocharging Internal Combustion Engines** (I.D.# C0314)
- **Advanced Diesel Particulate Filtration Systems** (I.D.# C0502)

Choose one elective:

- **Diesel Engine Noise Control Web Seminar or Web Seminar RePlay** (I.D.# WB1041; PD331041ON)
- **Exhaust Flow Performance and Pressure Drop of Exhaust Components and Systems** (I.D.# C0235)
- **Exhaust Gas Recirculation (EGR) for Diesel Engines** (I.D.# C1214)
- **Selective Catalytic Reduction for Diesel Engines** (I.D.# C0913)
- **Variable Valve Actuation Design and Performance Impact on Advanced Powertrains** (I.D.# C1332)
- **Engine Failure Investigation and Analysis** (I.D.# C1344)

Completion of the **Diesel Engine Technology Engineering Academy** can be used as a substitute for **Diesel Engine Technology** and one elective.
General Management and Leadership Certificate Program

This program focuses on four core management and leadership competencies: management capability, team leadership, project management, and finance providing a basis for growth into a leadership or management role.

All of the following courses are required:
- Managing Engineering & Technical Professionals (I.D.# C0608)
- Engineering Project Management (I.D.# 99003)
- Principles of Cost and Finance for Engineers (I.D.# C0828)
- Leading High Performance Teams (I.D.# C0410)

Attending the Engineering Management Academy serves as a substitute for Managing Engineering and Technical Professionals and Leading High Performance Teams required courses.

Product Engineering Tools and Methods Certificate Program

This program focuses on the study, development, management and implementation of product engineering principles, methodologies and techniques. When used properly, these tools and methods become powerful productivity enhancers reducing product development time and cost through improved communication, documentation, problem-solving, and quality.

This certificate program can be completed entirely online through web seminar or on-demand course participation.

All of the following courses are required:
- Design of Experiments (DOE) for Engineers Web Seminar (I.D.# WB0932) OR classroom seminar - Design of Experiments for Engineers (DOE) (I.D.# C0406)
- Finite Element Analysis (FEA) for Design Engineers Web Seminar (I.D.# WB1241)
- Fundamentals of Geometric Dimensioning & Tolerancing (GD&T) Web Seminar or Web Seminar RePlay (live, online: I.D.# WB0933; on-demand I.D.# PD330933ON)
- Tolerance Stack-Up Fundamentals Web Seminar or Web Seminar RePlay - (live, online: I.D.# C0842; on-demand I.D.# PD330842ON)
- Root Cause Problem Solving: Methods and Tools Web Seminar or Web Seminar RePlay (live, online: I.D.# WB0931; on-demand I.D.# PD330931ON)

Choose one elective:
- Accelerated Test Methods for Ground and Aerospace Vehicle Development (classroom - I.D.# C0316 or on-demand option)
- All three advanced web seminar/web seminar RePlay titles in the Geometric Dimensioning & Tolerancing Series (I.D.#s WB1319, WB1320, & WB1321)
- Design for Manufacturing & Assembly (DFM/DFA) (I.D.# 92047)
- Design Review Workshop (I.D.# C1506)
- Introduction to Design Review Based on Failure Modes (DRBFM) Web Seminar or Web Seminar RePlay (live, online I.D.# WB1047; on-demand I.D.# PD331047ON)

Additional elective courses:
Courses no longer offered by SAE but eligible to be used as electives for this program, providing they were completed within seven years of the date the Certificate is requested, include:
- Geometric Dimensioning & Tolerancing - classroom seminar (I.D.# C0133)
- Tolerance Stack-Up Analysis - classroom seminar (I.D.# C0022)
- Statistical Tolerance Design (I.D.# 88033)

Professional and Legal Issues Certificate Program

This program focuses on legal and risk management issues critical for engineers to master to facilitate the successful design and deployment of products from a safety and reliability perspective.

All of the following courses are required:
- Patent Law for Engineers (I.D.# 88007)
- Product Liability and The Engineer (I.D.# 82001)
- The Role of the Expert Witness in Product Liability Litigation (I.D.# 92054)
- Managing Programs and Associated Risks (I.D.# C0409)

SI Engine Certificate Program

This certificate is designed to familiarize engineers with key spark ignition engine components and technologies and how they function as a system. By completing the certificate, engineers can acquire fairly deep engine expertise and, at the same time, earn an SAE credential.

All of the following courses are required:
- Basics of Internal Combustion Engines (classroom - I.D.# C0103 or on-demand option)
- Internal Combustion Systems: HCCI, DoD, VCT/VVT, DI and VCR (I.D.# C0613)
- Turbocharging Internal Combustion Engines (I.D.# C0314)
- Powertrain Selection for Fuel Economy and Acceleration Performance (I.D.# C0243)

Choose one elective:
- Gasoline Direction Injection (GDI) (I.D.# C1009)
- Combustion and Emissions for Engineers (I.D.# 97011)
- Automotive Heat Transfer (I.D.# C1230)
- Exhaust Flow Performance and Pressure Drop of Exhaust Components and Systems (I.D.# C0235)
- Compact Heat Exchangers for Automotive Applications (I.D.# 97002)
- Fundamentals of Automotive Fuel Delivery Systems (I.D.# C0203)
- Engine Failure Investigation and Analysis (I.D.# C1344)
• Variable Valve Actuation Design and Performance Impact on Advanced Powertrains (I.D.# C1332)
• Introduction to Commercial and Off-Road Vehicle Cooling Airflow Systems Web Seminar RePlay (I.D.# PD3312400ON)

Additional elective courses:
Courses no longer offered by SAE but eligible to be used as electives for this program, providing they were completed within seven years of the date the Certificate is requested, include:
• Introduction to Commercial and Off-Road Vehicle Cooling Airflow Systems (classroom: I.D.# C0738; live online I.D.# WB1240)
• Piston Ring Design/Materials (I.D.# 86009)

Transmission/Drivetrain Certificate Program
This program familiarizes engineers with key drivetrain components and how those components function as a system. By completing the certificate, engineers can increase their expertise within the drivetrain body of knowledge and, at the same time, earn the SAE Certificate of Achievement.

All of the following courses are required:
• A Familiarization of Drivetrain Components (classroom - I.D.# 98024; or on-demand option)
• Fundamentals of Automotive All-Wheel Drive Systems (classroom - I.D.# C0305 or on-demand option)
• Fundamentals of Modern Vehicle Transmissions (classroom - I.D.# 99018; or on-demand option)
• Fundamentals of Gear Design and Application (I.D.# C0223)
• Powertrain Selection for Fuel Economy & Acceleration Performance (I.D. # C0243)

Vehicle Dynamics Certificate Program
Designed to equip engineers with key vehicle dynamics and handling theory and application from a systems perspective, the objective of this program is for engineers to understand the interaction and performance balance between the major vehicle subsystems. The program design requires completion of fundamental and advanced-level vehicle dynamics theory and application courses with three elective courses that best suit an individual's interest areas or engineering emphasis.

All of the following courses are required:
• Vehicle Dynamics for Passenger Cars and Light Trucks (classroom - I.D.# 99020; or on-demand option) OR
• Fundamentals of Heavy Truck Dynamics (I.D.#C0837)
• Advanced Vehicle Dynamics for Passenger Cars and Light Trucks (I.D.#C0415)

Choose three from these electives:
• Applied Vehicle Dynamics (I.D.# C0414)
• Fundamentals of Steering Systems (I.D.# C0716)
• Introduction to Brake Control Systems: ABS, TCS, and ESC - (classroom - I.D.# C0315; or on-demand option)
• The Tire as a Vehicle Component (I.D.# C0101)
• Tire and Wheel Safety Issues (I.D.# C0102)
• Fundamentals of Vehicle Suspension Design (I.D.# C1618)
• Commercial Vehicle Braking Systems (I.D.# C0233)
• Hydraulic Brake Systems for Passenger Cars and Light Trucks (I.D.# C0509)
• High-Performance Brake Systems (I.D.# C0718)

Courses no longer offered by SAE but eligible to be used as electives for this program, providing they were completed within seven years of the date the Certificate is requested, include:
• Chassis & Suspension Component Design for Passenger Cars and Light Trucks (I.D.# 95025)
• Heavy Vehicle Ride Comfort Engineering (I.D.# C0948)
• Fundamentals of Heavy Truck Dynamics (I.D.# C0837)
• Vehicle Dynamic Basics for Off-highway Trucks (I.D.# C1239)

Get more information on the curriculum-based, multi-course certificates at training.sae.org/credentialing/certificate/

Here’s how you obtain your SAE Certificate
Once you complete all required courses in any of the certificate programs, contact SAE Customer Service, +1.877.606.7323 (or +1.724.776.4970 outside U.S. & Canada) or email: customerservice@sae.org and request your Certificate. Your SAE transcript will be reviewed to verify completion of required courses and your Certificate will be mailed to you within 30 days.

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ARP4754A and the Guidelines for Development of Civil Aircraft and Systems

2 Days
I.D.# C1118

ARP4754A substantially revises the industry guidance for the development of aircraft and aircraft systems while taking into account the overall aircraft operating environment and functions. This development process includes validation of requirements and verification of the design implementation for certification and product assurance. ARP4754A provides the practices for showing compliance with regulations and serves to assist companies in developing and meeting its own internal standards through application of the described guidelines.

This two day seminar will provide attendees with an in-depth presentation of the guidelines introduced in the revised recommended practice for aircraft and systems development as well as the critical concepts used in aircraft and systems development processes for certification. The aircraft/systems development process and its interactions with the safety, hardware development and software development processes will be discussed along with the incorporated changes, with special emphasis on new material and development concepts. Additionally, the relationship and key interactions between the aircraft/system guidance material established in ARP4754A and the guidance material in DO-254 for hardware and DO-178B for software will be reviewed to ensure attendees gain insight into the expectations being established for aircraft certification.

In addition to the seminar handout, a copy of ARP4754A: Guidelines for Development of Civil Aircraft and Systems will be provided to each attendee.

Who Should Attend
This seminar is designed for engineers and other key personnel working in the design, development, and safety assessments of aircraft and aircraft systems.

Learning Objectives
By attending this seminar, participants will be able to:
• Identify the changes between the legacy ARP4754 and ARP4754A,
• Explain the aircraft/systems development process and its interaction with the safety assessment process,
• Identify the key aircraft/systems development processes and their interrelationships,
• Discover and be able to apply new guidelines on Functional and Item Development Assurance Levels (FDAL & IDAL)
• Apply the new guideline material within your own company context

Topical Outline
DAY ONE
• Introduction
  • Overview of seminar material
• ARP4754A Development History
  • How we got here.
  • Who contributed to the revision?
• ARP4754 to ARP4754A Change Highlights
  • Chapter by chapter change review
• Aircraft / Systems Development Process
  • Overview of Process
  • Discussion of Interactions with safety processes
  • Discussion of Interactions with hardware and software development processes
• Integral Processes
ARP4761 and the Safety Assessment Process for Civil Airborne Systems

2 Days
I.D.# C1245

ARP4761 describes guidelines and methods for performing safety assessments. This recommended practice is associated with showing compliance with certification requirements (14CFR/CS Parts 23 and 25, section 1309) and assisting a company in meeting their own internal safety standards. The safety processes described are primarily associated with civil airborne equipment but the processes and tools may be applied to many applications.

This 2 day seminar provides attendees with the guideline information for conducting industry accepted safety assessments consisting of Functional Hazard Assessment (FHA), Preliminary System Safety Assessment (PSSA), and System Safety Assessment (SSA). Discussion on various safety analysis methods needed to conduct the safety assessments is included. Safety analysis methods including Fault Tree Analysis (FTA), Dependence Diagram (DD), Markov Analysis (MA), Failure Modes and Effect Analysis (FMEA) and Common Cause Analysis (CCA). CCA is composed of Zonal Safety Analysis (ZSA), Particular Risks Analysis (PRA), and Common Mode Analysis (CMA) and will be covered in this seminar.

In addition to the seminar handout, a copy of the ARP4761: Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment standard will be provided to each attendee.

Learning Objectives
By attending this seminar, participants will be able to:
• Identify multiple safety assessment methods and tools
• Relate the key attributes of ARP4761 FHA, PSSA, SSA, FTA, DD, MA, CCA
• Identify the applications for safety tools
• Identify the interaction between the safety processes and the development processes
• Apply multiple safety methods in completing a PSSA or SSA
• Evaluate future tools and methods for inclusion in ARP4761A

Who Should Attend
This course is designed for engineers and professionals, working at all levels, who are involved in or interact with the aircraft and/or aircraft system safety assessment processes.

Topical Outline
Day One
• Course Overview
• Key Definitions
• Introduction and overview of ARP4761 course material
• Safety / Development Process
• Functional Hazard Assessment (FHA)
• Preliminary System Safety Analysis (PSSA)
• Fault Tree Analysis (FTA)
• Dependency Diagram (DD)
• Markov Analysis (MA)

Day Two
• Failure Modes & Effects Analysis (FMEA)
• Common Cause Analysis (CCA)
• Particular Risks Analysis (PRA)
• Zonal Safety Analysis (ZSA)
• Common Mode Analysis (CMA)
• System Safety Analysis (SSA)
• Contiguous Example (Appendix L)
• ARP4761A
• New tools / methods in the works
• Revision A timeline

• Summary and Review
• Review of presented material
• Question and Answer

Instructor: Eric M. Peterson
Fee $1440 1.3 CEUs
Design Considerations for Electromechanical Flight Control Actuation Systems

.5 Day
I.D.# C1207

This four-hour short course intends to present an overview of electrically powered flight control actuation systems, covering commercial applications. The scope covers issues related to the mechanical design of actuators themselves, with limited reference to their control electronics. Additionally, this course will provide participants an understanding of the design considerations behind these actuation systems.

Learning Objectives

By attending this seminar, participants will be able to:
• Explain electromechanical actuation systems in aircraft flight control systems
• Identify key design considerations of electromechanical actuators
• Identify a few key design considerations of electric actuator control electronics
• Evaluate overall design considerations of electromechanical flight control actuation systems

Who Should Attend

This seminar is designed for engineers and other key personnel with little or no previous electromechanical flight control actuation knowledge.

Topical Outline

• EMA Configurations
  • Rotary
  • Linear
  • Redundancy schemes
• Typical Requirements
  • Operating modes
  • Loads (applied, generated, and duty cycle)
  • Stroke
  • Rates
  • Life
  • Stiffness
  • Other typical requirements from ARP5812
• Actuator Components
  • Motors
  • Gears
  • Ball Screws
  • Roller Screws
  • Stops
  • Brakes
  • No-backs
  • Torque Limiters
  • Sensors
  • Failure Mechanisms
  • Dampers
  • Controllers - a few leading considerations
• Considerations
  • Jams
  • Efficiency
  • Back-drivability and load holding
  • Uncommanded motion
  • Sealing vs venting
  • Latency
  • Heat dissipation, temperature, and cooling
  • Materials, processes, and allowables
  • Test duration and acceleration
  • Space, envelope, form factor
• Performance Analysis
  • Static
  • Dynamic

Instructor: David Manzanares
Fee $810 .4 CEUs

Applying DO-254 for Avionics Hardware Development and Certification

2 Days
I.D.# C1703

The avionics hardware industry world-wide is now commonly required to follow DO-254 Design Assurance Guidance for Airborne Electronic Hardware all phases of development: Safety, Requirements, Design, Logic Implementation, V&V, Quality Assurance, etc. The DO-254 standard is a companion to the software DO-178B standard; however, there are many differences between hardware and software which must be understood. This basic course introduces the intent of the DO-254 standard for commercial avionics hardware development. The content will cover many aspects of avionic hardware including: aircraft safety; systems; hardware planning, requirements, design, implementation and testing. Attendees will learn industry-best practices for real-world hardware development, common DO-254 mistakes and how to prevent them, and how to minimize risks and costs while maximizing hardware quality. The avionics hardware development process will be summarized including DO-254C’s relationship to other standards including ARP-4761 for Safety and ARP-4754A for Systems Development.
Learning Objectives
By attending this seminar participants will be able to:
• Explain the intent of DO-254
• Explain how DO-254 fits into the avionics development process
• Implement hardware planning and standard requirements
• Assess the impact of avionic hardware requirements, design, implementation, and testing
• Employ basic configuration management and quality assurance techniques
• Identify how to mitigate common DO-254 risks and minimize cost while applying industry-best practices

Who Should Attend
This seminar is designed for Avionics Hardware Managers and Engineers from aviation industry.

Topical Outline
• DO-254 Basics
  • Avionics Ecosystem
  • Relationship to ARP-4754A and ARP-4761
  • Avionics Safety
  • Avionics Systems
• Hardware Development Planning
  • Criticality levels
  • Plan for Hardware Aspects of Certification (PHAC)
  • Hardware Process Assurance Planning (HPAP)
  • Hardware Configuration Management Planning (HCMP)
  • Hardware Development Planning - Requirements, Conceptual Design, Detailed Design, and Integration
  • Hardware Verification Planning (HVP) - Reviews, Tests, and Analysis (HVP)
• Hardware Verification and Validation Details
  • Robustness testing
  • Element Analysis & Structural Coverage
  • Hardware Validation
  • Hardware Reviews & Certification
• Hardware Traceability
  • Common Avionics Hardware Development Mistakes & How To Prevent Them
• Avionics Hardware and DO-254 Best Practices
• Avionics Hardware and DO-254 Gap Analysis
  • Common gaps
  • Cost estimation
  • Project Management and SOI’s
  • Hardware review checklist walkthrough

Fundamentals of Shielding Design for EMC Compliance

1 Day
I.D.# C0835

It is important for electronic and hardware engineers to not only be knowledgeable of a product’s intended function and performance, but also its ability to perform within electromagnetic compatibility (EMC) limits. This seminar introduces practical shielding theory, design fundamentals, and configurations, including shielding products, common and differential modes, electromagnetic fields, and enclosure shielding. A segment on enclosure testing is presented in conjunction with an aperture attenuation modeling program (which is used to model attenuation characteristics at various frequencies and aperture size prior to expensive FCC/CE compliance or MIL-STD 461 testing). Honeycomb vent panels, plating attenuation comparisons, and galvanic compatibility per MIL-STD 1250 will also be discussed. Although the concepts presented in this seminar may be applicable to the automotive industry, the examples and standards presented are primarily focused on military and commercial vehicle applications.

Learning Objectives
By attending this seminar, participants will be able to:
• Identify the basic characteristics of Common and Differential Mode
• Recognize E,H, and Plane wave fields, Surface current and “Skin effect” based on increased frequency
• Specify Galvanic compatibility of various metal plating
• Specify industry standard shielding products for EMC compliance
• Evaluate waveguide effect of EMI/RFI shielded honeycomb ventilation panels
• Analyze aperture attenuation modeling for EMC design

Who Should Attend
This seminar will benefit engineers requiring an understanding of their electronic product or system’s electromagnetic impact on meeting commercial EMC and MIL-STD 461 requirements, as well as those engineers needing to incorporate shielding products into new or current product improvement designs.

Prerequisites
Attendees should have knowledge of electrical and electronic products and proficiency in mathematics at an algebra level.

Topical Outline
• EMC Fundamentals
  • Definitions
  • Maxwell equations
  • EMI and apertures

Instructor: Vance Hilderman
Fee $1370 1.3 CEUs

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Introduction to DO-178C

2 Days
I.D.# C1410

The international standard titled DO-178C - Software Considerations in Airborne Systems and Equipment Certification is the primary standard for commercial avionics software development. This standard provides recommendations for the production of airborne systems and equipment software. Compliance with the objectives of DO-178C is the primary means for meeting airworthiness requirements and obtaining approval of software used in civil aviation products.

This two-day seminar will introduce attendees to industry best practices for real-world software development and how to avoid common DO-178C mistakes. This seminar is intended to present the information necessary to help minimize DO-178C risks and costs, while also maximizing software quality during avionics development. The instructor will guide attendees through topics such as aircraft safety, systems, software planning, software requirements, and software design/code/test. The entire ecosystem of aviation avionics software development will be summarized including DO-178C’s relationship to other industry standards including the SAE standards ARP-4761 for Safety and ARP-4754A for Systems Development.

Learning Objectives
By attending this seminar, participants will be able to:
• Evaluate the premise of DO-178C
• Identify how DO-178C fits into the avionics development ecosystem
• Examine software planning and standards
• Identify software requirements, design, code, and testing for avionics
• Describe basic configuration management and quality assurance
• Analyze how to mitigate common DO-178C risks and minimize cost while applying industry-best practices

Who Should Attend
This course is designed for Avionics Software Managers and Engineers seeking a higher level of understanding of the requirements and practices of using DO-178C in software development. In addition, other personnel in need of a greater understanding of this standard will benefit from the information presented in this seminar.

Topical Outline
Day One
• DO-178 Basics
  • Avionics Ecosystem
  • Relationship to ARP-4754A and ARP-4761
  • Avionics Safety
  • Avionics Systems
RFID Selection, Application, and Use in Aerospace, Space, and Transportation

1 Day
I.D.# C1310

Radio Frequency Identification (RFID) is an enabling technology that has been widely adopted in the retail industry. The powers of RFID are acknowledged by many, but a lack of understanding of the technology, its limitations, and how to select the right plan for its target installation has slowed efforts to migrate the technology into the aerospace, space, and transportation industries. While RFID is not a new technology, the rate at which it has been integrated into the aerospace industry has been slow due to unique considerations regarding qualification, regulations, and safety. New Department of Defense (DoD) policies requiring an integrated material supply chain process that fully supports military operational requirements will further advance the use of RFID technologies.

In addition the laws and regulations regulating its use are relevant for the proper application of this valuable technology. As industry strives for further cost reducing technologies, individuals will need to be able to identify, select, install, and operate the proper system for its application in these critical industry segments.

This one-day seminar will introduce participants to the technology of RFID and how it can be properly integrated into the aerospace, space, and transportation industries. With knowledge obtained as a project manager for the installation of over 30 successful systems, the instructor will begin with the technical aspects of RFID. The instructor will then guide participants through the business case for RFID followed by the selection, acquisition, and installation processes.

Learning Objectives
By attending this seminar, participants will be able to:
- Identify the different types of RFID systems and their applications (RFID, GLS, RTLS, GPS)
- Explain the different RFID components and their function within the system
- Identify the key areas within a factory for optimal success of an RFID system
- Evaluate the laws and regulations for using RFID in your facility
- Develop a RFID Return On Investment (ROI) for your application
- Apply a technology application roadmap for an RFID installation
- Identify testing criteria for tag placement and optimal read rates
- Identify the terms, power, and limitations of RFID

Who Should Attend
This seminar is intended for individuals requiring the critical knowledge that will assist them in understanding and participating in decision processes when RFID is being considered for their specific application.

Topical Outline
- Welcome, Introduction, and Assessment of Expectation
  - Overview of seminar material
  - Review of pre-submitted expectation forms
  - Introduction to RFID
  - What is RFID
  - Types of RFID
  - RFID System Components
- RFID Applications and Limitations
  - Retail applications
  - Aerospace applications
  - Transportation applications
  - Manufacturing applications
- Feasibility Analysis: Will RFID Work for You
  - How to perform a feasibility analysis
  - How to test feasible targets and optimize for success
  - Establishing expectations and accuracy
  - Participation exercise
- Developing Return On Investment (ROI)
  - Identifying current operating cost
  - System cost
  - Cost benefits analysis (ROI)
  - Participation exercise
- System Selection and Acquisition
  - Selecting the right system
  - Determining how much system to buy
  - Acquiring the system
- Summation: Out-Briefing
  - RFID technology review
  - Selection, acquisition, and installation review

Instructor: George (Nick) Bullen
Fee $810 .7 CEUs
Accelerated Test Methods for Ground and Aerospace Vehicle Development

2 Days
I.D.# C0316

Similar content is available in an on demand course. Review the course info in the On Demand Courses Guide on page 97.

Engineers and managers involved with product development are constantly challenged to reduce time to market, minimize warranty costs, and increase product quality. With less and less time for testing, the need for effective accelerated test procedures has never been greater. This course covers the benefits, limitations, processes, and applications of several proven accelerated test methods including accelerated reliability, step stress, FSLT (Full System Life Test), FMVT® (Failure Mode Verification Testing), HALT (Highly Accelerated Life Testing), and HASS (Highly Accelerated Stress Screening). A combination of hands-on exercises, team activities, discussion, and lecture are used throughout the course. Participants will also receive a copy of the instructor’s book, Accelerated Testing and Validation Management, which includes numerous hands-on exercises and a CD with analytical spreadsheets. Attendees are requested to bring a calculator to the seminar.

Learning Objectives
By attending this seminar, participants will be able to:
• Choose the accelerated test method for a given application
• Analyze accelerated testing results
• Explain how to accelerate one’s current test methods
• Explain how to accelerate one’s validation program
• Adjust accelerated test programs for business situations
• Describe how product development cycles can be reduced from 18 to 6 months

Who Should Attend
This seminar is designed for anyone involved in product design, life testing, reliability testing and validation for ground and aerospace vehicles, including reliability engineers, validation engineers, design engineers and their managers. Individuals who need to achieve shorter time to market or higher quality through custom test plans will find this course to be especially valuable. Purchasers or users of testing or engineering services will also find this course to be valuable. There are no prerequisites for this course although a technical background is helpful.

Topical Outline
• Statistical model for reliability testing
  • Fundamentals of a statistical reliability test
  • Effects of automotive supply chain on sample size and duration
  • Common pitfalls
  • Examine and solve two or three real life statistical data set problems
• Key Accelerated Tests, Terms, and Methods
  • Definitions: Information Goal, Basic Method, Limitations
  • Full System Life Test (FSLT)
  • Step Stress
  • Accelerated Reliability Highly Accelerated Life Test (HALT)
  • Failure Mode Verification Test (FMVT) — Development; Warranty; Life Prediction
• Test Acceleration vs. Program Acceleration
  • Advantages of accelerating a full validation program compared to an individual test
  • Examples of time/cost saved on individual test acceleration
  • Examples of time/cost saved on program acceleration
• Hybrid Acceleration Methods
  • Using information goals of individual test methods to combine and leverage tests
ENGINEERING TOOLS & METHODS

• Hands-on team exercise: combine test methods to solve a particular information need
• Decision and selection process
  • How to choose which method
  • Considering position in supply chain
  • Considering business model and product type
  • Considering development phase
  • Considering component, subsystem, and system level testing
  • Hands on team exercise: selecting optimal testing solution for several scenarios

<table>
<thead>
<tr>
<th>Instructor:</th>
<th>Alexander (Alex) J. Porter</th>
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<td>Fee: $1405</td>
<td>1.3 CEUs</td>
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ANOVA for Design of Experiments

1 Day

I.D.# C0714

This seminar is suggested for product or process experts who have a need to utilize more detailed information concerning Design of Experiments analysis. It primarily addresses the subject of ANOVA, analysis of variance, which is a statistically based, objective decision-making tool. This is an advanced seminar that covers the fundamentals required to analyze orthogonal experiments, interpret, and recommend further action based on the analysis. Emphasis is placed on the analysis phase of the DOE process. The seminar covers DOE basic review, simple and complex ANOVA situations, process capability estimation, and a review of available computer software for experimental design and analysis.

Learning Objectives

By attending this seminar, participants will be able to:
• Perform ANOVA for DOE analysis
• Interpret ANOVA results
• Estimate process capability from ANOVA information

Who Should Attend

This seminar is designed for product and process design engineers, manufacturing engineers, quality engineers (control, assurance, or supplier), testing and development engineers, and technical managers who are interested in more comprehensive experimental analyses and information. Although, more statistical in nature, this seminar does not require a statistical education or background to comprehend the contents; only fundamental mathematical skills are necessary. This seminar is also very helpful in providing a statistical foundation for those seeking certification in quality engineering.

It is strongly recommended that the registrant attend a Basic Design of Experiments course or have experience with fractional factorial experiments based on orthogonal arrays before attending the ANOVA for Design of Experiments course.

Topical Outline

• Training Objectives
• Design of Experiments Process Flowchart
• Planning and Conducting Phase Review
• Analyzing and Interpreting Results
  • observation method review
  • column effects method review
  • raw data ANOVA - one-way; two-way; multi-way with orthogonal arrays
  • variation ANOVA
  • attribute data ANOVA
  • interpreting experimental results

Accelerated Test Methods for Ground and Aerospace Vehicle Development

10 Hours

Similar content is available in the classroom seminar – see course info above.

This course offers more than 10 hours of instruction divided into fourteen modules; a coordinated handbook; and a copy of the instructor’s book, Accelerated Testing and Validation Management, which includes numerous hands-on exercises and a CD with analytical spreadsheets. Convenient, portable, and with core content from the instructor-led seminar (view description for classroom seminar above), the on demand course option offers new and alternative ways to receive the same instruction as the live classroom learning without the expense of travel and time away from the workplace.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

Quantity discounts and Site License options are available. Call the SAE Corporate Learning Solutions hotline at +1.724.772.8529 for a quote.
Design and Process Failure Modes and Effects Analysis (FMEA)

2 Days
I.D.# C1510

This seminar covers the five types of FMEAs with emphasis on constructing Design and Process FMEAs. Each column of the FMEA document will be clearly explained using an actual FMEA example. The course covers various methods for identifying failure modes, effects and causes with special attention given to severity, occurrence, and detection tables and how to develop effective recommended actions strategies. Throughout the class, participants will be involved in exercises/actual projects that demonstrate and incorporate direct application of learned principles.

Learning Objectives
By attending this seminar, participants will be able to:
• Describe the benefits, requirements and objectives of an FMEA
• Describe the five types of FMEAs and how to use them
• Develop and interpret a Design and Process FMEA form
• Identify and utilize various tools when performing an FMEA
• Describe the standard requirements/recommendations for an FMEA
• Select suitable projects and teams for completing an FMEA
• Complete a typical Design and Process FMEA form

Who Should Attend
This seminar is designed for core members of a Product Development Team such as project managers, product design, test, manufacturing, quality, reliability engineers and those responsible for assisting the PDT in design and development of product, manufacturing, assembly or services processes.

Topical Outline
• Understanding and Application of FMEA
  • FMEA as Part of the Product Development Life Cycle
  • The Various Industry FMEA standards
  • Why and When to use Concept, System and Design FMEAs
• The FMEA as a Risk Management Technique
• FMEA, Robust Design, and Design Reviews
• FMEA vs FMECA
• Using FMEA to Address Product and Process Liability Issues
• Managing the FMEA Process
  • The Steps to Generating a Quality FMEA
  • The Essentials of an Effective FMEA Database and Template FMEAs
  • Methods for Selecting Suitable Projects for Templating Design and Process FMEAs
  • FMEA Team Development
  • Champion and Facilitator Roles during FMEA Development
• Introducing the FMEA Exercise – Designing a Great Flashlight
• Constructing a Useful FMEA
  • The Five Types of FMEAs and the Uses
  • Design FMEA
    • Constructing the boundary and block diagrams
    • Column by column review of the Design FMEA form
    • Development of a company-specific table structure for severity, occurrence and detection
    • Techniques for RPN prioritization and developing recommended action
    • Developing effective design control techniques
    • Exercise 2 – Completing the Flashlight Design FMEA
  • Process FMEA
    • Gathering the necessary process documents
    • Column by column review of the Process FMEA form
    • Development of a company-specific table structure for severity, occurrence and detection
    • Techniques for RPN prioritization and developing recommended action
    • Exercise 3 – Completing the Flashlight Process FMEA
  • Application of the Machinery FMEA
    • Effective use of the occurrence and detection tables
    • Validating process and machinery control techniques

Instructor: Angelo E. Mago
Fee $1370 1.3 CEUs
Design for Manufacturing & Assembly

2 Days
I.D.# 92047

Design for Manufacturing and Assembly (DFM+A), pioneered by Boothroyd and Dewhurst, has been used by many companies around the world to develop creative product designs that use optimal manufacturing and assembly processes. Correctly applied, DFM+A analysis leads to significant reductions in production cost, without compromising product time-to-market goals, functionality, quality, serviceability, or other attributes. In this two-day seminar, you will not only learn the Boothroyd Dewhurst Method, you will actually apply it to your own product design!

This seminar will include information on how DFM+A fits in with QFD, Concurrent Engineering, Robust Engineering, and other disciplines. In addition, there will be a brief demonstration of computer software tools, which simplify the DFM+A analysis.

Each participant will receive and use the hard-bound authoritative reference textbook *Product Design for Manufacture and Assembly*, written by Geoffrey Boothroyd, Peter Dewhurst and Winston Knight.

**Learning Objectives**

Upon successful completion of this course, participants will be able to:

- Perform Design for Assembly (DFA) Analysis using the BDI Manual (Worksheet) Method
- Perform DFM Analysis (manufacturing cost estimation)
- Apply Design for Service (DFS) Principles
- Reduce your company’s production costs by analyzing and eliminating the factors that greatly affect the time, cost, and quality of manufacturing, assembly and service processes
- Utilize effective analysis, brainstorming, and trade-off techniques for redesigning assemblies and subassemblies

**Who Should Attend**

Product designers, product engineers, or manufacturing engineers will benefit by attending this seminar. Individuals involved in a new or ongoing product development process will also benefit by learning how to help synchronize and optimize fabrication and assembly activities. This course is most effective when attended by product development team members; however, this is not a requirement for attendance.

NOTE: You are strongly encouraged to bring a sample or drawing of one of your own designs to analyze during the course on Day Two. You are also asked to bring a calculator capable of making simple calculations.

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**Topical Outline**

**DAY ONE**

- What is DFM+A
  - The history of DFM+A
  - The various “Design fors”
  - Why companies are using DFM+A
  - DFM+A success stories
  - DFM+A benefits
  - Key factors in ensuring DFM+A success
- DFA Good Design Principles
  - The Boothroyd Dewhurst Design for Manual Assembly Method
  - Using the manual handling and insertion tables
  - Determining theoretical minimum part count
  - Filling in the BDI DFA worksheet
  - Computing the DFA Index
- DFM Cost Estimation Exercise (Pneumatic Piston)
- Redesign Project (Pneumatic Piston Assembly)
  - Developing design concepts
  - Identifying conservative and “stretch” designs
  - Selecting the best DFM concept
  - Analysis of redesign
  - Presentation of team results
- General Approach to Manufacturing Cost Estimation
  - Manufacturing cost drivers
  - Estimating piece cost
  - Cost calculation exercise
- BDI Design for Manufacture (DFM) Cost Estimation
  - Injection molding cost algorithms
  - Sample calculation
  - Exercise (analyzing part from pneumatic piston)

**DAY TWO**

- BDI DFM Cost Estimation (continued)
  - Review of die casting and/or sheet metal stamping cost algorithms
- Design for Service (DFS) Assessment
  - Two main approaches
  - Life cycle considerations
  - DFS exercise
- BDI DFM/A Software Toolkit Demonstration
  - DFA module
  - Injection molding or other module
- DFM+A Workshop Checklist
- Brainstorming Guidelines
- DFM+A Workshop Project (approximately 4 hours)
  - Project selection (from those brought to class)
  - Team identification
  - Baseline analysis
  - Redesign development
  - Development of project reports (illustrations, action plan, possible roadblocks, etc.)
  - Presentations of team results
Design of Experiments (DOE) for Engineers

2 Days
I.D.# C0406

Similar content is available in the live online Web Seminar – Design of Experiments (DOE) for Engineers Web Seminar – see course description below.

Design of Experiments (DOE) is a methodology that can be effective for general problem-solving, as well as for improving or optimizing product design and manufacturing processes. Specific applications of DOE include identifying proper design dimensions and tolerances, achieving robust designs, generating predictive math models that describe physical system behavior, and determining ideal manufacturing settings. This seminar utilizes hands-on activities to help you learn the criteria for running a DOE, the requirements and pre-work necessary prior to DOE execution, and how to select the appropriate designed experiment type to run. You will experience setting up, running, and analyzing the results of simple-to-intermediate complexity, Full Factorial, Partial Factorial, and Response Surface experiments utilizing manual methods as well as a hands-on computer tool that facilitates experimental design and data analysis. You will also receive an overview of Robust DOE, including the Taguchi DOE Method.

Participants will be given information on how to receive, install and configure a fully-functional 30-day trial version of Minitab for their use in class, and/or for their personal evaluation. While some computers will be available, attendees are encouraged to bring a laptop computer and/or a calculator to the seminar to provide additional hands-on time.

Learning Objectives

By attending this seminar, participants will be able to:

• Decide whether to run a DOE to solve a problem or optimize a system
• Set-Up a Full Factorial DOE Test Matrix, in both Randomized and Blocked forms
• Analyze and Interpret Full Factorial DOE Results using ANOVA, (when relevant) Regression, and Graphical methods
• Set-Up a Fractional (Partial) Factorial DOE, using the Confounding Principle
• Analyze and Interpret the results of a Fractional Factorial DOE
• Recognize the main principles and benefits of Robust Design DOE
• Decide when a Response Surface DOE should be run
• Select the appropriate Response Surface Design (either Plackett-Burman, Box-Behnken, Central Composite, or D-Optimal)
• Interpret Response Surface Outputs
• Utilize the MiniTab™ Software tool to analyze data

Who Should Attend

This seminar will benefit engineers, designers and quality professionals in research, design, development, testing and manufacturing who are interested or active in one or more of the applications listed above.

Topical Outline

• Icebreaker: Team Problem Solving Exercise Using Engineering Judgment
• What is DOE?
  • Types of Designed Experiments
  • Application Examples
• Where DOE Fits in with Other Tools/Methods
• DOE Requirements: Before You Can Run an Experiment
  • Writing Problem and Objective Statements
  • Ensuring DOE is the Correct Tool
  • Selecting Response Variable(s) and Experimental Factors
  • Actual vs. Surrogate Responses
  • Attention to Experiment Logistics
  • Test Set-up and Data Collection Planning
  • Selecting and Evaluating a Gage
• Full Factorial Experiments
  • Introduction to Cube Plots for 3- or 4-factor 2-level Experiments
  • Experiment Set-Up
  • Factor Levels, Repetitions, and “Right-Sizing” the Experiment
  • Experiment Terms to Estimate (Main Effects and Interactions)
  • High-Level Significance Evaluation
• DOE Statistical Analysis
  • ANOVA Principles for Simple Full Factorial Experiments
    -- Statistics Basics; Significance Test Methods; Effect of Non-Random Experiments; Estimating Significance Test “Power”; Confidence Intervals; Estimating Random Error
  • Analysis Plots -- Normal and Half-Normal Plots; Main Effect and Interaction Plots

Instructor: Kevin Zielinski
Fee $1550 1.3 CEUs
ENGINEERING TOOLS & METHODS

- Regression Analysis of Simple Full Factorial Experiments
- Using MiniTab™ for Full Factorial DOE Experiments
- Fractional (Partial) Factorial Experiments
- The Confounding Principle — How it Works; What Information We Lose with Confounding (and why we might not care)
- Selecting and Using Generators (Identities) to Set Up Confounding Strings
- Determining Which Factor Combinations to Run
- Analyzing Fractional Factorial Experiment Data
- Using MiniTab™ for Fractional Factorial Experiments
- Robust Design Experiments (Overview)
  - What is Robustness?
  - Control and Noise Factors
  - Classical and Taguchi Robust DOE Set-Up
  - Robustness Metrics
  - Analytical and Graphical Output Interpretation
- Response Surface Modeling
  - What Response Surface Models do BEST
  - Available Response Surface DOEs (Plackett-Burman, Box-Behnken, etc.) — Ideal Situation(s) to Use Each
  - Response Surface DOE Type; Cube Plot Set-up of Each Response Surface DOE
  - Analyzing Response Surface Experiment Data
  - Methods for Finding Optimum Factor Values
  - Using MiniTab™ for response Surface Experiments
- Notes and Wrap-up

Instructor: Kevin Zielinski
Fee $1420 1.3 CEUs

Design of Experiments (DOE) for Engineers Web Seminar and Web Seminar RePlay

12 Hours
Web Seminar: I.D.# WB0932
Web Seminar RePlay: I.D.# PD330932ON

Similar content is available in the classroom seminar — Design of Experiments (DOE) for Engineers — see course description above.

Design of Experiments (DOE) is a methodology that can be effective for general problem-solving, as well as for improving or optimizing product design and manufacturing processes. Specific applications of DOE include, but are not limited to, identifying root causes to quality or production problems, identifying optimized design and process settings, achieving robust designs, and generating predictive math models that describe physical system behavior. This competency-based web seminar utilizes a blend of reading, discussion and hands-on to help you learn the requirements and pre-work necessary prior to DOE execution, how to select the appropriate designed experiment to run, DOE execution, and analysis of DOE results. You will experience setting up, running, and analyzing simple-to-intermediate complexity Full Factorial and Partial Factorial experiments both by hand and using computer software. You will also set-up and analyze Robust/Taguchi and Response Surface experiments utilizing computer software.

Each participant will receive a 30 day Minitab™ product trial copy for use in the Web Seminar. Due to the nature of the Web Seminar format, each participant will be expected to dedicate approximately one hour to complete “homework” and/or short reading assignments in preparation for each session.

Learning Objectives

Upon successful completion of this course, participants will be able to:
- Determine when DOE is the correct tool to solve a given problem or issue
- Select the appropriate DOE experiment type (DOE Goal) for a given application
- Set up simple Full Factorial DOEs by hand, using cube plots
- Set up and analyze any Full Factorial DOE using Minitab
- Select the appropriate partial factorial design(s) based on one’s application
- Set-up and analyze Partial Factorial DOEs, simple Robust Design (Taguchi) DOEs, and simple Response Surface DOEs using Minitab
- Identify and execute the structured process steps recommend- ed when executing a DOE project

Who Should Attend

This course will benefit: engineers involved in problem-solving such as product design or product formulation (e.g., fluid/material composition, prepared food recipes/preparation, etc.) and/or optimization; process design and/or optimization; quality improvement efforts such as defect elimination, warranty avoidance or similar initiatives; test engineers who wish to maximize learning of system behavior with a minimum number of tests; and technicians, analysts and managers who support engineers in the above efforts, so they may be effective participants in DOE activities. This course has no specific course prerequisites. However, participants are expected to have some math background, including the ability to calculate elementary statistics parameters such as an average and a range. Since the course includes demonstration and hands-on use of Minitab, participants should have some familiarity with Windows-based personal computer applications.
Topical Outline

Session 1
• Introduction
• What is DOE (with Initial Data Collection Exercise)
• Full Factorial Experiments using Cube Plots
  • Identifying main effect and interaction terms
  • Determining effects for all terms
• Estimating How Much Experiment Data is Enough
• Assignment for Session 2: Hands-on Exercise in the use of Minitab using Simulator to Generate Data
Session 2
• Review of Exercise Assigned at the end of Session 1
• Set up and Analysis of a Full Factorial Experiment using Minitab
• Review of Minitab’s DOE Results
• Review of Methods for Determining Significance
• ANOVA and Regression Overview
• Assignment for Session 3: Hands-on Exercise using Minitab to Analyze Data and Interpreting Statistical and Graphical DOE Results
Session 3
• Review of Exercise Assigned at the end of the Session 2
• The Confounding Principle
• The Benefits and Disbenefits of Confounding and of Partial Factorial Experiments
• How Confounding Occurs in a DOE, including Generators and ‘Design Resolution’ Importance of the “Alias String”
• Minitab Demonstration: Setting up Partial Factorial Experiments using Default Generators and by Specifying Generators
• Assignment for Session 4: Partial Factorial Exercise using Minitab and a Simulator to Generate Data for the DOE
Session 4
• Review of Exercise Assigned at the end of the Session 3
• When Robust/Taguchi DOE is Appropriate
• How Robust/Taguchi DOE is Different
  • Two-Step Optimization Concept
  • Control vs. Noise
  • Importance of Control-by-Noise Interactions
  • Studying Robustness with Classical DOE vs. Taguchi
  • Taguchi’s Robustness Statistics: Signal-to-Noise (S/N) and Loss
  • Applications of Taguchi DOE (incl. Set-up and Analysis in Minitab)
• Minitab Demonstration: Setting up a Taguchi DOE
• Assignment for Session 5: Robust/DOE Exercise using Minitab and a Simulator to Generate Data for the DOE
Session 5
• Review of Exercise Assigned at the end of the Session 4
• When Response Surface DOE is Appropriate
• How Response Surface DOE is Different
  • Box-Behnken Concepts (with Demonstration of Minitab Set-up)
  • Central-Composite Concepts (with Demonstration of Minitab Set-up)
• Overview of Other Designs/Application: Plackett-Burman and Mixture
• Minitab Demonstration: Response Surface Set-up and Analysis
• Assignment for Session 6: Response Surface DOE Exercise using Minitab and a Simulator to Generate Data for the DOE
Session 6
• Review of Exercise Assigned at the end of the Session 5
• Best Practices: The Problem Solving Process
• Best Practices: The Structured DOE Process
  • The Multi-Step Process for Ensuring Effective DOE Execution and Meaningful Results
  • Discussion “Exercises”: Selecting Factors, Responses, Measurement Systems, etc. for Sample Situations
  • In-class Exercise: How to Conduct a DOE to Evaluate the Quality of a Gauge (Measurement System Assessment or “MSA”)
• FAQ Review and Question and Answer
• Summary

Instructor: Kevin Zielinski
Fee $835  1.2 CEUs

Design of Experiments - Basic Simplified Taguchi

2 Days
I.D.# C0231

Design of Experiments is a statistically based, structured approach to product or process improvement that will quickly yield significant increases in product quality and subsequent decreases in cost. Products and processes can be designed to function with less variation and with less sensitivity to environmental factors or customer usage. While still maintaining high quality from a customer’s viewpoint, products and processes can utilize lower cost materials and methods. Specifications can be opened up with wider tolerances while still maintaining high quality for customers. In summary, products and processes can be designed and developed in shorter times to reduce costs and become more competitive in the marketplace from a delivery and profit standpoint.

This seminar covers the fundamentals required in planning, conducting, and analyzing orthogonal experiments, which are the major steps in the Design of Experiments (DOE) process. Emphasis is placed on the DOE process, which, if diligently followed will yield an effectively completed experiment.
ENGINEERING TOOLS & METHODS

An introduction to parameter design is included. A short video introduces the experimental approach; the end of the session allows practice with the new methods in a hands-on workshop.

For more advanced study, attend ANOVA for Design of Experiments (#C0714; page 8). It is strongly recommended that any registrant attend a Basic Design of Experiments course prior to taking the advanced course.

Learning Objectives
By attending this seminar, students will be able to:
• Choose appropriate factors and factor levels to effectively plan DOEs
• Define an appropriate set of tests to evaluate the chosen factors and levels
• Utilize appropriate randomization strategies and choose appropriate sample sizes for conducting tests for DOE
• Utilize basic analytical methods to identify influential & non-influential factors in analyzing and interpreting DOE results
• Set specification limits for all factors for effective performance and low cost

Who Should Attend
This seminar is designed for product and process design engineers, manufacturing engineers, quality engineers, testing and development engineers. Although it would be helpful, no statistical education or background is required for this course; only fundamental mathematical skills are necessary.

Topical Outline
• Training Objectives
• Design Of Experiments Background
  • DOE definition
  • DOE and Taguchi history
  • DOE in the product life cycle
  • implementation strategy
• Design Of Experiments Process
  • flowcharts
  • injection molding case study
  • water pump leak case study overview
• Planning Phase
  • state problem(s)
  • state objective(s)
  • determine measurement method(s)
  • quality characteristic(s)
  • select factors
  • identify control and noise factors
  • select levels of factors
  • select orthogonal array
  • assign factors
• locate interactions
• modification of standard orthogonal arrays
• parameter design
• Conducting The Experiment
  • trial data sheets
  • testing logistics & assignments
  • identification of trial results
  • sample size per trial
  • randomization
  • good and bad data sets
• Analyzing And Interpreting Results
  • observation method
  • column effects method
  • plotting
  • ranking
  • analyzing variability
  • factor classification
  • attribute data
  • interpreting experimental results
  • confirmation experiment
• Experimental Workshop
  • popcorn experiment review
  • pendulum experiment

Instructor: Phillip J. Ross
Fee $1370 1.3 CEUs

Design Review Workshop
1.5 Days
I.D.# C1306
In today’s highly competitive and liability minded environment, Design Reviews (DR) are a must for all major mobility industries such as Automotive, DOD, Aerospace, Agriculture, Recreation, Marine and Rail. While Design Reviews are becoming increasingly important in product liability litigation, they also serve as an effective way to transfer organizational best practices for specific concerns and issues.

This hands-on workshop describes how formal Design Reviews can be used in conjunction with other new product development methods to improve product designs by uncovering potential problems before they are discovered at a later stage of development or application when the costs of correction are much higher. A range of effective techniques for organizing and conducting Design Reviews will be presented. Participants will receive specific guidance and tools to assist them in tailoring Design Reviews to reflect their own organization’s requirements. Topics are applicable to a broad range of new product develop-
ment programs, ranging from components to complete systems, for both OEMs and suppliers.

LEARN THEN DO -
In this workshop the attendee not only learns the essential elements of a robust Design Review process but also has the opportunity to apply these principles in the conduct of a mock Design Review. Participants will also experience some of the frequently encountered real-world issues that distract from accomplishing good results. During these “reviews” the attendee will experience each of the roles in a typical Design Review; leader, facilitator, recorder, and participant. An after-action review will be performed following each DR session to discuss positive outcomes and identify opportunities for improvement.

Learning Objectives
By attending this seminar, participants will be able to:
• Describe the relationship of the process to concurrent engineering and knowledge management
• Establish the requirements for a successful Design Review process
• Describe the types and timing of reviews
• Organize a typical Design Review
• Conduct a review and get positive results

Who Should Attend
The workshop is designed for individuals who are involved in the development of new products and who seek to improve that process. Product development team members including, but not limited to, directors, manager, project and program managers, design, development, process, product, quality, and application engineers will find the course valuable. It is aimed primarily at engineers and managers who will be facilitating or leading such reviews, but will also benefit manufacturing, marketing and purchasing personnel.

Topical Outline
DAY ONE
Design Review Process
• Why Design Reviews Should be Part of a Product Development Process
  • Market and quality drivers
  • Schedule and cost drivers
  • Litigation considerations
• Outline of the Design Review Process
  • Design reviews as part of an overall risk management process
  • What design reviews are and are not
• Types and Timing of Reviews
  • Concept reviews
  • Preliminary reviews
  • Critical reviews
• Production readiness reviews
• Other types of reviews
• Scope of Design Reviews
  • Design review vs gate (or phase) review
  • Formal and informal reviews
  • Key ingredients for a successful review
  • Implementing a DR process
DAY TWO (ends at 12:30)
Design Review Hands-on Workshop
• Organizing an Effective Design Review
  • Roles during the DR
  • Selecting participants
  • Preparing for the DR
  • Assignments leading to a DR
  • Duration of a review
• Conducting a Design Review
  • Conflict Management
  • Closure and follow-up
  • Using check lists to build organizational knowledge
  • Handling problem participants

Instructor: Angelo E. Mago
Fee $1370 1.0 CEUs

SAE PRODUCT ENGINEERING TOOLS AND METHODS CERTIFICATE PROGRAM
Watch for the certificate icon to indicate course titles that are part of an SAE multi-course certificate program.

This program focuses on the study, development, management and implementation of product engineering principles, methodologies and techniques. When used properly, these tools and methods become powerful productivity enhancers and facilitate the reduction of product development time and cost. Complete this certificate and earn up to seven graduate credits towards the SAE/Kettering University 20-credit Certificate in Automotive Systems and Kettering’s 40-credit M.S. in Mechanical Engineering. Visit training.sae.org/collegecredit for more information. For the complete list of required and elective courses and additional information on enrolling in this SAE certificate program, visit training.sae.org/certificate/engineering_tools.
**Design for Manufacture and Assembly (DFM/DFA)**

2 Days  
I.D.# CO418

This seminar provides a functional understanding of the principles involved in conducting a Design for Manufacture/Design for Assembly study. DFM/DFA can support both manual and automated processes resulting in significant cost savings through simpler designs with fewer components. Related topics include workstation layouts, ergonomic considerations and errorproofing. Actual examples from the automotive industry are used to support the lecture and participants complete actual design efficiency using the DFM/DFA worksheet.

**Learning Objectives**

By attending this seminar, participants will be able to:

- Recognize and list the benefits of the DFM/DFA method in creating product designs which support manufacturing processes leading to short and long term product cost savings
- Outline a Robust Manufacturing Plan that optimizes and simplifies product design without sacrificing quality
- Objectively determine which designs would be suitable as DFM/DFA candidates
- Perform the essential stages of a Design for Manufacture process including the analysis required to overcome typical manufacturing difficulties encountered in product design
- Construct an actual DFM/DFA worksheet and calculate design efficiency using an instructor provided project

**Who Should Attend**

Product Engineers, Designers and Managers, Manufacturing and Tooling Engineers, and Project Managers who desire to understand DFM/DFA as a product design tool to increase manufacturability of product assemblies. The course is best suited for individuals in the manufacturing industry and is beneficial to OEMs and Tier suppliers.

**Topical Outline**

**DAY ONE**

- Introduction to DFM/DFA and DFM/DFA objectives
  - DFM, DFA and Product Life Cycle
  - Six Steps of the DFM/DFA Life Cycle Model
  - DFM and DFA advantages and challenges in a Product Development environment
- Design Considerations
  - Creating the DFM/DFA Environment
  - Guidelines for selecting DFM candidates
  - Integrating FMEA and DFM/DFA
  - Material Selection process
  - Project Cost Estimation

- DFM Worksheet, Tables and Terms Defined
- Minimizing part count using the Minimum Part Criteria
- Finalizing the Critical Design Characteristics
- DFM introductory project

**DAY TWO**

- Design Considerations (cont)
  - Operator Interface Considerations - Handling, Insertion, and Fastening issues
  - Calculating initial design efficiencies
  - Prioritizing Design Improvement efforts using the Worksheet codes
  - Finalizing DFM project
- Process Considerations
  - Workplace Layout
  - Methods of Assembly
  - Lean Production Metrics
  - Errorproofing
- Introduction to DFM Concurrent Costing
- Total cost savings through DFM and DFAs

Instructor: Angelo E. Mago  
Fee $1370 1.0 CEUs

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**Finite Element Analysis (FEA) for Design Engineers Web Seminar**

12 Hours  
I.D.# WB1241

Similar content is available in an on demand course. Review the course info in the On Demand Courses Resource Guide on pages 97-139.

The Finite Element Analysis (FEA) has been widely implemented by automotive companies and is used by design engineers as a tool during the product development process. Design engineers analyze their own designs while they are still in the form of easily modifiable CAD models to allow for quick turnaround times and to ensure prompt implementation of analysis results in the design process. While FEA software is readily available, successful use of FEA as a design tool still requires an understanding of FEA basics, familiarity with FEA process and commonly used modeling techniques, as well as an appreciation of inherent errors and their effect on the quality of results. When used properly, the FEA becomes a tremendous productivity tool, helping design engineers reduce product development time and cost. Misapplication of FEA however, may lead to erroneous design decisions, which are very expensive to correct later in the design process.
This six-session web seminar provides design engineers with the skills necessary for proper use of FEA in the design process and to ensure that this powerful tool is implemented in the most efficient and productive way. Participants will study different types of analyses typically performed, discuss common misconceptions and traps in the FEA, and review Implementation of Management of FEA in the design environment. The online format will allow for some customization so problems of particular interest to participants and an exchange of FEA experiences may be discussed during the live sessions. Hands-on exercises focusing on the analysis of FEA errors and proper modeling techniques will be assigned.

All topics are illustrated by hands-on examples using FEA software SolidWorks® Simulation for which participants will be provided a Student License (compatible with Windows 7 SP1, 8.1, 10; IE 10,11; MS Excel and Word 2010, 2013, 2016). Acquired skills, however, are not software specific and no prior exposure to FEA software is required. The eBook, “Engineering Analysis with SolidWorks® Simulation” by Paul Kurowski, will also be included in the course materials. In-class, hands-on exercises and between-session assignments will provide an opportunity to put what is learned into practice.

**Learning Objectives**

By connecting with this web seminar, participants will be able to:

- Select preferable modeling approaches
- Analyze errors inherent to FEA results
- Identify FEA advantages and shortcomings
- Avoid mistakes and pitfalls in FEA
- Produce reliable results on time
- Request FEA analysis and use FEA results
- Provide effective FEA project management
- Ensure quality and cost-effectiveness of FEA projects

**Who Should Attend**

This course addresses the needs of design engineers who are not specialized analysts but need to use the Finite Element Analysis to analyze new product during the design process. Also non-specialist FEA users, R&D engineers and managers, project engineers, and product engineers will benefit from its coverage of different FEA formulations, tools for error analysis, common errors, traps and misconceptions, and an introduction to FEA project management.


**Topical Outline**

Session 1
- Fundamental Concepts in the FEA
- Finite Element Analysis Process

Session 2
- Origins and Types of FEA Errors
- Finite Element Mesh
- In-class Exercises

Session 3
- Control of Discretization Error – Convergence Process
- Verification and Validation of FEA Results
- In-class Exercises
- Homework Assignment

Session 4
- Modal Analysis
- Buckling Analysis
- In-class Exercises
- Homework Assignment

Session 5
- Nonlinear Geometry Analysis
- Nonlinear Material Analysis
- Contact Stress Analysis
- In-class Exercises
- Homework Assignment

Session 6
- Steady State Thermal Analysis
- Transient Thermal Analysis
- FEA Implementation
- FEA Project Management
- FEA Traps and Misconceptions
- Quiz in preparation to post-course learning assessment

**Instructor:** Paul Kurowski

**Fee:** $870 1.2 CEUs

**FEA Beyond Basics: Nonlinear Analysis Web Seminar**

7 Hours  
I.D.# WB1725

Finite Element Analysis (FEA) has been an indispensable tool for design simulation for several decades but this wide spread use has been limited to simple types of analyses. Relatively recently, more advanced analyses have given easy to use interfaces enabling design engineers to simulate problems formerly reserved for analysts. This three-session web seminar targets the FEA users who wish to explore those advanced analysis capabilities.
The course demonstrates how to move past the ubiquitous linear structural analysis and solve structural nonlinear problems characterized by nonlinear material, large displacements, buckling or nonlinear connectors. The discussion will help participants identify, set up and solve complex nonlinear problems and as well as use results of nonlinear analysis to support the product design process.

**Learning Objectives**

By connecting with this web seminar, participants will be able to:

- Identify a need for a nonlinear structural analysis
- Identify the types of nonlinearities
- Employ correct problem definition and solution strategy
- Select applicable modeling techniques
- Assess and implement results of nonlinear analysis

**Who Should Attend**

The course is intended for design engineers who already have a foundational understanding of FEA but need to elevate its use to an advanced level to predict product behavior more closely. Familiarity or experience with FEA equivalent to or as covered in the *Finite Element Analysis for Design Engineers* web seminar (I.D.# WB1241; page 16) or on-demand course (I.D.# PD531241; page 19) is recommended.

**Topical Outline**

**Session 1**
- Modal Analysis and Linear Buckling Analysis
  - Analogies and differences between modal analysis with pre-stress linear buckling analysis
  - Linear buckling analysis as an entry to nonlinear analysis
  - Structural stability
- Nonlinear Geometry Analysis
  - Large displacement
  - Stress stiffening/softening effect
  - Force and displacement boundary conditions
- Contact Analysis
  - Contact
  - Interference
  - Bolt connectors

**Session 2**
- Nonlinear Material Analysis
  - Plasticity
  - Residual stress
  - Hyper-elasticity

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**Instructor:** Paul Kurowski

**Fee:** $595 .7 CEUs

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**FEA Beyond Basics: Thermal Analysis Web Seminar**

7 Hours  
I.D.# WB1726

Finite Element Analysis (FEA) is a powerful and well recognized tool used in the analysis of heat transfer problems. However, FEA can only analyze solid bodies and, by necessity thermal analysis with FEA is limited to conductive heat transfer. The other two types of heat transfer: convection and radiation must by approximated by boundary conditions. Modeling all three mechanisms of heat transfer without arbitrary assumption requires a combined use of FEA and Computational Fluid Dynamics (CFD).

This three-session web seminar is for FEA users who need expand thermal analysis to include heat transfer in solids and fluids without the use of arbitrary convective or radiative boundary conditions. The course demonstrates how FEA and CFD work together to solve conjugate heat transfer problems producing results that simulate real life problems.

**Learning Objectives**

By connecting with this web seminar, participants will be able to:

- Identify mechanisms of heat transfer present in an analysis problem
- Implement FEA and/or CFD to analyze heat transfer
- Perform conjugate heat transfer analysis
- Select applicable modeling techniques
- Assess and implement results of thermal analysis

**Who Should Attend**

The course is intended for design engineers who already have a foundational understanding of FEA but need to elevate its use to an advanced level to predict product behavior more closely. Familiarity or experience with FEA equivalent to or as covered in the *Finite Element Analysis for Design Engineers* web seminar (I.D.# WB1241; page 16) or on-demand course (I.D.# PD531241; page 19) is recommended.

**Topical Outline**

**Session 1**
- Modeling Different Mechanisms of Heat Transfer
- Steady State Thermal Analysis
- Transient Thermal Analysis

**Session 2**
- Overview of Computational Fluid Dynamics (CFD)
- Comparison between FEA and CFD
- Internal and External Fluid Flow Problems
- Interfacing between FEA and CFD
- Conjugate Heat Flow
Session 3
• Analysis of Convective Heat Transfer with CFD and FEA
• Analysis of Radiative Heat Transfer with CFD and FEA

Instructor: Paul Kurowski
Fee $595 .7 CEUs

Finite Element Analysis for Design Engineers
8 Hours
I.D.# PD531241

Similar content is available in the web seminar, Finite Element Analysis (FEA) for Design Engineers. See the course description above.

This online on demand course provides the skills necessary for proper use of FEA in the design process and ensures that the powerful tool is implemented in the most efficient and productive way. Participants will begin with the foundational FEA process, observe expert demonstrations showing how FEA is conducted using real models, study different types of typically performed analysis, discuss common misconceptions and errors made, and explore how FEA can be implemented within the design environment. Hands-on exercises focusing on FEA fundamentals, different types of analysis, and proper modeling techniques are included.

An introduction module and various bundling options are available for this topic. Contact Corporate Learning Solutions to discuss the course options that best fit your need.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

Quantity discounts and Site License options are available. Call the SAE Corporate Learning Solutions hotline at +1.724.772.8529 for a quote.

FMEA for Robust Design: What, Why, When and How Web Seminar
12 Hours
I.D.# WB1422

Failure Modes and Effects Analysis (FMEA) is an integral part of product design activity applicable to any type of product or service. It is a quantitative and quantitative step-by-step approach for identifying and analyzing all actual and potential points of failure in a design, product or service. A successful team-based FMEA activity can use their collective experience with similar products to dramatically improve not only product performance but also reduce manufacturing issues at both a component and system and processing level.

This web seminar introduces the five basic types of FMEAs with emphasis on constructing a Design FMEA. Each column of the FMEA form is clearly explained using a typical FMEA example. This example can be a provided sample or a company sample provided candidate. The course covers various methods for clearly identifying product function at three levels, and associating distinct failure modes, effects and causes related to each function level. Special attention is given to Severity, Occurrence, and Detection and how to develop effective Risk Priority (RPN) strategies and Recommended Actions for significant RPNs.

All material is in conjunction with current industry standards.

Learning Objectives
Upon completion, the participant should be able to:
• State the relationship between Product Development, Voice of the Customer (VOC) and the FMEA process
• Recognize why and when to use the five types of FMEAs, specifically Systems and Design
• Apply the FMEA process as a risk management technique
• Organize an effective FMEA team and conduct FMEA work sessions
ENGINEERING TOOLS & METHODS

- Adapt the steps to generate a FMEA process to your specific company needs
- Develop and manipulate Risk Priority and Detection Strategies and customize Risk Ranking tables
- Assign effective Recommended Actions

Who Should Attend

The course is designed for individuals who are involved in the development of new products and who seek to improve that process. Product development team members including, but not limited to, project and program managers, design and development, process, product, quality, and application engineers will find the course valuable. It is aimed primarily at these managers and engineers who will be facilitating or leading such FMEA activities. Directors, marketing and purchasing personnel will also benefit by understanding why the FMEA process is important to developing a safe and effective product.

Topical Outline

Session 1
- FMEA Introduction
  - Background and History
  - The FMEA Standards - MIL-STD_1629, SAE J1739, AIAG
  - Relationship of Design and Process FMEA in a design & manufacturing environment

Session 2
- Five Types of FMEAs

Session 3
- FMEA and Risk Management
  - Defining Risk Management
  - FMEA and Robust Design FMEA as part of Design to Cost
  - FMEA as Product Liability Protection

Session 4
- Managing the FMEA Process
  - Assembling the FMEA Team
  - Facilitator Role during the FMEA Process
  - Capturing the 6 Levels of Voice of the Customer (VOC)
  - The FMEA Database and FMEA Templating
  - Tips for standardizing concise expression of failure modes, effects and causes

Session 5
- Column By Column Review of the FMEA - Part 1
  - Header
  - Item/Function - Primary, Secondary and Customer Satisfaction
  - Failure Mode
  - Effects and Severity
  - Causes and Occurrence
  - Controls and Detection

Session 6
- Column By Column Review of the FMEA - Part 2
  - Calculating and Assessing RPN
  - Risk Tables and RPN assignment strategies
  - Recommended Actions
  - Responsibility and Target Dates
  - Verification

Instructor: Angelo E. Mago
Fee $835 1.2 CEUs

Failure Modes and Effects Analysis (Product & Process) in Aerospace

2 Days
I.D.# C0939

This interactive Failure Modes and Effects Analysis (FMEA) product and process seminar introduces the participant to the analytical process by which potential failure modes, failure effects and causes of failure are identified. Engaging in a systematic method of studying failure can improve future outcomes. The severity, occurrence and probability of detection of a failure mode are used to prioritize which failure modes are most critical. Methodology is introduced for dealing with the effects of failure. The Design FMEA link to manufacturing is explained and amplified in terms of downstream Process FMEA. This course is based on “learning by doing” with interactive, in-class Design and Process FMEA generation and analysis in a lively team environment. This course will also detail relevant portions of the SAE Aerospace Recommended Practice for FMEA, ARP 5580 which is included in the course materials.

Learning Objectives

Upon completion of this seminar, participants will be able to:
- List the benefits, requirements and objectives of an FMEA (both Product Design & Process)
- Explain the steps and methodology used to analyze a Design or Process FMEA
- Demonstrate the application of a variety of tools utilized in conjunction with performing an FMEA
- Identify corrective actions or controls and their importance in minimizing or preventing failure occurrence
- Interpret the objectives of the SAE Aerospace Recommended Practice for FMEA, ARP5580

Who Should Attend

This seminar is designed for the design engineer, process assurance engineer, reliability engineer, test engineer, quality engineer, development engineer, logistics/support engineer, manufacturing engineer and their management or anyone responsible for the design and development of design or manufacturing, assembly or service processes in the completion of a Design or Process FMEA.
ENGINEERING TOOLS & METHODS

Prerequisites
Attendees should possess a basic understanding of the design principles/process and manufacturing/assembly process.

Topical Outline
DAY ONE
• Introduction and Overview
  • Definition
  • Requirements for an FMEA (both Design & Process) - Who drives the requirements?
  • FMEA detail
  • Design and Process FMEA similarities and differences -- performing an FMEA
  • Prerequisites
  • Basic analysis methodology -- approach; sequence
  • Prioritization of failure modes
  • Typical forms used: examples and recommendations
• Other Quality Tools to Aid in FMEA Development
  • Pareto chart
  • Fishbone diagram
  • Design review
  • Checklists
  • Lessons learned
  • Design of Experiments (DOE)
  • Statistical process Control (SPC)
  • Fault Tree Analysis (FTA)
  • Monte Carlo simulation
• Design FMEA: Class Exercise
  • What’s the requirement?
  • Forming the team
  • Process flow
  • Brainstorm design failure modes
  • Use FMEA form to document failure modes, severity, occurrence, detection
  • Prioritize failure modes
  • Work corrective actions
  • How good are these corrective actions?
  • Redo prioritization to compare to requirement
  • Modify product based on analysis, for objective testing
DAY TWO
• Complete Design FMEA exercise (continued)
  • Process FMEA: Class Exercise
  • What’s the requirement?
  • Forming the team
  • Process flow/Value Stream map
  • Brainstorm process failure modes
  • Use FMEA form to document failure modes, severity, occurrence, detection
  • Prioritize failure modes
  • Work corrective actions
  • How good are these corrective actions?

Fundamentals of Statistical Process Control
2 Days
I.D.# C0553
As competition for market share increases, so does the need to monitor processes and quality to ensure top-notch products. This hands-on seminar will provide you with the skills to apply and maintain statistical process control to assist your organization in the improvement of various processes to achieve higher percentage yield or higher quality products or services. Quality characteristics (process outputs to track), measurement systems, sampling strategies, types of control charts, construction of control charts, and control chart interpretation will be covered. The determination of the key process parameters and controlling them to provide consistent results will improve quality and lower costs, in particular, scrap and rework costs. Statistical theory and depth are kept to a minimum while you learn how to utilize the tools. Attendees will receive a copy of the Statistical Process Control Manual (SPC-3, 2nd Edition) by the Automotive Industries Action Group.

Learning Objectives
By attending this seminar, participants will be able to:
• Describe the purpose and uses of SPC
• Select the best measurement system to use for a specific application
• Identify an appropriate process sampling strategy
• Determine the basic type of control chart to use
• Collect data and construct basic control charts
• Interpret control chart results

Who Should Attend
Quality managers, engineers, and technicians, project engineers, manufacturing engineers, technical specialists and anyone with responsibility for product or process control who want to apply SPC in the workplace should attend this seminar. Individuals seeking to attain the Certified Quality Engineering status within the American Society for Quality will find this course particularly helpful.

Instructor: Breneman, Jim
Fee $1370 1.3 CEUs
Introduction to Design Review Based on Failure Modes (DRBFM) Web Seminar and Web Seminar RePlay

6 Hours
Web Seminar: I.D.# WB1047
Web Seminar RePlay: I.D.# PD331047ON

Design Review Based on Failure Modes (DRBFM) is a methodology focused on change management and continuous improvement. It centers on early prevention and engineering knowledge, eliminating time spent debating ranking systems, waiting for lead engineers to document and list their concerns, identifying what types of concerns are open for discussion and resolution, and brainstorming without any actionable closure.

This web seminar will explain all phases of the DRBFM methodology and provide details on how to accomplish the specific steps. With the Design Review Based on Failure Modes (DRBFM) and Design Review Based on Test Results (DRBTR) Process Guidebook that is bundled with the course, the instructor will provide specific information on each step. Formats, examples, notes and homework slides will be used to illustrate the defined steps of the new SAE J2886 DRBFM Recommended Practice. Similarities in content between DRBFM and FMEA will be discussed, however the focus will be on conducting DRBFM methodology.

This DRBFM web seminar will provide roles and responsibilities of management, design engineers, manufacturing engineers, facilitators and technical experts. Those interested in DRBFM will benefit from understanding the rationale behind this methodology and learn to guide teams through the paradigm shifts and mindset that are needed.

Learning Objectives

By connecting with this web seminar, participants will be able to:

• Outline the fundamental steps of DRBFM methodology, including:
  • DRBFM Plan and analysis requirements
  • Necessary preparation feeding DRBFM analysis
  • The two phases of DRBFM analysis
  • Documentation of design, validation and manufacturing actions
  • Feedback loop into engineering knowledge documents
  • Explain the intent and format of the DRBFM worksheets
  • Predict what it takes to gain and maintain proficiency and consistent application of the methodology
  • Find answers to most DRBFM questions

Who Should Attend

Product engineers, manufacturing engineers, quality engineers, supplier quality engineers, validation and test engineers, and
facilitators, trainers and consultants in all industries. This web seminar will benefit beginning engineers, advanced and senior engineers and managers who must participate in FMEA’s and DRBFM.

**Topical Outline**

Session 1

- DRBFM Procedure, Forms, Planning and Preparation
  - Process Guide and Workbook Overview
  - Scope and Purpose
  - Process Map - General Requirements
  - Planning - Formats, examples, homework
  - Planning Results and Output
  - Preparation - Formats, examples, homework
  - Preparation Results and Linkage with DRBFM Format
  - Definition of Change Section

Session 2

- DRBFM - Forum 1, Design Review, Action Results and Follow Up
  - DRBFM Forum 1 - Engineer analysis
  - Change Point definition
  - Identification of concerns
  - Identification of causes and influences on the vehicle
  - Identification of effects
  - Identification of severity/priority
  - Actions to gain engineering knowledge - evidence

Session 3

- DRBFM - Forum 2, Design Review, Action Results and Follow Up
  - DRBFM Forum 2 - Design Review introduction
  - Change Point overview
  - Identification of additional concerns
  - Identification of additional causes and influences on the product
  - Identification of effects
  - Identification of severity/priority
  - Actions taken to eliminate concerns
  - Design actions to gain engineering knowledge - evidence
  - Validation actions to gain evidence of reliability
  - Manufacturing, assembly, and supplier actions
  - Action results and feedback to design guidelines
  - Roles and responsibilities

**Instructor:** Bill Haughey

**Fee:** $615  .6 CEUs

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**Reverse Engineering: Technology of Reinvention**

2 Days
I.D.# C0559

During the past decade reverse engineering has become a common and acceptable practice utilized by many original equipment manufacturers and suppliers. This course focuses on the application of modern technologies used to decode the design details and manufacturing processes of an existing part in the absence of the original design data. It emphasizes the real-life practice of reverse engineering in the aerospace industry from both scientific and legal points of view. Attendees will learn the applicability and limitations of reverse engineering through case studies and hands-on exercises.

Various measurement instruments, ranging from traditional micrometers to computer-aided laser probes, will be compared for their merits and shortcomings. The statistics of dimensional measurements and the acceptable tolerance of variations, with emphasis on industrial standards in real-life practice will be discussed. Material identification, manufacturing process verification and the system compatibility of the subject part to be reverse engineered will be covered in substantial detail. In addition, the materials specifications will be exemplified as useful supporting documents for substantiation data.

Note: Participants should bring a calculator for in-class exercises.

**Learning Objectives**

By attending this seminar, participants will be able to:

- Define the critical elements of reverse engineering
- List the measurements and analyses required to duplicate/reproduce an OEM part by reverse engineering
- Recognize if an OEM part can be duplicated/reproduced by reverse engineering
- Judge if a “duplicated” part will meet the design functionality of the OEM part
- Evaluate the feasibility of a reverse engineering proposal/project
- Describe and implement a process to duplicate/reproduce a part by reverse engineering

**Who Should Attend**

This seminar is designed to assist individuals in various industries including, but not limited to, automotive, aerospace, off-highway, motorsports and parts brokerage firms. Corporate senior executives, engineering managers, engineers, technicians, government inspectors, sales managers, salespersons, lawyers and legal counselors will find the course relevant and informative.
ENGINEERING TOOLS & METHODS

Topical Outline

DAY ONE
• Introduction
  • Historical background
  • Reverse engineering vs. machine design
  • Three basic requirements: form, fit and function
• Geometrical Form
  • Dimensional measurement
  • Precision instruments of measurement
  • Tolerance
  • Virtual exercise of geometrical modeling
• Material and Process Identification
  • Chemical composition identification
  • Manufacturing process verification
  • Materials specification substantiation
  • Machining process identification
• Data Process and Analysis
  • Statistical analysis
  • Statistical exercise
  • Case study of statistical confidence
  • Reliability

DAY TWO
• Demonstration and Exercise
  • Demonstration of scanning
  • Hands-on exercise of reverse engineering
  • Case study
• Regulations and Certifications
  • Government regulations
  • Industrial standards
  • Certification requirements
• Fit and Function
  • System compatibility
  • Critical performance
  • Vendor substantiation
  • Safety and damage tolerance
• Acceptance and Legality
  • Evolving industry trends
  • Moral and legal issues
  • Examples - legal precedents

Instructor: Wego Wang
Fee $1370 1.3 CEUs

Robust Design

2 Days
I.D.# C1231

Engineers are taught to create designs that meet customer specifications. When creating these designs, the focus is usually on the nominal values rather than variation. Robustness refers to creating designs that are insensitive to variability in the inputs. Much of the literature on robustness is dedicated to experimental techniques, particularly Taguchi techniques, which advocate using experiments with replications to estimate variation. This course presents mathematical formulas based on derivatives to determine system variation based on input variation and knowledge of the engineering function. If the function is unknown, experimental techniques are presented to efficiently estimate a function.

The concept of designing for both nominal values and variability is expanded to multiple outputs and designing to minimizing costs. Traditionally, if the output variation is too large to meet requirements, the tolerances (variation) of the inputs are reduced. Using the approach presented in this course, the equations presented can be used to identify the contribution of each of the inputs to the output variation. The variation of the components with the largest contribution can be reduced which will reduce output variation. At the same time, the variation of the components contributing the least to the variation of the output can be increased which will reduce costs. A system of equations can be created that will allow an optimization routine to create a design optimized for total cost including the cost of poor quality and component cost.

Participants should bring a laptop computer for in-class exercises.

The book, Probabilistic Design for Optimization and Robustness for Engineers by Bryan Dodson, Patrick Hammett, & Rene Klerx is included in the course materials.

Learning Objectives

By attending this seminar, participants will be able to:
• Create designs that have a minimal sensitivity to input variation
• Reduce design costs
• Determine which design parameters have the largest impact on variation
• Optimize designs with multiple outputs

Who Should Attend

This course is relevant to design and manufacturing engineers, researchers and those interested in cost reduction. This methodology can link manufacturing to engineering design and help design engineering solve manufacturing problems.
**Topical Outline**

**DAY ONE**
- Basics of Variation - unique problems facing engineers; small sample sizes and the inability to obtain random samples; techniques for overcoming these problems
- Distributions
  - Normal, Lognormal, and Weibull
- Process Capability
  - Measuring process capability
  - Process capability indices
  - Estimating process capability for design inputs
- Robustness Concept
  - Statistical bias that results from input variation in a non-linear system
  - Modeling output variation
  - Circuit exercise
  - Projectile exercises
- Simulation
  - Determining the variability of the inputs
  - Random number generators
  - Verification & validation
  - Simulation modeling

**DAY TWO**
- Minimizing the Variance of a Single Output
  - Polynomial exercise
- Identifying Critical Parameters
  - Ranking the contribution to the output variation
  - Identifying parameters that are constrained
- How to Model and Optimize Multiple Outputs
  - Combustion exercise
- Adding Cost to the Design Model
  - Minimizing the total system cost including component, scrap and process costs
  - Electronics exercise

**Instructor:** Bryan Dodson  
**Fee:** $1465  
1.3 CEUs

**Root Cause Problem Solving: Methods and Tools Web Seminar**

**8 Hours**

Web Seminar: I.D.# WB0931  
Similar content is available in an on demand course. Review the course info in the On Demand Courses Resource Guide on pages 97-139.

Tough times require searching for things that we can change and making them better. But so often problems are solved with ‘band-aids’ and not root cause solutions. This approach is getting too expensive and at best only helps companies tread water. To combat these issues and adopt a fresh approach, teams can use the methods and tools of Root Cause Problem Solving to first view problems as opportunities for improvement, identify root causes and implement solutions to prevent recurrence. Benefits include improved quality and customer satisfaction, reduced operation costs, and greater employee knowledge of work processes.

This proven 8-step approach to problem solving will help improve operational and financial performance by identifying causes and implementing solutions to significant or recurring problems. This approach to problem solving is used by many major automotive manufacturers.

**Learning Objectives**

By connecting with this web seminar, participants will be able to:
- Describe the 8-Step Problem Solving Methodology
- Define the difference between Symptom and Root Cause
- Use tools and techniques to solve problems
- Evaluate effectiveness of problems solving efforts
- Describe the role of problem solving in continuous improvement
- Write an action plan to apply problem solving to a specific concern

**Who Should Attend**

This course is applicable to those directly working in or responsible for performance improvement of any definable, repetitive process, e.g. manufacturing, design, logistics, purchasing, sales, or distribution, including:
- Manufacturing managers, supervisors and team leaders
- Manufacturing engineers
- Design engineers
- Quality engineers and technicians
- Technical managers
- Project team leaders
- Problem solving and quality improvement facilitators
- Anyone whose role includes problem solving; therefore all supervisors and lead personnel
Topical Outline

Session 1
• Overview
  • Following a process approach
  • What is a problem?
  • Inhibitors to effective problem solving
  • 8-step problem solving process overview
• Step 1: See the Problem as an Opportunity
  • Framing the problem solving effort
  • Identifying team member; Team roles
• Step 2: Describe the Problem
  • Symptoms vs. Causes
  • Methods for describing the problem
  • Using and charting data
  • Problem Is/Is-Not analysis

Session 2
• Step 3: Implement Containment
  • Protect the Customer
  • Process Control Plan
• Step 4: Recognize Potential Root Causes
  • Identifying possible causes
  • Process Maps
  • Cause-Effect diagrams
  • 5-Why tool

Session 3
• Step 5: Design Solution
  • Solutions that don’t work
  • Process Controls and Error Proofing
  • Standardized Work
• Step 6: Implement Permanent Corrective Actions
  • Plan the work
  • Complete system changes
  • Verify effectiveness

Session 4
• Step 7: Prevent Recurrence
  • Was the problem eliminated?
  • Layered audits
  • Leverage learnings with FMEA
• Step 8: Recognize Efforts
  • Team debrief and lessons learned
  • Evaluate and celebrate success
• Summary
  • Sufficiency checklist for effective problem solving
  • Continuous Improvement

Instructor: Murray Sittsamer
Fee $640 .8 CEUs

Root Cause Problem Solving: Methods and Tools
8 Hours
I.D.# PD530931

Similar content is available in live web seminar - Root Cause Problem Solving: Methods and Tools. See the course description the previous page.

This course introduces the Root Cause Problem Solving approach. It explains how using the Root Cause approach can help improve operational and financial performance by identifying root causes and implementing solutions to significant or reoccurring problems. This problem-solving approach is used by many major automotive manufacturers to improve quality and customer satisfaction, reduce operation costs, and provide greater employee knowledge of work processes.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

Quantity discounts and Site License options are available. Call the SAE Corporate Learning Solutions hotline at +1.724.772.8529 for a quote.

Statistical Methods for Quality Engineering
3 Days
I.D.# C0554

Based on your test data or process data, do you ever wonder if:
• An improved product really performs better?
• A substitute material really processes the same?
• A cheaper material really performs satisfactorily?
• What confidence do you have in the final decision that you make?

This seminar helps individuals responsible for product or process development and testing to statistically assess the variation of the product or process performance and make effective decisions with confidence. Technical personnel are consistently making changes to product and process designs and the resultant performance changes need a statistical basis for moving ahead to the cost assessment and release phases. Various continuous and discrete probability functions are covered with the normal distribution receiving the most emphasis. Other distributions covered include Weibull, Exponential, Binomial, Poisson, Hypergeometric, and nonparametric comparisons. Various confidence intervals and tests of comparison, including Z test, Student’s t tests, Chi-Square test, F test, and ANOVA for the normal distribution for these probability functions are covered.
Learning Objectives
By attending this seminar, participants will be able to:
• Select the proper distribution model
• Determine valid sample sizes
• Design valid tests of comparison
• Make effective decisions at stated confidence levels

Who Should Attend
This course applies to anyone making product or process assessment or changes and will help them to make effective decisions concerning those situations. Product design managers and engineers, process design managers and engineers, and quality managers and engineers will particularly benefit from this course. Individuals seeking to attain the Certified Quality Engineering status within the American Society for Quality will find this course particularly helpful.

Prerequisites
Participants should have at least high school mathematics and graphing skills, a good technical understanding of products and processes in their work environment, and a good technical understanding of testing methods and protocols.

Topical Outline
DAY ONE
• Introduction
  • Training objectives
  • Statistical resources
• Concept of variation
  • Common development questions
  • Histograms
  • Descriptive statistics
• Distribution Models
  • Continuous
  • Discrete
  • Applications
• Model Selection
  • Empirical distribution functions
  • Cumulative distribution functions
  • Normal probability paper
  • Small sample sizes and median ranks
  • Tests for normality
DAY TWO
• Parametric Evaluations and Tests
  • Normal and log-normal data - Z confidence intervals and tests; t confidence intervals and tests; Chi-Square confidence intervals and tests; K factor confidence intervals; F tests;
DAY THREE
• Parametric Evaluations and Tests (continued) - analysis of variance
  • Weibull distribution, confidence intervals and tests
  • Exponential distribution tests
• Poission distribution applications
• Binomial distribution applications
• Hypergeometric applications
• Nonparametric Tests
  • Sign tests
  • Run tests
  • Rank tests

Instructor: Phillip J. Ross
Fee $1745 2.0 CEUs

Vibration Analysis Using Finite Element Analysis (FEA)
12 Hours
I.D.# WB1401
Web Seminar Replay: I.D. PD331401ON

Finite Element Analysis (FEA) has been used by engineers as a design tool in new product development since the early 1990’s. Until recently, most FEA applications have been limited to static analysis due to the cost and complexity of advanced types of analyses. Progress in the commercial FEA software and in computing hardware has now made it practical to use advanced types as an everyday design tool of design engineers. In addition, competitive pressures and quality requirements demand a more in-depth understanding of product behavior under real life loading conditions. This course will enable participants to expand the scope of FEA to vibration analysis to simulate product behavior under those conditions.

This six-session web seminar introduces vibration analysis performed with Finite Element Analysis (FEA). By considering time-dependent loads and inertial and damping effects, vibration analysis allows for a more in-depth product simulation thus reducing product development cost and time. The course reviews basic concepts of vibration analysis and illustrates how they are implemented in FEA to simulate product behavior. The most common types of vibration analysis such as modal, time response, and frequency response will be covered.

All topics are illustrated using FEA software, SolidWorks® Simulation, for which participants will be provided a student license (compatible with 64-bit Windows 7 SP1, 8.1, 10; IE 10,11; MS Excel and Word 2010, 2013, 2016) and opportunity to practice skills learned. Acquired skills, however, will not be software specific and no prior exposure to FEA software is required. The eBook, Vibration Analysis with SolidWorks® Simulation by Paul Kurowski, will also be included in the course materials. In-class, hands-on exercises and between-session assignments will provide an opportunity to put what is learned into practice.
ENGINEERING TOOLS & METHODS

Learning Objectives
By participating in this web seminar, participants will be able to:
• Evaluate the importance of dynamic effects in product simulation
• Analyze inertial and damping effects in structural response
• Perform modal analysis, time response analysis and frequency response analysis
• Apply proper FEA modeling techniques to model system vibration
• Use vibration analysis as a design tool

Who Should Attend
The course will be of interest to design, R&D, project, and product engineers who already use Finite Element Analysis (FEA) as a design tool and would like to explore if and how vibration analysis with FEA may benefit the design process. It builds on participants’ experience with static FEA and on knowledge of mechanical vibrations common to any mechanical engineer.

Prerequisites
Participants should have a degree in mechanical engineering and have some experience with FEA either by participating in the SAE Finite Element Analysis for Design Engineers webinar (I.D.# WB1241; page 16) or through equivalent work experience. Familiarity with Windows OS and some CAD is helpful. The textbook, Engineering Analysis with SolidWorks® Simulation by Paul Kurowski, is recommended reading.

Topical Outline
Session 1
• Structure vs. Mechanism
• Simulation Process with the FEA
• Verification and Validation of FEA Results
• Discrete and Distributed Systems
• Mode of Vibration
• Modal Analysis
• Eigenvalues and eigenvectors
• In-class Exercises/Homework Assignment

Session 2
• Modal Analysis
• Convergence of Frequencies
• Rigid Body Modes
• Properties of Lower and Higher Modes
• Modes of Vibration of Single Degree of Freedom Oscillator (1DOF) and Two Degrees of Freedom Oscillator (2DOF)
• In-class Exercises/Homework Assignment

Session 3
• Modal Analysis
• Modeling Techniques in Modal Analysis
• Modes Separation
• Modal Analysis as a Tool to Find “Weak Spots”
• Modal Analysis as a Diagnostic Tool
• In-class Exercises/Homework Assignment

Session 4
• Modal Analysis with Pre-Stress
• Buckling Analysis
• Analogies between Modal Analysis and Buckling Analysis
• Modes of Vibration
• Modal Superposition Method
• In-class Exercises/Homework Assignment

Session 5
• Time Response Analysis
• Load Excitation and Base Excitation
• Impulse Load
• Static vs. Dynamic Response
• Time Response of a 1DOF and 2DOF Systems Time Response of a Distributed System
• In-class Exercises/Homework Assignment

Session 6
• Frequency Response Analysis
• Steady State Harmonic Response
• Force and Base Excitation
• Resonance
• Modal Damping
• Frequency Response of a 1DOF and 2DOF Systems
• Frequency Response of a Distributed System
• Linear vs. Non-linear Vibration Analysis
• Summary for Post-Course Learning Assessment

Instructor:  Paul Kurowski
Fee $870  1.2 CEUs

Weibull-Log Normal Analysis Workshop
3 Days
I.D.# 86034

RMS (Reliability-Maintainability-Safety-Supportability) engineering is emerging as the newest discipline in product development due to new credible, accurate, quantitative methods. Weibull Analysis is foremost among these new tools. New and advanced Weibull techniques are a significant improvement over the original Weibull approach. This workshop, originally developed by Dr. Bob Abernethy, presents special methods developed for these data problems, such as Weibayes, with actual case studies in addition to the latest techniques in SuperSMITH® Weibull for risk forecasts with renewal and optimal component replacement. Class work is used to reinforce key concepts, lectures are based on actual case studies, and personal computers and hands-on experiments are used to analyze dozens of Weibull & Log Normal problems. Students will be fully capable of performing basic and advanced RMS Engineering analysis with their own software on completion of the workshop.

**Bonus Introductory Course Included**
To accelerate your learning, you may want to complete the SAE On Demand Course, *Introduction to Weibull Solution Methods* prior to the Workshop. Your registration will give you online access to this highly recommended, 75-minute overview of Weibull Analysis approximately 10 days in advance of the course start date. Access will end the last day of class.

**Learning Objectives**
By attending this seminar, participants will be able to:
- Analyze design, development, production, and service failures
- Model product lifetime and reliability
- Evaluate calibration and maintainability plans
- Analyze inspection data
- Reduce test substantiation, time and costs

**Who Should Attend**
An engineering undergraduate degree in any discipline would be beneficial. Engineers responsible for reliability, safety, supportability, maintainability, materials, warranties, life cycle cost, design, structures, instrumentation and logistics will find these Weibull techniques extremely useful.

**Topical Outline**

**DAY ONE - Undergraduate Weibull Analysis**
- Background, Development & Introduction - 23-Minute Video Short Course
- How to do Weibull Analysis
- Interpretation of Good Weibulls - 2 & 3 Parameter
- Are two Weibull datasets significantly different?
- Interpretation of Bad Weibulls
- Risk and Failure Forecasting Case Studies
- Weibull Experiments (Wire Rupture, Torsion, LCF, Accelerated Testing), Classwork Problems and Solutions
- Log Normal Analysis
- Optimal Replacement Intervals, Block Replacement

**DAY TWO - Postgraduate Weibull Analysis**
- Maximum Likelihood Weibull Theory and Application
- Weibayes Analysis
- Dauser Shift, Warranty Analysis
- Rank Regression vs. Maximum Likelihood
- Extremely Small Samples Analysis
- One Failure Weibull Case Study
- An Introduction to SuperSMITH® Software, Features, Input, Analysis, Output
- Summary of Weibull Methods
- Class Work Problems
- Experimental Wire Data Distribution Analysis
- Playtime With SuperSMITH® Tutorial
- DAY THREE - Confidence Intervals and System Models
- Confidence Intervals, “The Good, The Bad and The Complicated”
- Comparing Designs
- The Binomial & Poisson
- Crow-AMSAA Reliability Growth Modeling - Useful Technology for Tracking Development Testing and Any Significant Event to be Managed
- The Exponential Related to the Poisson and the Weibull
- Kaplan-Meier Survival Analysis
- Crow-AMSAA Employed for Analyzing Renewal-Repairable Systems
- System Models
- Classwork
- Complete Playtime With SuperSMITH®
- Ph.D. Oral Examination

**Instructor:** Wes Fulton

**Fee:** $2275 2.0 CEUs

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**Introduction to Weibull Solution Methods**

**75 Minutes**
I.D.# PD530946ON

This is an introductory module; more in-depth content is available in the seminar, *Weibull-Log Normal Analysis Workshop*. See the course description above.

The Weibull Solution Methods course is designed for technical personnel and engineers who want to discover the best toolset for continuous improvement at their organization or business. The course will benefit those in any industry including automotive, aerospace, electrical/electronic, transportation, design, manufacturing, test planning, warranty, reliability, quality, liability, value engineering, and management, among others. This course is appropriate for anyone who needs an awareness of Weibull’s basic premises and benefits as well as those who need this foundational knowledge as a prerequisite for additional training toward becoming an expert Weibull practitioner.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

Quantity discounts and Site License options are available. Call the SAE Corporate Learning Solutions hotline at +1.724.772.8529 for a quote.
ENGINEERING TOOLS & METHODS

Tolerance Stack-up Fundamentals Web Seminar and Web Seminar RePlay

6 Hours
Web Seminar: I.D.# C0842
Web Seminar RePlay: I.D.# PD330842ON

Analysis of tolerance stacks varies widely. This web seminar introduces the basic tools to create a common methodology for tolerance stack-ups, and ensure seamless documentation. Participants will create 1-D tolerance stacks for parts and assemblies that use geometric dimensioning and tolerancing using a tolerance stack spreadsheet. This simple, manual spreadsheet method produces an easily interpreted and checked documentation trail, and is easily adaptable to common electronic spreadsheet programs. Multiple examples will be provided to assist engineers in applying tolerance stack-up fundamentals to Y14.5 issues.

Learning Objectives
By connecting with this Web Seminar, participants will be able to:
• Perform and develop a tolerance stack-up analysis
• Correctly enter geometric feature control frame data into a tolerance stack
• Apply a common step-by-step methodology to tolerance stack analysis

Who Should Attend
Engineers familiar with concepts and practices contained within Y14.5 and who are looking for a fundamental step-by-step process for getting geometric dimensioning and tolerancing (GD&T) into a tolerance stack will benefit from this course. A basic understanding of GD&T symbols and concepts is required.

Topical Outline
Session 1
• Introduction and review
  • Introduction and tolerancing review
  • Tolerancing strategies
  • Review of GD&T
Session 2
• Stack fundamentals
  • How to identify the stack path
  • The two-column stack spreadsheet
  • Entering dimensions into the spreadsheet
  • Examples with coordinate dimensions
Session 3
• Factoring GD&T into a Stack
  • Location and runout tolerances
  • Profile tolerances
  • Form and orientation tolerances

Session 4
• Bonus and shift tolerance in a stack
  • Overview of bonus and shift tolerance
  • Part vs. assembly stacks
• Wrap-up

Instructor: John-Paul Belanger
Fee $640 .6 CEUs

Fundamentals of Geometric Dimensioning & Tolerancing (GD&T) Web Seminar and Web Seminar RePlay

16 Hours
Web Seminar: I.D.# WB0933
Web Seminar RePlay: PD330933ON

Geometric dimensioning and tolerancing (GD&T) is used as a symbolic way of showing specific tolerances on drawings. GD&T is a valuable tool that effectively communicates the design intent to manufacturing and inspection. It is governed by the technical standard ASME Y14.5M-2009. This course introduces participants to the GD&T system, providing a working knowledge of the correct interpretation and application of each symbol, general rules, the datum system, and ‘bonus’ tolerance and highlighting some of the changes in the updated Y14.5 standard. The material is reinforced with many practice exercises.

Learning Objectives
By connecting with this web seminar, participants will be able to:
• Explain the benefits of geometric tolerancing
• Identify datum features and determine their order of precedence
• Identify and interpret each of the characteristic symbols
• Describe the material condition modifiers and how “bonus” tolerance occurs
• Correctly interpret GD&T feature control frames, and explain the impact on manufacturing and inspection

Who Should Attend
This course is ideal for anyone who has a need to apply or interpret geometric tolerances on a product print. Product engineers, manufacturing engineers, CAD designers, quality inspectors, and other engineering and manufacturing personnel will all benefit from a better understanding of design requirements; improved communication with customers and suppliers; and improving designs by taking advantage of bonus tolerance and other GD&T benefits. Participants should have an understanding of basic...
blueprint reading. If employees are already applying basic GD&T concepts, consider advanced competency courses Advanced GD&T Competencies: Composite Positioning web seminar (I.D. # WB1321), Advanced GD&T Competencies: Datum Usage web seminar (I.D. # WB1319), and Advanced GD&T Competencies: Profile of a Surface web seminar (I.D. # WB1320). Descriptions on following pages.

Topical Outline
Session 1
• Why Use GD&T?
  • Review of traditional dimensioning
  • Benefits of GD&T
  • Technical standards
  • Definitions
  • Basic dimensions
  • How to read the feature control frame
Session 2
• Rules and the Form Symbols
  • Rule #1: Size controls form
  • Rule #2: Assume RFS
  • Flatness
  • Surface straightness
  • Circularity
  • Cylindricity
Session 3
• Bonus Tolerance
  • GD&T applied to a feature of size
  • Bonus and the MMC modifier
  • Virtual condition
  • Gaging and inspection of GD&T
Session 4
• Datums
  • Datum vs. datum feature
  • The datum reference frame
  • Primary, secondary, and tertiary datums
Session 5
• Profile and Orientation
  • General definition of profile
  • Profile of a line
  • Profile of a surface
  • Use of datums with profile
  • Perpendicularity
  • Angularity
  • Parallelism
Session 6
• Position Tolerance I
  • True position
  • Position tolerance RFS
  • Using MMC or LMC
  • The “boundary” concept
  • The pitch diameter rule
Session 7
• Position Tolerance II
  • Projected tolerance zone
  • Inspecting parts for position
  • Calculating tolerance values
  • Composite position tolerance
Session 8
• Symmetry and Coaxial Controls
  • Concentricity
  • Symmetry
  • Circular runout
  • Total runout
• Wrap-up

Instructor: John-Paul Belanger
Fee $995 1.6 CEUs

Advanced GD&T Competencies: Composite Positioning Web Seminar and Web Seminar RePlay
1.5 Hours
Web Seminar: I.D. # WB1321
Web Seminar RePlay: I.D. # PD331321ON

While the basics of position are covered in a standard Geometric Dimensioning & Tolerancing (GD&T) course, and sometimes a lone example of composite position is given, those discussions often overlook the variations allowed that enable more accurate control based on part function. This advanced web seminar will clarify the proper use of “double-decker” position controls in GD&T. There are two distinct types: composite position (one symbol) and two single-segment position controls (two symbols). These are commonly used to locate patterns of features (bolt circles, etc.), but they are rarely taught in any depth. In this course, participants will learn the difference in showing one vs. two position symbols and the importance of the datum references in understanding each meaning, per the ASME Y14.5-2009 standard. Many samples will be shown of the proper tolerancing of patterns of holes and pins that use each method. Examples and exercises will be provided to allow participants to practice several calculations. Learning these advanced techniques will permit better communication of part and assembly requirements between designers and manufacturers.
Learning Objectives
By connecting with this web seminar, participants will be able to:
• Explain composite positioning tolerancing
• Explain two single-segment tolerancing
• Apply the appropriate callout based on functional requirements
• Describe gages for each and calculate gage sizes

Who Should Attend
This advanced-level course is intended for designers, product engineers, manufacturing engineers, manufacturing personnel, and quality/gaging inspectors with a basic knowledge of GD&T concepts. It is a companion to the Advanced GD&T Competencies: Profile of a Surface and Advanced GD&T Competencies: Datum Usage web seminars - immediately following.

Prerequisites
For those new to GD&T, the Fundamentals of Geometric Dimensioning & Tolerancing web seminar is a recommended prerequisite. See course description on page 30.

Topical Outline
• Brief review of position and bonus tolerance
• Explanation of composite tolerancing
• The need to control orientation vs. location
• Adding secondary and tertiary datums to the lower tolerance
• Two single-segment position tolerancing
• Functional gaging and CMM gaging perspectives

Instructor: John-Paul Belanger
Fee $215 .15 CEUs

Advanced GD&T Competencies: Datum Usage Web Seminar and Web Seminar RePlay
1.5 Hours
Web Seminar: I.D.# WB1319
Web Seminar RePlay: I.D.# PD331319ON

While the basics of datums are covered in a standard Geometric Dimensioning & Tolerancing (GD&T) course, those discussions often overlook the variations that enable datums to be used in complex ways. This advanced course will detail the proper use of datums, showing their full potential to make your drawings as effective as possible. Most people who use GD&T are familiar with traditional datums derived from flat surfaces, and have adequate knowledge of the principle of establishing 3-2-1 contact points. In this web seminar, participants will learn to select, identify, simulate, and describe datums and datum features for special uses such as irregular shapes, flexible parts, and datum references that use the maximum material modifier. Also covered are several new modifiers and options given in the ASME Y14.5-2009 standard. Learning these advanced techniques will allow designers to better communicate certain requirements.

Learning Objectives
By connecting with this web seminar, participants will be able to:
• Explain the difference between a datum and a datum feature
• Select appropriate datums for irregularly shaped parts such as body or interior panels
• Properly simulate given datums
• Explain effects of a modified datum on a geometric tolerance
• Interpret new datum tools such as translation and custom degrees of freedom

Who Should Attend
This advanced-level course is intended for designers, product engineers, manufacturing engineers, manufacturing personnel, and quality/gaging inspectors with a basic knowledge of GD&T concepts. It is a companion to the Advanced GD&T Competencies: Composite Positioning and Advanced GD&T Competencies: Profile of a Surface Web Seminars. See course descriptions on previous page.

Prerequisites
For those new to GD&T, the Fundamentals of Geometric Dimensioning & Tolerancing Web Seminar is a recommended prerequisite. See the course description on page 30.

Topical Outline
• Brief review of traditional datum usage
• Selecting datums: surface vs. feature of size
• Use of the MMB modifier (formerly MMC)
• Using a pattern as a single datum
Advanced GD&T Competencies: Profile of a Surface Web Seminar and Web Seminar RePlay

1.5 Hours
Web Seminar I.D.# WB1320
Web Seminar RePlay: I.D.# PD331320ON

While the topic of profile is covered in a basic Geometric Dimensioning & Tolerancing (GD&T) course, those discussions often ignore the variations allowed with these symbols that enable them to be used in complex ways. This advanced web seminar will clarify the proper use of the profile tolerances in GD&T and uncover the nuances of these two symbols. Since profile of a surface is arguably the most powerful GD&T symbol, its full potential will be explored. It can be used to control size, form, orientation, and location and its relationship to datums can be varied. Learning these advanced techniques will allow designers to better communicate certain requirements. The examples given in this session will also illustrate several of the new options for profile that were introduced in the ASME Y14.5-2009 standard.

Learning Objectives
By connecting with this web seminar, participants will be able to:
• Explain when profile tolerances require a datum reference
• Determine which aspects of GD&T a given profile tolerance controls
• Interpret unilateral, bilateral, and nonuniform tolerances
• Describe how to properly measure profile tolerances

Who Should Attend
This advanced-level course is intended for designers, product engineers, manufacturing engineers, manufacturing personnel, and quality/gaging inspectors with a basic knowledge of GD&T concepts. It is a companion to the Advanced GD&T Competencies: Datum Usage and Advanced GD&T Competencies: Composite Positioning Web Seminars. See course descriptions on previous page.

Prerequisites

Instructors Wanted...
To shape the future of mobility engineering, SAE International Professional Development is seeking experienced engineering professionals with industry and/or academic backgrounds to develop and teach live classroom or online courses.

We are seeking expertise in a variety of Aerospace-related topics including: Certification, Regulations, and Standards.

Contact SAE International Professional Development to explore how you can help to shape the future of industry.

Kevin Perry: Kevin.Perry@sae.org, +1.724.772.7502
WE ARE PLEASED TO ANNOUNCE GD&T EDUCATION AND TRAINING AND REFERENCE RESOURCES FROM EFFECTIVE TRAINING INC. (ETI), AN SAE INTERNATIONAL COMPANY.

Getting where you need to go in your job.

A seasoned training company founded by globally recognized GD&T expert Alex Krulikowski, ETI offers an array of training products designed to train industry engineers at all levels of GD&T usage. High-quality learning products including classroom and digital courses, text books and reference guides, and job resources all meant to produce the world’s best GD&T practitioners. All ETI instructors are ASME certified and mentored by Alex Krulikowski.

Explore public workshops, on-site training, computer-based training, and other GD&T resources from ETI.

Course titles from ETI include:

- Engineering Drawing Requirements
- ASME Y14.5M-1994-2009 Comparison
- GD&T for Manufacturing (ASME Y14.5-2009)
- Functional Gaging and Measurement

- Critical Concepts of Tolerance Stacks
- Solid Model Tolerancing (ASME Y14.41)
- Introduction to Statistical Tolerance Stacks
- The GD&T Trainer: Fundamentals 2009

For more information or to arrange GD&T training or resources for your whole team, visit etinews.com or contact sales@etinews.com

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Engineering Drawing Requirements

1 Day
I.D.# ET2701

Providing you have a basic understanding of engineering drawings, this course teaches how to correctly interpret engineering drawings. It will improve a student’s understanding of print reading and result in more effective communication on the job.

Utilizing the expertise of world-renowned GD&T expert Alex Krulikowski, the course focuses on practical application of print interpretation providing a better understanding of the view representation, dimensions, tolerances, and symbols used.

Each attendee receives a robust collection of learning resources.

**Learning Objectives**

By attending this class, participants will be able to:

- Describe the types of engineering drawings
- Recognize common drawing formats
- Explain line conventions and lettering used on drawings
- Recognize types of drawing views
- Recognize the section views on drawings
- Describe dimensioning and tolerancing practices on drawings
- Explain surface texture standards and symbols
- Describe how weld symbols are used on drawings
- Recognize the symbols and conventions used on electronic diagrams

**Who Should Attend**

This course is valuable for individuals who create or interpret engineering drawings, product and gage designers; process, product, and manufacturing engineers; supplier quality engineers/professionals; CMM operators; buyers/purchasers; checkers; inspectors; technicians; and sales engineers/professionals. Attendees should have a basic understanding of engineering drawings prior to enrollment.

**Topical Outline**

- Engineering Drawings
- Engineering drawings
- CAD
- The purpose and importance of engineering drawings
- Standards used on engineering drawings
- Types of engineering drawings
- Layout, detail, assembly, control, and diagram drawings
- Drawing Formats
- Drawing sheet sizes
- Drawing zones

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3 ways to get a no-obligation price quote to bring a course to your company:
- Call SAE Corporate Learning at +1.724.772.8529
- Fill out the online quote request at sae.org/corplearning
- Email us at Corplearn@sae.org
Solid Model Tolerancing (Based on ASME Y14.41)

1 Day
I.D.# ET2501

Providing you have a basic understanding of Y14.5 Dimensioning and Tolerancing practices, this course explains the fundamental definitions, concepts, and methods from the ASME Y14.41 Standard on Digital Product Definition Data Practices.

Utilizing the expertise of world-renowned GD&T expert and former Chairman of the Y14.41 Committee, Alex Krulikowski, the course focuses on understanding the benefits of a math-based product development process.

Each attendee receives a robust collection of learning resources.

Learning Objectives
By attending this class, participants will be able to:
• Explain the benefits of a math-based product development process (PDP)
• Describe the history, basic information, and definitions from the Y14.41 standard
• Explain how to create product definition data sets
• Describe data set requirements
• List drawing model data set requirements
• Explain various requirements that apply to annotated model data sets
• List the requirements when using the annotated model method
• Recognize the gaps, issues, and challenges of implementing a math-based PDP

Who Should Attend
This course is valuable for designers, engineers, and managers who are considering implementation of a math-based product development process. Attendees should have a basic understanding of Y14.5 Dimensioning and Tolerancing practices.

Topical Outline
• The Product Development Process
  • The characteristics of current PDP’s
  • Problems with current PDP’s
  • What a math-based PDP is
  • The benefits of math-based PDP’s
  • The role of standards in implementing math-based PDP’s
• General Information on the ASME Y14.41 Standard
  • The history of the Y14.41 standard
  • Basic information about Y14.41
  • Y14.41 terms

<table>
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<tr>
<th>Instructor:</th>
<th>This course is taught by one of ETI’s approved instructors, each of whom has been vetted and mentored by Alex Krulikowski</th>
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<tr>
<td>Fee</td>
<td>Contact ETI for pricing information 0.7 CEUs are offered for this course</td>
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ENGINEERING TOOLS & METHODS

- The Data Set Concept
  - The data set concept explained
  - Two methods in the standard for creating product definition data sets
- Common Requirements for Data Sets
  - Data set and design model requirements that apply to both the annotated model data set and drawing data set
  - Display management requirements
  - Reasons for model value query
  - Requirements for resolved, basic, and size dimensions
- Requirements for the Drawing Data Set Method
  - The data set requirements that apply to the drawing data set method
  - General method requirements for drawing data set method
  - The requirements for work coordinate systems in orthographic and axonometric views
  - The requirements for specifying section views, dimensions in axonometric views, datums, and geometric tolerances
- Requirements for the Annotated Model Method
  - The data requirements that apply to annotated model data sets
  - The design model requirements for the annotated model method
  - The requirements for views, annotation, query, and notes on annotated models
- Tolerancing Using the Annotated Model Method
  - The requirements for plus-minus tolerances
  - The requirements for datum applications
  - The requirements for displaying geometric tolerances
- Gaps, Issues, and Challenges of Implementing a Math-Based Development Process
  - The benefits of the Y14.41 standard
  - The major questions that companies need to answer to implement a math-based development process
  - The gaps and issues when trying to achieve a math-based product development process

Instructor: This course is taught by one of ETI’s approved instructors, each of whom has been vetted and mentored by Alex Krulikowski

Fee: Contact ETI for pricing information

.7 CEUS are offered for this course

Fundamentals of GD&T (Based on ASME Y14.5M-1994)

3 Days
I.D.# ET2001

This subject is offered in multiple course lengths.

Providing you have a basic understanding of mechanical drawings, this course teaches the terms, rules, symbols, and concepts of GD&T as prescribed in the ASME Y14.5M-1994 Standard. Utilizing the expertise of world-renowned GD&T expert Alex Krulikowski, the course offers an in-depth explanation of geometric symbols, including each symbol’s requirements, tolerance zones, and limitations. It also includes a comparison of GD&T to coordinate tolerancing; an explanation of tolerance zones; Rules #1 and #2; form and orientation controls; tolerance of position; runout and profile controls. Newly acquired learning is reinforced throughout the class with more than 300 practice problems.

Each attendee receives a robust collection of learning resources.

Learning Objectives

By attending this class, participants will be able to:
- Describe engineering drawings: importance, drawing conventions, dimensions and tolerances, standards
- Explain why geometric tolerancing is superior to coordinate tolerancing
- Describe the key terms used in geometric tolerancing
- Recognize the modifiers and symbols used in GD&T
- Explain the rules used in GD&T
- Describe the concepts of basic dimensions, worst-case boundary, virtual condition, inner and outer boundary, and bonus tolerance
- Interpret the various types of tolerances (flatness, straightness, circularity, cylindricity, perpendicularity, angularity, parallelism, position, concentricity, symmetry, runout, and profile)
- Describe the datum system
- Interpret applications of datum targets, feature of size datum specifications (RFS & MMC)
- Describe the fundamental concepts of tolerance of position
- Interpret tolerance of position special applications

Who Should Attend

This course is valuable for individuals who create or interpret engineering drawings, product and gage designers; process, product, and manufacturing engineers; supplier quality engineers/professionals; CMM operators; buyers/purchasers; checkers; inspectors; technicians; and sales engineers/professionals.

Attendees should have completed ETI’s Engineering Drawing Requirements course (I.D.# ET2701; page 34) or equivalent.
Topical Outline

- Introduction
  - Engineering drawings
  - GD&T/coordinate dimensioning comparison
  - Eight key GD&T terms
- Terminology
  - GD&T modifiers and symbols
  - Rule #1 and Rule #2
  - Basic dimensions, virtual condition, bonus tolerance
- Form Controls
  - Flatness
  - Straightness
  - Circularity
  - Cylindricity
- Datums
  - The datum system (planar datums)
  - Interpreting datum targets
  - Feature of size datum specifications (RFS)
  - Feature of size datum specifications (MMC)
- Orientation Controls
  - Perpendicularity
  - Angularity
  - Parallelism
- Tolerance of Position Controls
  - Definitions, conventions, advantages, basic theories
  - RFS and MMC tolerance of position applications
  - Cartoon gages for tolerance of position (MMC) applications
  - Tolerance of position special applications
  - Calculating distances on parts dimensioned with tolerance of position
  - Fixed and floating fastener formulas
- Concentricity / Symmetry Controls
  - Concentricity
  - Symmetry
- Runout Controls
  - Circular runout
  - Total runout
- Profile Controls
  - Profile tolerancing
  - Profile of a surface; Profile of a line

Fundamentals of GD&T for Inspectors
(ASME Y14.5M-1994, Y14.5.1, and Y14.43 Standards)

2 Days
I.D.# ET2053

Providing you have a basic understanding of geometric dimensioning and tolerancing fundamentals, this course teaches an introduction to how to inspect GD&T requirements.

Utilizing the expertise of world-renowned GD&T expert Alex Krulikowski, this course offers an explanation of the geometric symbols, rules, and concepts, the datum system, and how to inspect GD&T requirements using tools from the four categories of inspection tools (CMM; comparison instruments and fixed gages; hand tools and open set up; and production gaging systems). Newly acquired learning is reinforced throughout the class with numerous practice problems. The scope of this course does not include how to use the various inspection tools. For example, the course will discuss how to locate a part for inspection on a CMM, but it will not cover how to program the CMM to gather the data point.

Each attendee receives a robust collection of learning resources.

Learning Objectives

By attending this class, participants will be able to:
- Describe inspection and engineering drawings
- Explain key terms used in GD&T and how they affect interpretation and inspection
- Recognize the modifiers and symbols used in geometric tolerancing
- Interpret and inspect Rule #1, Rule #2, flatness, straightness, circularity, cylindricity, perpendicularity, angularity, parallelism, concentricity, symmetry, circular and total runout
- Explain the concepts of basic dimensions, virtual condition, inner and outer boundary and bonus tolerance and their effects on inspection
- Interpret and simulate planar datums and datum targets for inspection
- Interpret and inspect feature of size datums RFS and MMC
- Explain the fundamental concepts of tolerance of position: definitions, conventions, advantages and interpretations and their effects on inspection
- Interpret and inspect tolerance of position RFS, MMC, and special applications
- Describe functional gages for tolerance of position (MMC) applications
- Explain profile tolerancing
- Interpret and inspect profile of a surface and profile of a line applications

Instructor:
This course is taught by one of ETI’s approved instructors, each of whom has been vetted and mentored by Alex Krulikowski

Fee
Contact ETI for pricing information
2.0 CEUs are offered for this course
ENGINEERING TOOLS & METHODS

Who Should Attend

This course is valuable for individuals who create or interpret engineering drawings, product and gage designers; process, product, and manufacturing engineers; supplier quality engineers/professionals; CMM operators; buyers/purchasers; checkers; inspectors; technicians; and sales engineers/professionals.

Attendees should have completed ETI’s Engineering Drawing Requirements course (I.D.# ET2701; page 34) or equivalent prior to enrollment.

Topical Outline

• Inspection
  • Quality parts and quality drawings
  • Inspection, importance, components, and the characteristics of an expert inspector
  • Sources of variation
  • Categories of inspection tools

• The Engineering Drawing
  • Engineering drawings, communication, and drawing errors
  • Dimension, tolerance, limit tolerance, plus-minus tolerance
  • Metric unit dimensions on drawings
  • Interpreting dimensional limits
  • ASME Y14.5M-1994 and the fundamental dimensioning rules

• Key Terms and Their Effect on Interpretation and Inspection
  • Feature, feature of size, cylindrical feature of size, planar feature of size
  • Actual local size, actual mating envelope of external and internal feature of size
  • Maximum and least material condition of a feature of size
  • Non-feature of size dimensions and regardless of feature size

• Modifiers and Symbols
  • Modifiers, geometric characteristic symbols, and controls
  • Radius and controlled radius
  • Feature control frame

• Interpreting and Inspecting Rule #1 and Rule #2
  • Rule #1, envelope boundary, size dimension, overriding, and exceptions
  • Rule #1 effects on the interrelationship between features of size
  • Inspecting a feature of size controlled by Rule #1
  • Rule #2

• Basic Concepts
  • Basic dimensions, virtual condition and uses in inspection
  • Inner, outer, worst-case boundary, and virtual condition of a feature of size
  • Geometric tolerance applied to feature or feature of size
  • Bonus tolerance calculations
  • MMC and LMC modifiers and inspection

• Interpreting and Inspecting Flatness
  • Flatness, flatness tolerance zone, location, and inspection
  • Rule #1 as an indirect flatness control
  • Legal flatness specification
  • Establishing a reference plane for flatness

• Interpreting and Inspecting Straightness
  • Straightness, straightness tolerance zone, and Rule #1 as indirect straightness control
  • Legal straightness specification
  • Inspecting straightness applied to a surface
  • Determining if a straightness control is applied to a surface or a feature of size

• Interpreting and Inspecting Circularity
  • Circularity, circularity tolerance zone, and inspection
  • Rule #1 as an indirect circularity control
  • Legal circularity specification

• Interpreting and Inspecting Cylindricity
  • Cylindricity, cylindricity tolerance zone, and inspection
  • Rule #1 as an indirect cylindricity control
  • Legal cylindricity specification

• Interpreting and Simulating Planar Datums for Inspection
  • True geometric counterpart, datum feature simulator, and simulated datum
  • Datum feature symbol, planar datums, datum reference frame
  • Choosing datum features and what controls their orientation
  • Six degrees of part freedom in space and the 3-2-1 Rule
  • Datum-related and non datum-related dimensions
  • Datum reference frame for a part with inclined datum features
  • Coplanar datum features and simulation for inspection

• Interpreting and Simulating Datum Targets for Inspection
  • Datum targets, specification, requirements and the datum target symbol
  • Basic dimensions used to locate datum targets
  • Point, line, and area datum targets
  • Simulated gage for a point, line, and area datum target applications
  • Simulating datum targets for inspection

• Interpreting and Inspecting Feature of Size Datums (RFS)
  • Datum that results from a feature of size datum feature
  • Specifying an axis or center plane as a datum
  • How feature of size datum references communicate size condition
  • Datum feature simulators and coaxial datum features

• Interpreting and Inspecting Feature of Size Datums (RFS)
  • Datum that results from a feature of size datum feature
  • Specifying an axis or center plane as a datum
  • How feature of size datum references communicate size condition
  • Datum feature simulators and coaxial datum features

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ENGINEERING TOOLS & METHODS

- Interpreting and Inspecting Feature of Size Datums (MMC)
  - Referencing a feature of size datum at MMC
  - Special-case feature of size datums
  - Datum shift and datum application
  - Datum feature simulator – external / internal feature of size datum feature (MMC primary), MMC primary and secondary virtual condition
  - Datum axis for a pattern of features of size (MMC secondary)
  - Datum reference sequence and part to gage setup
  - Simulating datum features of size MMC for inspection
- Interpreting and Inspecting Perpendicularity
  - Perpendicularity tolerance on implied right angles, tolerance zone shapes
  - Perpendicularity of a surface and the surface flatness
  - Multiple datum references with a perpendicularity control
  - Perpendicularity of the axis/center plane of a feature of size
  - Perpendicularity control and worst-case boundary of a feature of size
  - Gage for verifying perpendicularity at MMC
  - Indirect perpendicularity controls, legal perpendicularity specification; inspection
- Interpreting and Inspecting Angularity
  - Angularity, tolerance zone, and inspection
  - Angularity of a surface and the surface flatness
  - Angularity control and the worst-case boundary of a feature of size
  - Angularity of the axis/center plane of a feature of size
  - Indirect angularity controls, legal angularity specification
- Interpreting and Inspecting Parallelism
  - Controlling parallelism when no symbol is shown
  - Parallelism, tolerance zone shapes, applied to a surface, and inspection
  - Parallelism of a surface and the flatness of the surface
  - Controlling the parallelism of the axis/center plane of a feature of size
  - Parallelism control and the worst-case boundary of a feature of size
  - Tangent plane modifier with a parallelism control
  - Indirect parallelism controls, legal parallelism specification
- The fundamental Concepts of Tolerance of Position: Definitions, Conventions, Advantages and Interpretations and Their Effects on Inspection
  - True position
  - Tolerance of position control, advantages, use of MMC modifier
  - Implied basic relationships
  - Virtual condition boundary and axis interpretation
- Interpreting and Inspecting Tolerance of Position RFS and MMC Applications
  - Tolerance of position control (RFS), tolerance zone, and tolerance zone shapes
  - Worst-case boundary of a feature of size controlled with tolerance of position at RFS
  - MMC modifier used in a tolerance of position application
  - Tolerance zone in tolerance of position (MMC) applications
  - Bonus tolerance available for a tolerance of position application
  - Datum shift available in a coaxial diameter tolerance of position application
  - Legal tolerance of position specification, inspection
- Functional Gages for Tolerance of Position (MMC) Applications
  - Functional and cartoon gages and benefits
  - Cartoon gage for a tolerance of position application
- Interpreting and Inspecting Tolerance of Position Special Applications
  - Interpreting position - applied to non-parallel holes and not perpendicular to the datum axis, a bi-directional position application, applied to elongated holes, with the projected tolerance zone modifier, in a symmetrical relationship, with the LMC modifier
  - Inspecting a projected tolerance zone
  - Bonus tolerance in an LMC application
  - Position used to control the spacing and orientation of a hole pattern
  - Multiple single-segment position control and zero tolerance at MMC dimensioning
- Interpreting and Inspecting Concentricity
  - Concentricity, tolerance zone, median point, application, and inspection
  - Concentricity compared to total runout and tolerance of position (RFS)
  - Legal concentricity specification
- Interpreting and Inspecting Symmetry
  - Symmetry, tolerance zone, application, and inspection
  - Differences between symmetry and tolerance of position
  - Legal symmetry control specification
- Interpreting and Inspecting Circular Runout
  - Specifying datum axis for a runout application
  - Circular runout, tolerance zone (dia.), composite control, inspection
  - Amount of axis offset from a circular runout callout
  - Worst-case boundary in a circular runout application
  - Legal circular runout control specification
- Interpreting and Inspecting Total Runout
  - Total runout, tolerance zone (dia.), composite control, inspection
  - Amount of axis offset from a total runout callout
  - Worst-case boundary in a total runout application
  - Legal total runout control specification and circular vs. total runout
  - Distances on a part that uses runout
- Profile Tolerancing
ENGINEERING TOOLS & METHODS

• Profile tolerancing with or without datum references and true profile
• Part characteristics that profile can affect, tolerance zone coverage, advantages
• Bilateral and unilateral profile tolerance zones, between and all around symbols
• Interpreting and Inspecting Profile of a Surface Applications
• Tolerance zone for profile applied to planar and coplanar surfaces
• Multiple single-segment profile application
• Legal profile of a surface specification, inspection
• Interpreting and Inspecting Profile of a Line Applications
• Profile of a line used in a multiple single-segment control
• Used with a coordinate tolerance
• Inspecting profile of a line

Who Should Attend
This course is valuable for individuals who create or interpret engineering drawings, product and gage designers; process, product, and manufacturing engineers; supplier quality engineers/professionals; CMM operators; buyers/purchasers; checkers; inspectors; technicians; and sales engineers/professionals.

Please be aware that this is not an introductory course. Students should have completed ETI’s Tolerance Stacks Using GD&T course or equivalent prior to enrollment.

Topical Outline
• Importance of statistical stacks
  • The three assumptions that apply to Worst-case tolerance stacks
  • The two laws of probability that apply to statistical stacks
  • Two common probability distribution curves used in statistical stacks
  • The probability of an assembly of six parts with uniform distributions reaching extreme limits
  • The probability of an assembly of six parts with normal distributions reaching extreme limits
• Statistical stacks terminology
  • Statistics and data
  • Uniform and normal frequency distributions
  • Range, mean, and deviation
  • Variance and standard deviation
  • Specification limits
  • Standard normal curve and the Empirical Rule
  • A Z score and parts per million rejects
  • Control limits
  • How CP and CPK relate to a normal distribution
  • The difference between dependent and independent variables
• Common statistical tolerance stacks methods
  • What a statistical tolerance stack is
  • The Realistic Predicted Limits (RPL) method its assumptions
  • The Root Sum of Squares (RSS) method and its assumptions
  • The Motorola Six Sigma Root Sum of Squares method and its assumptions
  • The Motorola Six Sigma Dynamic Root Sum of Squares (DRRSS) method and its assumptions
  • The Monte Carlo Simulation method and its assumptions
• The formulas for and results of using the different statistical stack methods
• Three benefits of statistical stacks
• Two common reasons why statistical stacks are done
• The ETI statistical stack form
  • How to complete the ETI statistical stack form
  • The four stack consequences that must be considered when doing statistical stacks

Introduction to Statistical Tolerance Stacks
1 Day
I.D.# ET2055

Providing you have an understanding of tolerance stacks, this course teaches an introduction to statistical tolerance stacks, a crucial skill in today’s competitive workplace. Utilizing the expertise of world-renowned GD&T expert Alex Krulikowski, the course includes a brief overview of several terms used in statistical stacks. It explains four methods for applying statistics to tolerance stacks and covers precautions about when and how to use statistics in stacks. Newly acquired learning is reinforced throughout the class with stacks that allow the student to practice applying statistical methods.

Each attendee receives a robust collection of learning resources.

Learning Objectives
By attending this class, participants will be able to:
• Define the terminology used with statistical tolerance stacks
• Describe common statistical tolerance stacks methods
• Calculate statistical tolerance stacks using the RSS method
• Calculate statistical tolerance stacks using the realistic method
• Apply the RPL method to statistical tolerance stacks
• Apply the Monte Carlo method to tolerance stacks
• Describe precautions needed when using statistical tolerance stacks

Instructor: This course is taught by one of ETI’s approved instructors, each of whom has been vetted and mentored by Alex Krulikowski

Fee: Contact ETI for pricing information

1.3 CEUs are offered for this course

Fee Contact ETI for pricing information

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The RPL statistical stack method
- The formula for calculating the RPL factor
- A qualified dimension used in the RPL method
- How to do the RPL method using the ETI statistical stacks form
- The advantages and disadvantages of the RPL method
- Calculating a statistical stacks using the RPL method

The Six Sigma DRSS statistical method
- The derivation of the standard RSS statistical stack formula
- The seven steps in calculating a RSS statistical stack
- Calculating a stack using the RSS method with a safety (Bender) factor applied
- The Motorola Six Sigma RSS formula and its advantages
- The Dynamic RSS (DRSS) formula and its advantages
- The eight steps in calculating a DRSS statistical stack
- How to do a DRSS stack using the ETI statistical stack form
- How to interpret the stack results shown on the ETI statistical stack form
- How to adjust a statistical stack to handle dependent variables (bonus & shift)
- Statistical stack results before and after adjusting for dependent variables

The Monte Carlo statistical simulation method
- Simulation and Monte Carlo simulation
- The parameters used in a Monte Carlo simulation
- List common distributions used in a Monte Carlo simulation stack
- The minimum number of trials that should be used in a Monte Carlo simulation stack
- Available software that can perform Monte Carlo simulations
- How a Monte Carlo simulation works
- How to do a Monte Carlo simulation using the ETI stack form with RiskAMP plug-in

Statistical tolerance stacks precautions
- The guidelines for determining when a statistical stack should be done
- The seven assumptions of RSS statistical tolerance stacks
- The four precautions to reduce risk of using statistical tolerance stacks
- Why the ST symbol from Y14.5 should be used on a drawing that specifies statistical tolerances
- How the ST is used on a drawing to indicated a tolerance is based on statistical methods
- The benefits of using the ST symbol on product drawings

DRSS and RPL statistical stack calculations
- Calculating statistical tolerance stacks
- Making adjustments for bonus and shift
- Calculating a stack using the DRSS and RPL methods
- Using CPK values in a statistical stack

Instructor: This course is taught by one of ETI’s approved instructors, each of whom has been vetted and mentored by Alex Krulikowski

Fee: Contact ETI for pricing information

.7 CEUS

Critical Concepts of Tolerance Stacks
(Based on Y14.5M-1994 & Y14.5-2009)

2 Days
I.D.# ET1701

This subject is offered in multiple course lengths.

This two-day course provides an in-depth explanation of how to use tolerance stacks to analyze product designs and how to use geometric tolerances in stacks. You will learn the essential methods and concepts used for creating 1D part and assembly tolerance stacks. The course was developed utilizing the expertise of world-renowned GD&T expert Alex Krulikowski and features numerous practice problems and in-depth coverage of tolerance stacks applications.

In order to understand the course content, students should have a good understanding of GD&T based on the ASME Y14.5-2009 Standard either through work experience or knowledge gained by participating in a course such as the ETI course Fundamentals of GD&T. Find the course information on page 50. Basic GD&T concepts will not be covered in this course.

Each attendee receives a robust collection of learning resources.

Learning Objectives

By attending this class, participants will be able to:
- Describe how virtual condition affects the assembly of parts
- Explain the importance of tolerance stacks and be familiar with stack methods, the stack form and the stack spreadsheet
- Calculate part stacks using coordinate dimensions, runout and concentricity tolerances, equal bilateral and unilateral profile tolerances, multiple geometric tolerances, position tolerances at RFS and MMC with datum references at MMB
- Calculate assembly stacks using coordinate dimensions, runout and concentricity tolerances, equal bilateral and unilateral profile tolerances, multiple geometric tolerances, position tolerances at MMC with datum references at MMB
- Calculate stacks using form and orientation applied to features and features of size
ENGINEERING TOOLS & METHODS

**Who Should Attend**

This course is valuable for individuals who create or interpret engineering drawings; product and gage designers; process, product, and manufacturing engineers; supplier quality engineers/professionals; CMM operators.

**Topical Outline**

- **Introduction to Tolerance Stacks**
  - Stack definition
  - Importance/purpose/benefits of stacks
  - When stacks should be calculated
- **Introduction to 1D Stack Methods**
  - Definition and stack conventions
  - Effects of rounding
  - Four basic stack steps
  - Virtual condition concepts, calculations, clearance/interference between mating part features
- **ETI Stack Form and Spreadsheet**
  - Major parts of the stack form
  - Stack abbreviations
  - Use and limitations of the spreadsheet
- **Part Stacks Using:**
  - Coordinate dimensions
  - Runout tolerances
  - Profile tolerances
  - Position tolerances at RFS
  - Position tolerances at MMC
  - Position tolerances at MMB - basics of datum shift
  - Position tolerances at MMB - datum shift exceptions
  - Multiple geometric tolerances
- **Assembly Stacks Using:**
  - Coordinate dimensions
  - Runout tolerances
  - Profile tolerances
  - Position tolerances at MMC/MMB
  - Form and orientation tolerances applied to surfaces and features of size
  - Multiple geometric tolerances
- **Course Summary**
  - The six critical concepts of tolerance stacks
  - Course assessment

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**GD&T for Manufacturing (ASME Y14.5-2009 Standard)**

1 Day  
I.D.# ET2726  

Providing you have an understanding of GD&T fundamentals, this course teaches an introduction to geometric dimensioning and tolerancing and its impact on the manufacturing process.

Utilizing the expertise of world-renowned GD&T expert Alex Krulikowski, the course focuses on the basic requirements of engineering drawings, size dimensions, form tolerances, and the datum system, as well as the impact of tolerancing requirements on production.

Each attendee receives a robust collection of learning resources.

**Learning Objectives**

By attending this class, participants will be able to:

- Understand the basic facts about engineering drawings
- Recognize the types of dimensions and tolerances used on engineering drawings
- Explain the basic concepts and requirements of size dimensions
- Answer five basic questions for interpreting form tolerances
- Describe the basic concepts of the datum system and planar datums
- Describe the basic concepts of datum targets and size datums
- Answer five basic questions for interpreting orientation, position, runout, and profile of a surface tolerances
- Explain the purpose and limitations of in-process inspection methods
- Assess the GD&T on a typical drawing and determine the impact to manufacturing

**Who Should Attend**

This course is designed for product engineers, designers, checkers, and engineering managers, and supplier quality engineers. Attendees should have completed ETI’s Engineering Drawing Requirements course (I.D.# ET2701; pg 74) prior to enrollment.

**Topical Outline**

- **Engineering Drawings**
  - Engineering drawing purposes
  - Relationship between drawings and part function
  - Applicable standards on drawings
  - Why drawings are legal documents
  - Fundamental tolerancing rules
- **Dimensions and Tolerances**
  - Geometry attributes of a part

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**Instructor:** This course is taught by one of ETI’s approved instructors, each of whom has been vetted and mentored by Alex Krulikowski

**Fee**

Contact ETI for pricing information  
1.3 CEUs are offered for this course
Applications of GD&T (Based on ASME Y14.5M-1994 & Y14.5-2009)

2 Days
I.D.# ET2512

Providing you have an understanding of GD&T fundamentals, this course teaches the thought processes involved in assigning GD&T to components. It will change the way many engineers think about part tolerancing.

Utilizing the expertise of world-renowned GD&T expert Alex Krulikowski, the course focuses on what constitutes good and poor drawing practices, common dimensioning methods used in industry, using GD&T to communicate system functions on component dimensions, and the logic of how to apply GD&T to components. Newly acquired learning is reinforced when students perform a design function analysis on a part assembly provided by your company, then specify GD&T on assembly components during the course. (This is optional in case of concerns over drawings and privacy.)

Newly acquired learning is reinforced when students perform a design function analysis on a part assembly provided by your company, then specify GD&T on assembly components during the workshop. (This is optional in case of concerns over drawings and privacy.)

Attendees will receive a robust collection of learning resources.
Learning Objectives
By attending this class, participants learn how to do a design functional analysis on an assembly and use this information to assign dimensions and tolerances. They will also learn how to select datum features and how to fully define component surfaces using GD&T. Establishing tolerance values is not covered. Small groups (8-12) are most effective in this workshop. The students will work in teams and actually create GD&T tolerance mark-ups of their company parts in the workshop.

By attending this class, participants will be able to:
• Describe the importance of technically correct drawings
• List three major areas that affect the creation and interpretation of technically correct drawings
• Explain the common approaches to part tolerancing
• Identify and specify datum features based on the fit and functional requirements of the part
• Use GD&T to communicate functional requirements of a component
• Describe how to specify nonfunctional dimensions
• Explain the five-step approach to functionally dimensioning a component
• Apply the five-step method to functionally dimensioning a component to your company product

Who Should Attend
This course is for product engineers, designers, checkers, and engineering managers, and supplier quality engineers.

Please be aware that this is not an introductory course. Attendees should have completed 16 hours of formalized classroom training in GD&T or ETI’s Fundamentals of GD&T course (I.D.# ET1150, page 50) experience interpreting or applying GD&T in an industrial setting, and working knowledge of the ASME Y14.5M-1994 Standard or ASME Y14.5-2009 Standard.

Topical Outline
• Importance of Technically Correct Drawings
  • Engineering drawings
  • Purpose of drawings
  • Three common paradigms about drawings
  • Effects of a poor drawing
  • Benefits of a technically correct drawing
• Three Areas that Affect the Creation and Interpretation of Engineering Drawings
  • Importance of standards
  • Three methods for creating drawings
  • How drawing creation affects interpretation
  • The six principles of dimensioning
• Four Common Approaches to Part Tolerancing
  • Pros and cons of each dimensioning approach
  • Dimensioning approach to be used in this class
• Selecting Datums
  • Why datum feature selection is controversial
  • Selecting datum features based on the functional approach
  • Mounting and performing datum features
  • Qualifying datum features
• Using GD&T to Communicate Functional Requirements
  • Where to use a linear or geometric tolerance
  • Customer robust and customer sensitive dimensions
  • Where to use MMC, LMC, and RFS
  • Converting functional requirements into GD&T specifications
• Specifying Nonfunctional Dimensions
  • What a nonfunctional dimension is
  • Risks of not tolerancing nonfunctional dimensions and using restrictive general tolerances
  • When to apply general or local tolerances
  • General tolerancing practices
  • Application requirements of general geometrical tolerances
  • Interpreting general tolerances
• Understand the 5-Step Method to Functionally Dimension a Component
  • The functional dimensioning design philosophy
  • Advantages of functional dimensioning
  • How functional dimensioning supports the PDP
  • The principles of dimensioning and technically correct drawings
• Applying the 5-Step Method to Functionally Dimension Components of a Customer’s Products
  • Review the functional dimensioning process and 5-step method
  • Review the DFA
  • Review when dimensioning compromises should be considered

Instructor: This course is taught by one of ETI’s approved instructors, each of whom has been vetted and mentored by Alex Krulikowski

Fee Contact ETI for pricing information
1.3 CEUs are offered for this course

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Functional Gaging and Measurement (ASME Y14.43, Y14.5, Y14.5.1, B89.3.1, B89.7.2, and B89.7.3 Standards)

2 Days
I.D.# ET8200

Providing you have a basic understanding of geometric dimensioning and tolerancing fundamentals, this course is an introduction to functional gaging design and teaches how to verify part dimensional requirements using functional gages and other measurement methods.

Utilizing the expertise of world-renowned GD&T expert Alex Krulikowski, this course offers an explanation of metrology, the roles of the metrologist and inspector, measurement uncertainty, inspection tools, functional gages, inspection planning and reporting, and simulating datums.

The scope of this course does not include measurement systems analysis or sampling strategies.

Each attendee receives a robust collection of learning resources.

Learning Objectives
By attending this class, participants will be able to:
• Describe the functions of inspection in an organization
• Define what measurement uncertainty is.
• Explain the basic operating principles, strengths, and weaknesses of the three major categories of inspection tools
• List the types, uses, and tolerance methods for attribute gages
• Explain attribute gage design fundamentals
• Develop a measurement / inspection plan
• Describe the purpose and content of an inspection report
• Inspect and report size dimensions
• Describe the basic concepts of datums related to inspection
• Understand how to simulate datums for inspection
• Verify flatness, straightness, circularity, cylindricity, orientation, position, runout, profile of a surface, and profile of a line tolerance requirements

Who Should Attend
This course is a valuable tool for individuals who inspect parts, create inspection plans, or approve inspection methods. Typical attendees include CMM operators, inspectors, gage designers, manufacturing engineers, technicians, supplier quality engineers.

Prerequisites
Please be aware that this is not an introductory course. In order to understand the course content, you should have:
1. Completed 16 hours of formalized classroom training in GD&T
2. Experience interpreting or applying GD&T in an industrial setting
3. Have a working knowledge of the ASME Y14.5-2009 Standard
A certificate from the GD&T Trainer: Fundamentals 2009 (page 55) or ETI's Fundamentals of GD&T (I.D.# ET2001, page 36) course is acceptable.

Topical Outline
• Inspection in an Organization
  • Quality; the purpose and contents of a quality manual
  • Metrology and the roles of a metrologist
  • Importance and types of inspection, roles of inspector
• Introduction to Measurement Uncertainty
  • Terms, importance, and major contributors
  • Using calipers for size measurements
  • Type A, type B, combined, and expanded uncertainties
  • Measurement uncertainty standards and major contributors
  • Decision rule, requirements, and factors that affect the choice of a decision rule
  • Guard band, simple acceptance, and simple rejection
  • Pros and cons of measurement uncertainty decision rules
  • Uncertainty calculator software
• Three Major Categories of Inspection Equipment
  • Three categories, types, and pros and cons of inspection tools
  • Attribute and variables gages and data, operating principles
  • Common sources of attribute and variables gage errors
  • Operating principles of algorithmic measurement
  • Common sources of CMM errors
• Attribute Gaging Concepts
  • Supporting Y14.5 concepts, common types, uses
  • Basic concept of functional gages
  • Options for gaging tolerance policies
  • Y14.43 recommendations and cost effects
  • The five gagemakers’ tolerance classes
• Attribute Gaging Design Fundamentals
  • Design constraints of functional gages
  • Considerations for workpiece distortion during gaging
  • In-process, final acceptance, and referee gages
  • Calculating gage pin size using absolute, tolerant, and optimistic tolerancing policies
  • Gage tolerance accumulation
  • How RMB datum references affect gage design
• Benefits of RMB Datum Feature Simulation
  • Permitted departure from MMC and LMC principles of a gage design
  • Measurement / Inspection Plan
  • Dimensional measurement plan (DMP) purposes, contents, and importance
  • Eight inputs to a DMP
3 ways to get a no-obligation price quote to bring a course to your company • Call SAE Corporate Learning at +1.724.772.8529
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ENGINEERING TOOLS & METHODS

• Classification of dimensional characteristics
• Seven steps to creating a DMP
• Inspection Reporting
  • Inspection reports, requirements, standards for reporting
  • Common methods for indicating inspection numbers
  • Mark up a drawing to number the dimensions for inspection
  • Non-conformance report and contents
• Inspecting and Reporting Size Dimensions
  • Y14.5 requirements for a feature of size
  • Relationship between Rule #1 and a size dimension
  • Inspecting MMC size limits
  • Minimum CMM probe points
  • Rule #1 MMC boundary, actual local size inspection
  • Reporting MMC & LMC size inspection results
• Datums Related to Inspection
  • Y14.5 requirements
  • Effects of datum sequence on inspection
  • Y14.5.1 candidate datum set concept
• Simulating Datums for Inspection
  • Simulate datum planes using a fixture, datum reference frame with a functional fixture
  • Effects of datum reference frame simulation with a fixture on inspection
  • Simulating datum planes and a datum reference frame using a CMM
  • Simulating a datum axis (RMB) on a functional fixture and using a CMM
  • Simulating a datum axis (MMB) on a fixture
  • How a functional gage accounts for datum shift
  • How a CMM simulates datum shift (MMB)
• Verifying Flatness Tolerance Requirements
  • Y14.5 requirements
  • Applied to a surface: verification using variable and algorithmic measurement
  • At MMC: verification with attribute measurement
  • Dimensional measurement planning and inspection reporting
• Verifying Straightness Tolerance Requirements
  • Y14.5 requirements
  • Applied to a surface using variable and algorithmic measurement
  • Applied to a feature of size at MMC with attribute and variable measurement
  • Dimensional measurement planning and inspection
• Verifying Circularity and Cylindricity Tolerance Requirements
  • Circularity and cylindricity tolerance Y14.5 requirements
  • Circularity: inspecting using variable and algorithmic measurement
  • B89.3.1 circularity verification and filtering requirements
  • Cylindricity: verification using variable measurement and a CMM
  • Dimensional measurement planning, inspection
• Verifying Orientation Tolerance Requirements
  • Y14.5 requirements for an angular dimension, perpendicularity tolerance applied to a surface and feature of size (RFS and MMC)
  • Angular tolerance verification and sources of uncertainty
  • Perpendicularity tolerance applied to a surface verification using variable and algorithmic measurement, sources of uncertainty
  • Perpendicularity tolerance of a feature of size MMC verification using attribute measurement, RFS verification using variable measurement, sources of uncertainty
  • Perpendicularity tolerance applied to a feature of size RFS & MMC verification using algorithmic measurement, sources of uncertainty
  • Perpendicularity tolerance: inspection planning and reporting
• Verifying Position Tolerance Requirements
  • Y14.5 requirements for a position tolerance (RFS and MMC)
  • Position tolerance (MMC) verification using an attribute gage, sources of uncertainty
  • Position tolerance (RFS) verification using variable measurement, sources of uncertainty applied at RFS & MMC using algorithmic measurement, sources of uncertainty
  • Inspection planning and reporting
• Verifying Circular and Total Runout Tolerance Requirements
  • Y14.5 requirements
  • Applied to a diameter: verification using a variable and algorithmic measurement methods, sources of uncertainty
  • Inspection planning and reporting
• Verifying Profile of a Surface and Profile of a Line Tolerance Requirements
  • Controlling parallelism when no symbol is shown
  • Y14.5 requirements of profile of a surface and line tolerances
  • Verification using an attribute, variable, and algorithmic measurement methods, sources of uncertainty
  • Inspection planning and reporting

Instructor: This course is taught by one of ETI’s approved instructors, each of whom has been vetted and mentored by Alex Krulikowski

Fee
Contact ETI for pricing information
1.3 CEUs are offered for this course
Advanced Concepts of GD&T (Based on ASME Y14.5M-1994)

3 days
I.D.# ET2011

This course is offered in a 2-day, 20-hour, and 3-day format.

Providing you have a basic understanding of geometric dimensioning and tolerancing fundamentals, this course teaches the advanced concepts of GD&T as prescribed in the ASME Y14.5M-1994 Standard.

Utilizing the expertise of world-renowned GD&T expert Alex Krukilowski, this course offers an in-depth explanation of advanced GD&T topics like composite tolerancing, tolerance analysis, datum selection, non-rigid part dimensioning, and many more key dimensioning topics, including the system approach for part dimensioning.

Each attendee receives a robust collection of learning resources.

Learning Objectives
By attending this class, participants will be able to:
• Explain the importance of product design and functional dimensioning
• Define the terms “feature” and “feature of size”
• Recognize which dimensioning standards apply to an engineering drawing
• Explain the fundamentals of drawing interpretation and how to handle substandard drawings
• Recognize the difference between a rigid and a flexible (non-rigid) part
• State the requirements for tolerancing parts measured in the restrained state
• Identify the two special considerations for datum usage on restrained (non-rigid) parts
• Calculate advanced applications of form controls
• Describe uses, advantages, misconceptions, and common errors of the datum system
• List nine common datum feature types
• Describe advanced datum target concepts
• Explain how to specify / interpret specialized datum feature applications
• Describe modifier usage in tolerance of position applications
• Describe the effects of simultaneous and separate requirements with tolerance of position
• Explain composite position tolerancing and multiple single-segment position tolerancing
• Interpret tolerance of position applications with a conical tolerance zone

• Explain composite profile tolerancing and multiple single-segment profile tolerancing
• Describe profile applications

Who Should Attend
This course is valuable for individuals who create or interpret engineering drawings, product and gage designers; process, product, and manufacturing engineers; supplier quality engineers/professionals; CMM operators; buyers/purchasers; checkers; inspectors; technicians; and sales engineers/professionals.

Please be aware that this is not an introductory course. In order to understand the course content, attendees should have completed ETI’s GD&T Fundamentals course (I.D.# ET2001, page 36) or equivalent.

Topical Outline (3-day format)
• GD&T Fundamentals Review
  • GD&T skills survey
  • GD&T fundamentals for further study
• Importance of Product Design
  • Product design effects on costs
  • Consequences of drawing errors
  • Advantages of GD&T
• Functional Dimensioning
  • The purpose of tolerances
  • The importance of specifying proper tolerances
  • The importance of a common tolerancing approach
  • Tolerancing principles and benefits
• Interpretation of Feature
  • The terms “element,” “gap,” and “interruption”
  • Y14.5 definition of feature and types
  • Regular, element, complex, and interrupted feature; sub-feature
• Interpretation of Feature of Size
  • The terms “opposed,” “fully opposed,” “partially opposed,” “size dimension,” and “cylindrical”
  • Importance of distinguishing between a feature and feature of size
  • The definition of feature of size from Y14.5
  • Requirements and categories of a feature of size
  • Identifying and interpreting a complete, interrupted, partial, and bounded feature of size
• Applicable Drawing Standards
  • Determining on which standards an engineering drawing is based
  • Clarifying a drawing when no dimensioning standard is referenced
  • Reducing confusion on dimensioning standards
• Drawing Interpretation
  • Interpreting an engineering drawing
  • Drawing title block, revision column, general drawing notes
ENGINEERING TOOLS & METHODS

- Fundamental rules that affect drawing interpretation
- Surface coating and heat treat
- Geometric controls and a valid datum system
- Misconceptions on measuring parts that use the datum system
- Controlling characteristics for each part feature
- Proper uses for coordinate tolerancing
- Specification / interpretation

- Using Substandard Drawings
  - Categories of substandard drawing specifications
  - Steps for dealing with substandard drawings
  - Things not to do when using a substandard drawing

- Rigid/Non-Rigid Parts Definitions
  - Free state
  - Restrained state
  - Rigid part
  - Non-rigid part and part feature

- Tolerancing Non-Rigid Parts
  - Tolerancing a non-rigid (restrained) part
  - Roles of a restraint note
  - Determining restraining conditions on non-rigid parts
  - Requirements that need to be addressed in a restraint note
  - The difference between a general note and a local restraint note
  - When a free state symbol should be used
  - Areas that need special attention when inspecting a non-rigid part

- Restrained Part Datum Usage
  - How to use datum targets to support, orient, and locate a restrained part in the datum reference frame
  - How datum shift occurs on a restrained part

- Form Controls
  - Calculating the flatness tolerance value for a gasketed joint application
  - Calculating the cylindricity tolerance value in a support application
  - Calculating the straightness tolerance value in an assembly application
  - Overriding Rule #1 to limit flatness on a thin part

- The Datum System
  - When to use the datum system.
  - Advantages of the datum system.
  - Common misconceptions about the datum system.
  - Common errors in datum usage

- Datum Feature Types
  - Common datum feature types
  - When each datum feature type is typically used
  - Degrees of freedom restrained when each datum feature type is used
  - The datum feature simulator for the datum features referenced in a geometric tolerance

- Datum Targets
  - Reducing the impact that using datum targets has on functional dimensioning
  - Application requirements
  - Applications where datum targets should be used
  - Specifying fixed and movable datum targets
  - Special datum target types
  - Dimensioning a simulated gage for datum target applications

- Specialized Datum Applications
  - Specifying a screw thread as a datum feature and interpreting application
  - Specifying a gear or spline feature as a datum feature and interpreting application
  - Temporary and permanent datum features
  - Major disadvantage of temporary datum features

- Tolerance of Position Usage
  - When to use a tolerance of position control
  - Loss function curve, customer robust dimension, and customer sensitive dimension
  - Tolerance of position control and material condition used

- Simultaneous and Separate Requirements
  - Simultaneous and separate requirements, effects and where they apply
  - Tolerance of position at MMC simultaneous requirement
  - Tolerance of position controls as separate requirements
  - One exception to the simultaneous requirement

- Composite Position Tolerancing
  - Rules, advantages, and when to use it
  - “FRITZ” and “PLTZF”
  - Tolerance of position composite application

- Multiple Single-Segment Tolerance of Position Tolerancing
  - Rules, advantages, and when to use it
  - Tolerance of position vs. composite tolerance of position

- Conical Tolerance Zones
  - A conical tolerance zone and advantage of use
  - Specifying a conical tolerance zone in a tolerance of position application
  - When to use tolerance of position with a conical tolerance zone

- Profile Tolerances
  - Myths about profile controls
  - When to use a profile control
  - The four characteristics profile can control
  - Converting coordinate tolerances into profile callouts
  - The profile datum rule

- Profile and Simultaneous Requirements
  - Simultaneous requirement applied to profile
  - Profile controls with separate requirements

- Composite Profile Tolerancing
  - Composite profile tolerancing, rules, and advantages
  - Interpreting a composite profile application
ISO Geometrical Tolerancing (Based on ISO 1101:2004 and related standards)

3 Days  
I.D.# ET7100  

This subject is offered in a 2, 3, or 4-day format. Contact ETI to determine which course length best suits your specific need.

Providing you have a basic understanding of mechanical drawings, this course teaches how to use engineering drawings that use the International Standards Organization (ISO) standards. Utilizing the expertise of world-renowned GD&T expert Alex Krulikowski, this course teaches proper recognition of requirements for standard-compliant drawings and geometrical tolerances based on the ISO standards. The course combines information from dozens of ISO standards into a logical understandable topic. Each attendee receives a robust collection of learning resources.

**Learning Objectives**

By attending this class, participants will be able to:
- Describe the ISO standards system on technical drawings
- Recognize ISO drawing practices
- Explain the structure of GPS and the domains of features
- Recognize the symbols used in geometrical tolerancing
- Describe linear size and size conditions
- Explain the principle of independency and the envelope requirement
- Explain geometrical tolerancing concepts: MMR, LMR, RPR, virtual conditions, and collective requirements
- Describe the ISO 286 system of limits and fits
- Describe the datum system (planar datums)
- Interpret datum target and size datum specifications
- Interpret the flatness, straightness, roundness, cylindricity, perpendicularity, angularity, and parallelism tolerances
- Explain the fundamental concepts of position tolerances
- Interpret the position tolerance at MMR and special applications
- Interpret the coaxiality, concentricity, symmetry, circular and total run-out tolerances
- Interpret the profile any surface and profile any line tolerances
- Explain the ISO system for general tolerances
- Interpret work piece edge specifications
- Interpret surface texture and surface imperfection requirements

**Who Should Attend**

This course is valuable for individuals who create or interpret engineering drawings, product and gage designers; process, product, and manufacturing engineers; supplier quality engineers/professionals; CMM operators; buyers/purchasers; checkers; inspectors; technicians; and sales engineers/professionals.

Attendees should have completed ETI’s Engineering Drawing Requirements course (I.D.# ET2701; page 34) or equivalent prior to enrollment.

**Topical Outline**

- ISO Standards and Drawing Conventions
  - The ISO standards system used on technical drawings
  - ISO drawing practices
- GPS Basics
  - Modifiers and symbols used in geometrical tolerancing
  - Fundamental ISO geometrical tolerancing concepts
  - Feature types and levels
  - Linear size and material conditions
  - Independency and envelope principles
  - Key geometrical tolerancing concepts: maximum, least, and reciprocity requirement; virtual condition; bonus tolerance
- Limits and Fits
  - The ISO 286 system of limits and fits
- The Datum System
  - The datum system (planar datums)
  - Datum target specifications
  - Datum specifications
- Form Controls
  - Flatness
  - Straightness
  - Roundness
  - Cylindricity
- Orientation Controls
  - Perpendicularity
  - Angularity
  - Parallelism
- Location Controls
  - Position
  - Position tolerance RFS, MMR, and LMR
  - Concentricity
  - Symmetry
ENGINEERING TOOLS & METHODS

• Location Controls
  • Circular run-out
  • Total run-out
  • Profile tolerance
  • Profile any surface tolerance
  • Profile any line tolerance
• General Tolerances
  • ISO system for general tolerances for linear and angular dimensions
  • ISO system for general tolerances for geometrical tolerances (ISO 2768-2)
• Workpiece Edges
  • Interpret workpiece edge specifications
• Surface Texture and Surface Imperfections
  • Surface texture and surface imperfection requirements
• ISO/ASME Comparison
  • Major differences between the tolerancing standards

Learning Objectives
By attending this class, participants will be able to:
• Recognize forty new or revised terms
• Explain the revisions and additions to the fundamental rules
• Describe twelve new or revised modifying symbols
• Recognize the revisions and new symbols for datum specifications
• Describe new geometric symbols and specifications
• Describe the revisions and new additions to 3D digital data sets
• Summarize the major changes in the standard
• Describe considerations for implementing the new standard

Who Should Attend
This course is valuable for individuals who create or interpret engineering drawings, product and gage designers; process, product, and manufacturing engineers; supplier quality engineers/professionals; CMM operators; buyers/purchasers; checkers; inspectors; technicians; and sales engineers/professionals. Attendees must have a basic understanding of Y14.5M-1994 Dimensioning and Tolerancing practices.

Topical Outline
• 24 revised terms in ASME Y14.5-2009
• 16 new terms in ASME Y14.5-2009
• Revised and new modifying symbols
• The datum system
• Revisions to geometric symbols
• 3-D digital data sets
• Summary of major changes
• Implementing a new standard

Instructor:
This course is taught by one of ETI’s approved instructors, each of whom has been vetted and mentored by Alex Krulikowski

Fee
Contact ETI for pricing information
CEUs vary based on course length

ASME Y14.5 1994-2009 Comparison
1 Day
I.D.# ET8000

Providing you have a basic understanding of geometric dimensioning and tolerancing fundamentals, this course teaches the significant revisions, additions, and deletions prescribed in the new ASME Y14.5-2009 Standard. Utilizing the expertise of world-renowned GD&T expert Alex Krulikowski, the course offers an in-depth cross-examination and comparison of features in the 2009 and 1994 ASME Standards.

The one-day ASME Y14.5 1994-2009 Comparison course will teach you about the pertinent changes made to the Y14.5 standard. You’ll learn how the subject matter has been reorganized, and about new sections that have been created for profile, orientation, and form.

Newly acquired learning is reinforced throughout the class with numerous practice problems, and a set of comprehensive comparison charts that highlight itemized changes in the standard are included in the course price. Each attendee receives a robust collection of learning resources.

Instructor:
This course is taught by one of ETI’s approved instructors, each of whom has been vetted and mentored by Alex Krulikowski

Fee
Contact ETI for pricing information
.7 CEUs are offered for this course

Fundamentals of GD&T (Based on ASME Y14.5-2009)
2 Days
I.D.# ET1150

This course is offered in multiple length formats. Contact Effective Training Inc to determine which course length best suits your specific need.

Providing you have a basic understanding of mechanical drawings, this course teaches the terms, rules, symbols, and concepts of GD&T as prescribed in the ASME Y14.5-2009 Standard.
Utilizing the expertise of world-renowned GD&T expert Alex Krulikowski, Fundamentals of GD&T offers an in-depth explanation of geometric tolerancing symbols, their tolerance zones, applicable modifiers, common applications, and limitations.

The class includes a comparison of GD&T to coordinate tolerancing; Rules #1 and #2; form and orientation controls; tolerance of position; runout and profile controls.

**Learning Objectives**

By attending this class, participants will be able to:
- Explain the importance of standards on engineering drawings
- Describe the types of dimensions, tolerances, and notes
- Explain why geometric tolerancing is superior to coordinate tolerancing
- Interpret the general dimensioning symbols
- Define the key terms used in GD&T
- Recognize the symbols and modifiers used in GD&T
- Explain the rules used in GD&T
- Describe the concepts of worst-case boundary, virtual condition, and bonus tolerance
- Interpret the various types of tolerance (flatness, circularity, cylindricity, straightness, perpendicularity, parallelism, angularity, position, runout, and profile)
- Describe the datum system
- Interpret applications of datum targets, size datum features (RMB), and size datum features (MMB)

**Who Should Attend**

This course is valuable for individuals who create or interpret engineering drawings, product and gage designers; process, product, and manufacturing engineers; supplier quality engineers/professionals; CMM operators; buyers/purchasers; checkers; inspectors; technicians; and sales engineers/professionals. Attendees should have completed ETI’s *Engineering Drawing Requirements* course (I.D.# ET2701; page 34) or equivalent prior to enrollment.

**Topical Outline**

- Introduction
  - GD&T importance, six components
  - CARE test and Significant Seven test
  - Real-world applications
- Dimensions, Tolerances, & Notes Used on Drawings
  - Metric unit conventions
  - Dimensions, tolerances, basic dimensions
  - Interpreting dimensional limits
- Key Terms Used in GD&T
  - Size and actual local size
  - Feature, feature of size, regular and irregular features of size
  - Least and maximum material condition
  - Related and unrelated actual mating envelope
  - MMC, LMC, RFS
  - Specifying a pattern on a drawing
- GD&T Symbols & Modifiers
  - Geometric characteristic symbols
  - Five categories, five geometric attributes, twenty-one geometric modifying symbols
  - Feature control frame and placement
  - Continuous feature modifier effects on a feature and feature of size
- GD&T Rules
  - Sixteen fundamental dimensioning rules
  - Rule #1: applied to a feature of size, exceptions, overriding, inspecting
  - Independency concept, Rule #2, GO/NOGO gage
- GD&T Concepts
  - Virtual condition, calculations, and worst-case boundary
  - Bonus tolerance concept and calculations
  - Verification principles for a virtual condition boundary
- Flatness Tolerance
  - Derived median plane, tolerance zones
  - Rule #1 as a flatness control
  - Applied to a planar surface and feature of size
  - Bonus tolerance (at MMC)
  - Interpreting flatness tolerances using the Significant Seven Questions
  - Real-world applications, CARE test
- Straightness Tolerance
  - Derived median line, tolerance zones
  - Rule #1 effects
  - Standard-compliant specification
  - Applied to a surface and a feature of size
  - Bonus tolerance (at MMC)
  - Interpreting straightness tolerances using the Significant Seven Questions
  - Real-world applications, CARE test
- Circularity Tolerance
  - Tolerance zones
  - Rule #1 effects
  - Standard-compliant specification
  - Interpreting circularity tolerances using the Significant Seven Questions
  - Real-world applications, CARE test
- The Datum System
  - Implied datums, benefits, terminology
  - Datum reference frame and symbol
  - Six degrees of freedom
  - Coplanar datum features
  - Multiple datum reference frames
  - Datum-related dimensions
- Datum Targets
  - The datum target symbols, usage, requirements
3 ways to get a no-obligation price quote to bring a course to your company • Call SAE Corporate Learning at +1.724.772.8529
• Fill out the online quote request at sae.org/corplearning • Email us at Corplearn@sae.org

ENGINEERING TOOLS & METHODS

- Point datum target, line datum target, datum target simulators, movable datum targets
- Datum target applications

Size Datum Features: RMB
- Terms, methods to specify a feature of size as a datum feature
- Effects of a datum feature (RMB)
- Coaxial datum features of size, datum feature simulator for coaxial datum features of size (RMB)

Size Datum Features: MMB
- Maximum material boundary (MMB) and effects
- Datum shift, datum sequence, datum feature simulators
- Using a hole pattern as a datum feature

Perpendicularity Tolerance
- Implied 90° angles
- Perpendicularity and perpendicularity tolerance
- Common tolerance zones
- Indirect perpendicularity tolerances
- Modifiers used with perpendicularity tolerance
- Interpreting a perpendicularity tolerance using the Significant Seven Questions
- Real-world applications, inspection methods, CARE test

Parallelism Tolerance
- Implied parallel relationships
- Parallelism and common tolerance zones, indirect parallelism controls
- Modifiers used with parallelism tolerances
- Interpreting a parallelism tolerance using the Significant Seven Questions,
- Real-world applications, CARE test

Position Tolerance Introduction
- True position and common tolerance zones
- Implied relationships and advantages
- Surface and axis interpretations
- Real-world applications, CARE test

Position Tolerance: RFS & MMC
- Conditions of RFS and MMC applications
- Interpreting a position tolerance using the Significant Seven Questions

Circular & Total & Runout Tolerances
- Circular runout and total runout tolerance, interpretation, and comparison
- Tolerance zone shape
- Three ways to establish a datum axis
- Real-world applications, CARE test

Profile Tolerances: Introduction
- Profile and true profile
- Part characteristics affected by profile tolerances
- Effects of datum references
- Advantages, tolerance zone options and extents, CARE test

Instructor:
This course is taught by one of ETI’s approved instructors, each of whom has been vetted and mentored by Alex Krulikowski

Fee
Contact ETI for pricing information
CEUs offered vary based on course length


1 Day
I.D.# ET2025

Providing you have a basic understanding of Y14.5 Dimensioning and Tolerancing practices, this course explains the major differences between the ASME and ISO standards in a concise, easily understood manner. Utilizing the expertise of world-renowned GD&T expert Alex Krulikowski, the course focuses on how the standards compare when dealing with symbols, feature control frames, tolerances, form controls, datums, and more. Newly acquired learning is reinforced throughout the class with numerous practice problems. Each attendee receives a robust collection of learning resources.

Learning Objectives
By attending this class, participants will be able to:
- Explain how ASME and ISO standards are developed
- Recognize the advantages and cautions of using ASME and ISO standards
- List the major differences in technical drawing presentation
- Recognize the major differences between ASME and ISO geometric tolerancing terms and symbols
- Recognize the major differences between ASME and ISO datum systems
- Identify the differences in ASME and ISO drawings

Who Should Attend
This course is valuable for individuals who work with ISO standards on drawings, designers, engineers, inspectors, and machinists. All attendees should have a basic understanding of Y14.5 Dimensioning and Tolerancing practices prior to enrolling in this course.

Topical Outline
- Standards and Technical Drawings
  - Importance of standards
  - ASME and ISO organizations
  - Stages of standard development
  - Major differences in scope of standards
• Advantages and Cautions
  • Why each standard should be used
  • ISO GPS concept
  • Three domains of ISO specifications
  • Comparing ASME and ISO GPS systems
  • Five cautions when using ASME standards
  • Six cautions when using ISO standards
• Technical Drawing Presentation Differences
  • Technical drawing standards
  • Items that are the same in both standards
  • View projection methods
  • Dimensioning termination and presentation methods
  • Dimensioning symbols
  • Angular tolerance interpretation
  • Workpiece edge requirements and general tolerance specification
  • Size dimensions and limits and fits expressions
  • Surface texture is specification
• Tolerancing Term Differences
  • Feature and feature of size
  • Envelope requirement and independency principle
  • Eight major terms
  • Bonus tolerance and collective requirement
• Datum System Differences
  • Datum specifications
  • Datum interpretations
  • Candidate and single solution datums
  • Datum target specifications
• Geometric Tolerancing Symbol Differences
  • Specification / use for each geometric tolerance symbol
  • Interpretation for each geometrical tolerance
  • Specification / use for modifiers and symbols
• ASME and ISO Drawing Differences
  • Applicable standards
  • Drawing symbol differences; Geometrical tolerance specification and interpretation differences

<table>
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<th>Instructor:</th>
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<td>Fee</td>
<td>Contact ETI for pricing information. 7 CEUs are offered for this course</td>
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**GD&T EDUCATIONAL & REFERENCE RESOURCES FROM ETI**

**Fundamentals of Geometric Dimensioning and Tolerancing Using Critical Thinking Skills**
*(based on ASME Y14.5-2009)*

**3rd Edition**
By Alex Krulikowski

A unique book that meets the needs of readers studying industrial technology, CAD, engineering technology, or manufacturing technology. This book clearly organizes geometric dimensioning and tolerancing fundamentals into small, logical units for step-by-step understanding. Measurable performance objectives help readers assess their progress. Discussion questions promote interaction and higher-order thinking, and practice problems ensure thorough understanding of the concepts presented. Fundamentals of Geometric Dimensioning and Tolerancing (2009) 3rd Edition defines and fully encompasses the ASME Y14.5-2009 Standard to keep readers current on these important industry standards.

**TOPICS INCLUDE:**
- Form
- Orientation
- Runout, Concentricity, Symmetry
- Key GD&T Terms, Rules, & Concepts
- Datum System
- Position
- Profile
- Position, profile, and datums

**THIS BOOK IS A VALUABLE TOOL FOR:**
- Designers
- Product, Manufacturing, and Quality Engineers
- CMM Operators
- Checkers

**SKILL LEVEL**
A basic understanding of engineering drawings is required.

**ISBN:** 978-1111129828  
448 pp.  
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**$133.00 List**  
Product Code PD021101
**Fundamentals of Geometric Dimensioning and Tolerancing**
*(based on ASME Y14.5M-1994)*

2nd Edition  
By Alex Krulikowski


**CHAPTER GOALS INCLUDE:**
- Understand why geometric tolerancing is superior to coordinate tolerancing
- Understand eight key terms and how they affect the interpretation of a drawing
- Understand the modifiers and symbols used in geometric tolerancing
- Understand Rule #1 and Rule #2
- Understand the concepts of basic dimensions, virtual condition, inner and outer boundary, worst-case boundary, and bonus tolerance
- Interpret: flatness; straightness; circularity; & cylindricity
- Understand the datum system (planar datums)
- Interpret datum targets
- Interpret feature of size datum specifications (RFS)
- Interpret feature of size datum specifications(MMC)
- Interpret the perpendicularity control
- Understand the fundamental concepts of tolerance of position: the definition and conventions, the advantages, and the basic theories
- Interpret RFS and MMC tolerance of position applications
- Draw cartoon gages for tolerance of position (MMC) applications
- Interpret tolerance of position special applications
- Calculate distances on a part dimensioned with tolerance of position
- Calculate tolerance of position tolerance values using the fixed and floating fastener formulas
- Interpret the: concentricity control; symmetry control; circular runout control; total runout control
- Understand profile tolerancing
- Interpret the profile of a surface control & line control

**Critical Concepts of Tolerance Stacks Material Set**
*(Applicable to ASME Y14.5-2009 and ASME Y14.5M-1994 Standards)*

Proficiency in tolerance accumulation studies (also referred to as stacks) separates the exceptional engineers from the rest. More than simply the study of dimensional relationships within assemblies, tolerance stacks are the key to creating robust, efficient, and successful designs. Use stacks to create designs that maximize fit, function, and return on investment. Optimize part tolerances for design function and manufacturing processes.

**MATERIALS SET INCLUDES***:
- Tolerance Stacks Exercise Workbook
- A Tolerance Stacks Drawing Package
- An Excel tolerance stack spreadsheet template – electronic delivery

*Materials in this set are not available for individual sale.

**MATERIALS ADDRESS:**
- Step-by-step approach to a 1D two-column stack methodology
  - Over 60 performance objectives
  - Applicable to both part and assembly stacks
  - Mathematically based to account for all tolerance variation
  - Correctly apply
  - Coordinate tolerances
Advanced Concepts of Geometric Dimensioning and Tolerancing
(based on ASME Y14.5M-1994)

2nd Edition
By Alex Krulikowski

This reference book stresses the application of GD&T in today's industrial workplace, and it's the perfect resource to expand and deepen your understanding of GD&T. Advanced Concepts of Geometric Dimensioning and Tolerancing includes examples and explanations of tolerancing concepts that are often problematic in real world applications. This must-have text features 26 chapters that cover a broad range of tolerancing practices common in industry, but not well documented in national standards. The text includes 50 exercises with over 250 problems designed to reinforce the material.

TOPICS INCLUDE:
• Tolerancing non-rigid parts
• Position, profile, and datums
• Functional dimensioning
• Drawing interpretation
• Advantages and misconceptions of the datum system
• Relating tolerance applications to a loss function curve
• Tolerancing of threaded holes
• Composite position tolerancing
• Profile applications

THIS BOOK IS A VALUABLE TOOL FOR:
• Designers
• Product, Manufacturing, and Quality Engineers

The GD&T Trainer: Fundamentals 2009
(based on ASME Y14.5-2009) Computer-Based Training

The GD&T Trainer: Fundamentals 2009 is a comprehensive training program consisting of 29 lessons covering basic rules, definitions, and concepts of GD&T. This software package contains newly updated course administration tools with enhanced student progress tracking capabilities as well as:
• Student/course records storage
• Learning assessments
• 2,000 student maximum capacity
• Simultaneous record access for multiple administrators
• Report generator to track student and course progression
• Password protection for student records
• And much more.

The GD&T Trainer can be used as:
• A complete course in GD&T, with quizzes, final exam, and certificate of completion
• A geometric tolerancing seminar
• A supplement or review for live training
• An internal GD&T certification
• An on-the-job reference

SKILL LEVEL
Users should have completed ETI's Engineering Drawing Requirements course or use drawings regularly on the job.

VERSIONS
This course is available in various platforms to team member or the entire team:
• Corporate—unlimited learners in multiple locations
• Single Site—preset number of learners or unlimited learners in a single location
• Multi-user or Single-user on a stand-alone PC
ENGINEERING TOOLS & METHODS

SYSTEM REQUIREMENTS
• Pentium 4-based computer with a 2GHz or higher CPU
• 512 MB RAM minimum, 1024 MB or higher recommended
• 500 MB or more of free hard drive space
• Sound card with speakers
• Video card capable of displaying 24-bit color at a resolution of 1024x768
• Windows 7/8
• Adobe Flash Player 13.0 or higher
• Visual Basic 6 Runtime (Admin and Reporter only)
• .NET Framework 2.0

Contact ETI to determine the version that best fits your training need.
Product Code PD021249

The GD&T Trainer: Fundamentals 1994
(based on ASME Y14.5M-1994) Computer-Based Training

The GD&T Trainer: Fundamentals 1994 is a comprehensive training program consisting of 28 lessons covering basic rules, definitions, and concepts of GD&T. This software package features newly updated administration tools for tracking student progress as well as:
• Student course record storage
• Learning assessments
• Up to 2,000 student capacity
• Simultaneous records access for multiple administrators
• Report generator and database access to track student progress
• Password protection for student records
• And much more.

The GD&T Trainer can be used as:
• A complete course in GD&T, with quizzes, final exam, and certificate of completion
• A geometric tolerancing seminar
• A supplement or review for live training
• An internal GD&T certification
• An on-the-job reference

SKILL LEVEL
Users should have completed ETI’s Engineering Drawing Requirements course or use drawings regularly on the job.

VERSIONS
This course is available in various platforms to team member or the entire team:
• Corporate—unlimited learners in multiple locations

• Single Site—preset number of learners or unlimited learners in a single location
• Multi-user or Single-user on a stand-alone PC

SYSTEM REQUIREMENTS
• Pentium III-based computer with a 1GHz or higher CPU
• 256 MB RAM minimum/512 MB or higher recommended
• 1 GB minimum of free hard drive space
• Sound card with speakers
• Video card capable of displaying 24-bit color at a resolution of 1024x768
• Windows XP (SP2)/XP/64-bit/Vista/7
• Adobe Flash Player 10.0 or higher
• Visual Basic 6 Runtime (Admin and Reporter only)
• .NET Framework 2.0
• NOTE: Windows 3.x/98/ME/2000 are not supported

Contact ETI to determine the version that best fits your training need.
Product Code PD025073

ISO GPS Quick Reference

The ISO GPS Quick Reference software is a valuable on-the-job resource for locating technical drawing information without navigating through multiple standards. The ISO GPS Quick Reference software covers more than 250 related topics with full-color drawings and illustrations, and user-friendly navigation for easy transition between topics. The software covers the most common aspects of product design. It was created by GD&T expert Alex Krulikowski, member of ISO/TC 213-US Technical Advisory Group.

The program is based on four major ISO GPS standards:
• ISO 8015:1985
• ISO 1101: 2004
• ISO 2768-1: 1989
• ISO 2768-2: 1998
• plus more than 40 related standards.

REFERENCE HIGHLIGHTS
• Explanations of more than 250 topics cover all aspects of ISO GPS standards
• “Hotwords” in topics link to a glossary of more than 250 terms and definitions
• Detailed graphics with full explanations of concepts
• Interactive charts defining symbols and abbreviations
• Topics are cross-referenced with the ISO standards
The ISO GPS Quick Reference software is a valuable tool for anyone who creates or interprets engineering drawings.

Site and corporate licenses are available.

**COURSE FORMATS**
- A complete course in GD&T including quizzes, final exam, and certificate of completion
- A geometric tolerancing seminar
- A supplement or review for live training
- Post training content review
- An internal GD&T certification
- An on-the-job reference

**SKILL LEVEL**
Users should have completed ETI’s Engineering Drawing Requirements course or use drawings regularly on the job.

**VERSIONS**
- LAN 2-seat (up to 10 seats)
- Corporate

**SYSTEM REQUIREMENTS**
- Pentium 4-based computer with a 2GHz or higher CPU
- 512 MB RAM minimum/1024 MB or higher recommended
- 4 GB minimum of free hard drive space
- Video card capable of displaying 24-bit color at a resolution of 1024x768
- Windows XP (SP2)/XP/Professional 64-bit/Vista/7
- Adobe Flash Player 10.0 or higher

Starting at $1200.00 List
Contact ETI to determine the version that best suits your need.
Product Code PD027201

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The ETI eLearning System
*(Based on ASME Y14.5M-1994 & Y14.5-2009 Standards)*

ETI’s eLearning System gives those responsible for GD&T skill development a comprehensive solution for fundamentals training in both standards, comparison instruction to understand the differences, and access to powerful GD&T dictionary, quick reference, and skill survey tools.

The ETI eLearning System is the ideal software package for anyone considering or currently operating in a multi-standard environment.

Users will receive all the same benefits as each of our individual GD&T trainer packages as well as:
- Three fully interactive, narrated courses
  - Fundamentals of GD&T (2009)
  - Fundamentals of GD&T (1994)
  - ASME Y14.5 Standard Comparison
- Over 60 significant revisions, additions, and deletions
- Student/course record storage
- Digital Design Dictionary
- A copy of the Ultimate GD&T Pocket Guide:

**COURSE FORMATS**
- A complete course in GD&T including quizzes, final exam, and certificate of completion
- A geometric tolerancing seminar
- A supplement or review for live training
- Post training content review
- An internal GD&T certification
- An on-the-job reference

**SKILL LEVEL**
Users should have completed ETI’s Engineering Drawing Requirements course or use drawings regularly on the job.

**VERSIONS**
- LAN 2-seat (up to 10 seats)
- Corporate

**SYSTEM REQUIREMENTS**
- Pentium 4-based computer with a 2GHz or higher CPU
- 512 MB RAM minimum/1024 MB or higher recommended
- 4 GB or more of free hard drive space
- Sound card with speakers
- Video card capable of displaying 24-bit color at a resolution of 1024x768
- Windows XP/XP Professional/64-bit/Vista/7
- Adobe Flash Player 10.0 or higher
- Visual Basic 6 Runtime (Admin and Reporter only)
- .NET Framework 2.0

Contact ETI for pricing
Product Code PD021201
Fundamentals of Geometric Dimensioning and Tolerancing Video Training Program – Video Workbook
(based on ASME Y14.5M-1994)

By Alex Krulikowski

This unique self-study course is designed as a supplement to the Fundamentals of GD&T Video Training Package (ask your ETI sales representative for details). The GD&T Video Workbook contains 30 exercises and over 300 questions on the fundamentals of geometric tolerancing. Diagrams, tips, charts, and key points correspond to its companion video to provide reinforcement of concepts learned in each section. Users can gauge their comprehension through assessments included at the conclusion of each lesson. The GD&T Video Workbook can be used as an ongoing practice and reference guide well after the initial training is complete.

THIS BOOK IS A VALUABLE TOOL FOR:
• Designers
• Product, Manufacturing, and Quality Engineers
• CMM Operators
• Checkers

SKILL LEVEL
Basic blueprint reading skills is required; must have also completed courses in GD&T fundamentals and advanced concepts.

Spiral Binder
Starting at $64.00 List
Product Code PD024051

GD&T Workbook with Engineering Drawings
(based on ASME Y14.5M-1994)

By Alex Krulikowski

The GD&T Workbook enhances student skills through instruction and exercises on topics learned via ETI’s training practicum. A perfect companion to the Fundamentals of GD&T textbook, the GD&T Workbook can be used in the classroom as reinforcement to the ETI Fundamentals of GD&T training course, and as an ongoing practice guide after classroom training is complete. For instructors, the Workbook is designed for use with the Fundamentals of GD&T Digital Instructor’s Kit to complement lesson plans and teaching aids. Users will gain practical experience from the GD&T Workbook with typical industrial engineering drawings through insightful questions and examples covering key terms, concepts, and interpretations. Learning goals and objectives are clearly outlined making the GD&T Workbook the perfect supplement to your live or e-learning GD&T training.

TOPICS INCLUDE:
• Interpreting Engineering Drawings
• Understanding Why GD&T is Superior to Coordinate Tolerancing
• Recognizing Key Terms
• Identifying Modifiers and Symbols Used in GD&T
• Understanding Rules #1 and #2
• Recognizing GD&T Concepts
• Interpreting Flatness, Straightness,Circularity, and Cylindricity
• Specifying and Interpreting Planar Datums, Datum Targets, and Size Datums (RFS and MMC)
• Interpreting Perpendicularity, Angularity, Parallelism, and Position (RFS/MMC/LMC)
• Drawing Cartoon Gages
• Interpreting Tolerance of Position Special Applications
• Calculating Part Distances and Fastener Formulas
• Interpreting Concentricity, Symmetry, Circular Runout, Total Runout
• Interpreting Profile Tolerancing, Profile of a Surface, and Profile of a Liner

THIS BOOK IS A VALUABLE TOOL FOR:
• Designers
• Product, Manufacturing, and Quality Engineers
• CMM Operators
• Checkers

SKILL LEVEL
Student should have taken ETI’s Engineering Drawing Requirements course or have a basic understanding of engineering drawings.

204 pp.
Spiral Bound
$36.00 List
Product Code PD024030

3 ways to get a no-obligation price quote to bring a course to your company • Call SAE Corporate Learning at +1.724.772.8529
• Fill out the online quote request at sae.org/corplearning • Email us at Corplearn@sae.org
Fundamentals of GD&T Self-Study Workbook
(based on ASME Y14.5-1994)

2nd Edition
By Alex Krulikowski

also available
Fundamentals of GD&T Self-Study Workbook
Spanish Edition

The Fundamentals of GD&T Self-Study Workbook is a popular cost-effective option for learning GD&T at your own pace. Practical examples incorporating real world applications separate this workbook from all competitors. The Fundamentals Self-Study Workbook’s versatility goes beyond self-study and can be multi-purposed for team learning. Users will find useful charts, diagrams, innumerable tips and suggestions, assessments, and other learning resources to maximize your learning objectives.

The Fundamentals of GD&T Self-Study Workbook package also comes complete with 30 targeted lessons, self-study flash cards, and pre- and post tests to measure and track learning goals.

Product highlights: The GD&T Self-Study Workbook is packed with examples, charts, logic diagrams, on-the-job guidelines, and over 500 practice problems with solutions.

Each lesson begins with a pre-inventory test to assess your current skill level. The lesson continues with illustrated, step-by-step training in each concept and provides problems to allow you to practice those concepts. Each lesson ends with a summary quiz and a post-inventory, giving you immediate feedback on your progress. Includes a send-in final exam.

THIS BOOK IS A VALUABLE TOOL FOR:
• Designers
• Product, Manufacturing, and Quality Engineers
• Technicians
• Purchasers
• Checkers

SKILL LEVEL
A basic understanding of engineering drawings is required.

Tolerance Stacks Self Study Course
By Alex Krulikowski

This unique all-in-one self-study course comes delivered in a multi-volume package and is intended as a course in geometrical tolerancing. Each volume stresses applications found on-the-job in real-world industrial situations. Practice tools replicate actual drawings to maximize knowledge transfer from the training room to the jobsite.

Volume 1 formally outlines the importance of stacks as it relates to product design, the course format, and also offers useful tips on setting personal goals to maximize user’s learning habits.

Volume 2 contains 25 practice stacks based on the ETI Drawing Package (included), progress charts, helpful tips, and solutions to gauge user’s learning progression.

Product highlights: Stresses applications that are found on the job in real-life industrial situations. The practice stacks are from actual drawings that are provided in a separate Drawing Package. It includes a skills assessment tool and exercises at the end of each chapter to practice the concepts.

Additional package items include a Stacks Summary Chart and blank stacks forms for use in documenting practice content.

THIS BOOK IS A VALUABLE TOOL FOR:
• Designers
• Product, Manufacturing, and Quality Engineers
• Inspectors
• Machine Builders

SKILL LEVEL
Basic blueprint reading skills is required; must have also completed courses in GD&T fundamentals and advanced concepts.

ISBN: 0-924520-03-5
Part 1005
Multiple Packaging
Starting at $210.00 List
Product Code PD021005

ISBN: 09245420-01-9,
Part 4002
570 pp.
Spiral Bound
Starting at $170.00 List
Product Code PD024002
Product Code (Spanish Language Edition) PD024004
**ENGINEERING TOOLS & METHODS**

### Alex Krulikowski’s ISO Geometrical Tolerancing Reference Guide

**By Alex Krulikowski**

The ISO Geometrical Tolerancing Reference Guide clarifies interpreting standard-compliant technical drawings that use ISO 1101:2004 and its companion published standards. It guides the user as to which ISO standards should be referenced on a drawing and what the standards cover. The book includes several features to help the reader find information quickly:

- A visual index inside the front cover
- Individual table of contents for each section
- Indexed page edges for each section
- Numerical cross-references
- A comprehensive alphabetical index
- A glossary of more than 100 terms
- More than 250 endnotes that reference ISO standards with clauses that support concepts
- Numerous authors’ comments that provide insights about concepts
- Hidden spiral binding allows it to lay flat
- Comprehensive reference charts and drawings inside the foldout covers

**TOPICS INCLUDE:**

- ISO drawing conventions
- GPS basics
- Size and boundary conditions
- Limits and fits
- The datum-system
- Form tolerances
- Orientation tolerances
- Location tolerances
- Run-out tolerances
- Profile tolerances
- General tolerances
- Workpiece edges
- Surface texture
- ISO/ASME comparison
- Non-rigid parts
- Restraint specifications

**THIS BOOK IS A VALUABLE TOOL FOR:**

- Engineers
- Designers
- Inspectors
- Machinists

ISBN: 978-0-924520-17-4
376 pp.
Spiral Bound 2010
$110.00 List
Product Code PD027101

### ASME Y14.5M-1994 to ASME Y14.5-2009 New Features Comparison Chart

**based on ASME Y14.5-2009**

Compare the features of ASME Y14.5M-1994 and ASME Y14.5-2009 quickly and easily with the New Features Comparison Chart Set. This set of two, 2-sided charts illustrates the itemized changes in the standard for quick, on-the-job drawing interpretation. An ideal tool for the working designer, engineer or design manager, this pair of fully illustrated, 11” x 17” charts fits in a 3-ring binder.

- Provides itemized changes in the standard for quick, on-the-job drawing interpretation
- Compares features of ASME Y14.5M-1994 and ASME Y14.5-2009
- Includes references to the ASME Y14.5-2009 Standard so you can quickly find additional information
- Makes an excellent teaching aid or on-the-job reference

ISBN: 978-0-924520-22-8
(2) 11”x17”
$13.00 List
Product Code PD021030

### ASME Y14.5M-1994 Reference Chart

Compare features of ANSI and ASME Standards, and Tolerance Stacks quickly and easily with these handy comparison sets. Each chart contains a fully illustrated breakdown of changes in the standard for quick, on-the-job drawing interpretation. These easy-to-read charts are the ideal tools for the working designer, engineer and design manager. Order one or multiple copies for your home, office and/or remote jobsite.

- Defines and illustrates important GD&T terms, modifiers, and symbols.
- Shows examples of each tolerance with facts about datums, MMC/RFS, bonus tolerances, and tolerance zone boundaries.
- Explains the new datum system.

ISBN: 00-924520-12-4
(1) 11”x17”
$5.50 List
Product Code PD024012

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3 ways to get a no-obligation price quote to bring a course to your company:

- Call SAE Corporate Learning at +1.724.772.8529
- Fill out the online quote request at sae.org/corplearning
- Email us at Corplearn@sae.org
The Ultimate GD&T Pocket Guide
(based on ASME Y14.5-2009)

The Ultimate GD&T Pocket Guides are the perfect on-the-job reference tools for anyone who uses GD&T on the job or in the classroom. Each guide delivers a wealth of concise practical information on current ASME Standards and GD&T topics through helpful tips, charts and detailed illustrations for easy reference. Use The Ultimate GD&T Pocket Guides to reference datum applications, conversion charts, formulas, tolerancing, and much more.

PRODUCT HIGHLIGHTS INCLUDE:
• Over 100 detailed drawings to illustrate concepts
• More than 40 charts for quick reference
• Explanation of each GD&T symbol and modifier
• Examples of datum application
• Sections on surface texture and composite tolerancing
• A conversion chart for coordinate measurement to diameter tolerance zone
• Full definitions of major concepts
• Clarification of important rules and topics
• Definitions of fixed and floating fastener formulas
• Handy inch/millimeter conversion charts

2nd Edition
Spiral Bound
122 pp.
$20.00 List
Product Code PD024070

Kindle Edition (e-book)
$9.99 List

The Ultimate GD&T Pocket Guide
(based on ASME Y14.5M-1994)

The Ultimate GD&T Pocket Guides are the perfect on-the-job reference tools for anyone who uses GD&T on the job or in the classroom. Each guide delivers a wealth of concise practical information on current ASME Standards and GD&T topics through helpful tips, charts and detailed illustrations for easy reference. Use The Ultimate GD&T Pocket Guides to reference datum applications, conversion charts, formulas, tolerancing, and much more.

PRODUCT HIGHLIGHTS INCLUDE:
• Over 50 detailed drawings to illustrate concepts
• Explanation of each GD&T symbol and modifier
• Examples of datum application
• Sections on surface texture and composite tolerancing
• A handy inch/millimeter conversion chart
• A conversion chart for coordinate measurement to diameter tolerance zone
• Full definitions of major concepts
• Clarification of important rules and topics
• Definitions of fixed and floating fastener formulas

ISBN: 0-924520-14-0 Part 4071
Saddlestich
77 pp.
$12.00 List
Product Code PD024071

Spanish Edition
ISBN: 0-924520-14-0 Part 4072
$12.00 List
Product Code PD024072
The ISO GPS Ultimate GD&T Pocket Guide


More than 15 standards were directly reviewed and more than 30 standards indirectly used in creating the book. One entire section is devoted to a quick comparison of ASME and ISO standards. Author’s comments throughout the text provide insights about concepts and how to apply or interpret geometrical tolerancing in a cost-effective manner.

TOPICS INCLUDE:
- GPS basics
- View projection options
- Linear size
- Non-size dimensions
- Datum systems
- Geometrical tolerances

RELATED TRAINING SOLUTIONS

Some of our courses apply to more than one technology category. Consider these related courses described in other sections of this resource guide.

Creating and Managing a Product Compliance Program

You will learn best practices in creating a compliance program for your products and markets, and how to use this program at all stages of product development and production. Read more about this course on page 75.

Engineering Project Management

Project Management and Advanced Product Quality Planning (APQP) are two critical techniques used in product development in the mobility industry today. This seminar will bring these techniques together in an easy to understand format that goes beyond the typical concept of constructing timelines and project planning, by exploring not only the AIAG APQP process, but also specific aspects of PM processes. Read more about this course on page 78.
SAE CAREER COUNSELOR SERIES

Concise, effective training videos focused on your career needs:

- Time Management
- Goal Setting Strategies
- Communication Strategies
- Generations in the Workplace
- And more...

View the episodes at go.sae.org/careercounselor.html
MANAGEMENT: LEADERSHIP & PRODUCT DEVELOPMENT

Includes: strategic leadership, team building, principles of cost and finance, effective decision making, and project and program management

MANAGEMENT AND LEADERSHIP

The Art of Leadership Presence
40 Minutes
I.D.# PD271738

We all experience surprises. What if you could meet these surprises with ease and confidence? And what if you could create, through your own personal presence, space for more positive, collaborative engagements between people?

You can when you adopt the mindset of an improv actor! This means learning and practicing how to show up and be ready – ready to lead, to influence, and to contribute whether things go the way you expected or not. And to have leadership presence: something that builds the trust we need to work together through good times and bad.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

Doing the Right Things Right
30 Minutes
I.D.# PD271715

Based on the book by bestselling author and award-winning speaker Laura Stack, Doing the Right Things Right: How the Effective Executive Spends Time, this course focuses on how today’s leaders and managers can obtain profitable, productive results by managing the intersection of two critical values: effectiveness and efficiency.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

Quantity discounts and Site License options are available. Call the SAE Corporate Learning Solutions hotline at +1.724.772.8529 for a quote.

Effective Decision-Making: A Methodology Approach
1 Day
I.D.# C1354

Effective decision making is critical to maximizing profit/minimizing expenses, return on capital spending, and operational efficiency. To understand the impact of decisions that affect the enterprise, professionals at every level must secure and integrate relevant cross-functional information. Register for this seminar

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

Quantity discounts and Site License options are available. Call the SAE Corporate Learning Solutions hotline at +1.724.772.8529 for a quote.
and learn skills needed to base decision making on solid business knowledge and sound financial principles instead of on emotion or “your gut.” The instructor walks you through the tenets of structured decision-making and teaches a step-by-step approach to make practical, effective decisions. Participants are requested to bring a scientific calculator capable of doing exponential calculations for class analyses.

**Learning Objectives**

By attending this seminar, participants will be able to:

• Define the decision boundaries and expectations for decision outcomes
• Select the optimal methodology for decision making
• Select the best decision-making criteria in making project decisions and allocating capital budgets
• Determine the lowest enterprise costs in raising capital through debt and equity offerings
• Analyze make-buy, buy-lease, replacement and other alternative enterprise decisions based on the best financial strategies
• Articulate the financial sensitivity of project decisions and the use of decision tools for integrating cross-functional business requirements
• Develop an effective decision-making structure for your unique specific project criteria and your organization

**Who Should Attend**

This seminar will benefit individuals having responsibilities in engineering, business, finance, marketing, purchasing, manufacturing, research, and program management. In addition, local government leaders and individuals in non-profits may benefit from these decision-making case studies in determining business decisions including which projects and grants should be supported. A group from the same organization may find it advantageous to attend together.

**Topical Outline**

• Decision Boundaries and Expectations
  • Region & Functions Impacted
  • Time Frame of Decision
  • Outcomes
  • Plan B
• Decision-Making Principles
  • Evolution
  • Terminology
  • Types
  • Stages
• Financial Principles
  • Time Value of Money, Interest & Inflation
  • Worth (Present Value, Future Value, etc.)
  • Financial Decision Methods (NPV, IRR, Payback Period, etc.)
  • Case Studies
  • Decision-Making Criteria
  • Market Demographics
  • Product or Service Position/Leadership, Parity
  • Financials & Price/Margin/Cost Reduction
  • Quality/Customer Satisfaction
  • Change in Business Direction/Vision
  • Personnel/Job Creation
• Cost Impact & Enterprise Decisions
  • Cost of Capital: Equity & Debt, Revenue Sources
  • Cost of Ownership: Depreciation, Accelerated Cost Recovery
  • Influence of Tax Obligations
  • Case Studies
• Alternative Financial Decisions for the Enterprise (Principles & Case Studies)
  • Make/Buy
  • Buy/Lease
  • Replace/Repair
  • Investments of Unequal Life
• Sensitivity & Scenario Analysis & Decisions (Case Studies)
• Decision-Making Methodology
  • Matrix Priority Rating System
  • Case Study by Attendees

**Instructor:** James Masiak  
**Fee:** $810 .7 CEUs

**SAE GENERAL MANAGEMENT AND LEADERSHIP CERTIFICATE PROGRAM**

Watch for the certificate icon to indicate course titles that are part of an SAE multi-course certificate program.

This program focuses on four core management and leadership competencies: management capability, team leadership, project management, and finance providing a basis for growth into a leadership or management role. View the list of required and elective courses and more information on enrolling in this SAE certificate program: training.sae.org/certificate/management_leadership
Effective Writing for Engineering and Technical Professionals

2 Days  
I.D.# C1605

The ability to write concise and unambiguous reports, proposals, manuals, or other technical documents is a key skill for any high-functioning engineer or technical staff person in the mobility industries. Through a combination of class discussions, interactive workshop activities, assignments, checker teams (review teams) and job aids, this course delivers real-life technical writing techniques and tools that can be immediately applied. Attendees discover the importance of knowing their audiences and how to communicate technical information in a “user-friendly” style.

During the conclusion of the final session, participants will also share their action plans and learn more about available resources (books, online courses, tools, etc.) to enrich their learning experiences.

To enhance social learning, participants will organize into “Checker Teams” to support each other with developing and critiquing session assignments. Review checklists will be provided to support Checker Team activities.

Because this course is highly interactive, participants are required to bring samples of their own writing projects (past, present, or future ideas) to analyze and develop during class. There may be some sharing of documents among participants on Day Two, so please bring non-proprietary document samples for some class activities. If proprietary documents are to be reviewed, the instructor is available to provide confidential, one-on-one coaching for each participant during the end of Day Two.

A critical resource included as part of this course is Hacker, D. & Sommers, N. (2014), Pocket Style Manual: Updated With MLA’s Guidelines and Internet Resources 7th Edition.

Learning Objectives
By attending this seminar, participants will be able to:
• Describe basic technical writing techniques
• Interpret documentation including procedures, work instructions, specifications, and reports
• Apply your technical writing knowledge to documentation and projects

Who Should Attend
This course is valuable for anyone motivated to enhance his or her writing skills in the technical environment. Job roles that may benefit from this workshop include engineering, testing/validation, procurement, marketing, quality management, and management.

Topical Outline
• Technical communication and how to identify the good from the bad
• Complete a self-assessment to identify personal technical writing goals
• Form Checker Teams for workshop activities
• Objectives and purposes of various forms of technical documentation
• Identifying audience needs using audience analysis job aid
• Strategies for gathering, organizing, and developing content effectively, focusing on: “Readability”, “usability” and “accuracy”
• Principles of proper grammar, mechanics, and spelling using the Hacker Pocket Style Manual
• Principles of graphically representing text and data
• Formatting techniques to enhance readability
• Other “unwritten rules” and considerations
• Exercise: writing and editing your own documentation
• Exercise: personal goals based on the self-assessment
• Exercise: personal success plan refinement
• Instructor coaching on writing

Instructor: Norina L. Columbaro  
Fee $1400  1.3 CEUs

Leading High Performance Teams

2 Days  
I.D.# C0410

Product development is organizationally a complex undertaking that requires effective coordination within a company and between companies. During product development, teams are confronted with a number of ongoing organizational challenges and there is a high potential for conflict between participants in the process.

This course addresses teamwork and other “soft-side” factors that largely determine whether product development programs are successfully completed on schedule. The content is relevant for both OEMs and suppliers.

Learning Objectives
By attending this seminar, participants will be able to:
• Explain the importance of effectively managing ‘soft-side’ issues that cause problems and delays during product development programs
• Employ successful practices of chartering and launching teams
• Implement techniques to successfully lead and facilitate effective teams
• Effectively troubleshoot problems on a team and employ techniques to remain productive
• Implement proven tips for conducting effective team meetings

**Who Should Attend**
Engineers and business people involved in various product development team activities will find the subject matter practical and useful. The content is of particular value to professionals from engineering, manufacturing, purchasing, quality, marketing, and finance functions in ground vehicle OEMs and suppliers.

**Topical Outline**
- **Designing High Performance Team**
  - Characteristics of effective teams
  - Systems aspects of team design
  - Addressing systemic variables
  - Identifying key stakeholders
  - Establishing the team’s charter
- **Leadership and Group Dynamics**
  - Responsibilities of the team leader
  - Understanding human behavior in groups
  - Motivating team members
  - Establishing a productive team culture
  - Developing team support
  - Productive and destructive team roles
  - Effective communications
  - Influence of personality styles
- **Launching the Team**
  - Stages of team development
  - Pre-meeting considerations
  - Selecting the team
  - Common reasons meetings fail
  - Managing the first team interface
  - Establishing group norms
  - Structuring the agenda
- **Making Sound Decisions**
  - Situational analysis: problems, decisions and polarities
  - Common errors in decision making
  - Essential steps in the decision process
  - Quality and acceptance factors in decision making
  - When to use and avoid group consensus
  - Identifying the decision makers
  - Facilitating consensus decisions
- **Flawless Facilitation**
  - Recognizing and defusing common group problems
  - Managing conflict and providing feedback
  - Mind mapping, story boarding and other techniques
  - Making work assignments
  - Assessing group performance
  - Concluding the meeting

**Managing Engineering & Technical Professionals**

### 3 Days
I.D.# C0608

In the fast paced and competitive environment of today’s global economy, the work of technical professionals is often the difference between success and failure in an organization. Providing leadership for engineers is uniquely challenging, and the transition from working engineer to first-line technical supervisor is one of the most difficult career challenges that an engineer may face. First-time engineering supervisors and mid-level managers who wish to sharpen their skills and learn new techniques for guiding, coaching, and motivating working engineers, technicians, and designers will find this seminar valuable. A mix of lecture and attention-grabbing exercises are used to develop intense and lasting learning results.

**Learning Objectives**
By attending this seminar, participants will be able to:
- Describe the basic value proposition of management: what managers bring to an organization that makes them worthwhile
- Avoid the most common errors that supervisors and managers make
- Describe the evolution of management thought, and utilize the latest proven concepts for improving the performance of people in complex organizations
- Explain the issues that drive the psychology of effective leadership and develop greater emotional intelligence
- Implement strategies to enhance your skills in meeting management, coaching, and performance review that are essential in today’s professional workplace

**Who Should Attend**
Engineers and technical professionals who are either recently promoted into a management position, or have some experience as a manager but would like to learn how to become more effective will benefit from attending this workshop. The concepts and skills developed during this interactive experience will be of interest to those involved in product development, manufacturing, service, or quality engineering, and all related technical activities in automotive, aerospace, manufacturing, and off-highway industries.

**Topical Outline**

### DAY ONE
- The Management Perspective - How Managers Earn Their Keep
  - The value proposition of management
  - The “Peter Principle” and how to avoid this trap
  - Understanding the most important errors that managers commonly make - and how to steer clear of major supervisory pitfalls

**Instructor:** Joseph Doyle

**Fee:** $1370 1.3 CEUs

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MANAGEMENT

• Why people usually struggle to cooperate, and how you can reduce this
• What You Need to Know about Today’s Workforce
  • The evolution of leadership thought, and why recent events have significantly changed effective leadership methods
  • Understanding what leadership is really about
  • Why teamwork and cooperation are necessary in modern corporate structures
  • How you can generate consistent focus and daily commitment among technical and engineering professionals
  • Playing “The Tower Game” - applying focus and commitment
• The Psychology of Successful Modern Leadership
  • Process centered leadership: getting sustained results
  • Task and relationship balances
  • Why “Output Leadership” is ineffective and counter-productive
  • Different kinds of team models - and which is most effective
  • How to reduce the influence of “bad” politics in an organization through constructive decision making processes

DAY TWO
• The Psychology of Change
  • Why change is often stressful
  • Five stages of change
  • How to make change exciting and interesting
• Emotional Intelligence: Building an Effective Leadership Style
  • Why “emotional intelligence” is important - the research results
  • The five elements of emotional leadership
  • How to practice and develop greater emotional intelligence
  • Solving typical meeting problems with emotional intelligence
• Coaching in Supervision
  • Building trust
  • Coaching roles
  • Improving communication for constructive coaching
• Using Meeting Time Effectively
  • Five key issues for successful meetings
  • How teamwork breaks down in meetings, and how to correct this

DAY THREE
• Dealing with Practical Issues
  • Dealing with difficult people
  • Learning how to delegate effectively
• Basic Negotiation Principles
  • Soft & hard negotiating approaches
  • Win-win negotiation
  • Positions, interests, & goals
• How to Make Performance Reviews Constructive
  • Legal requirements
  • Style issues
  • 360 reviews

Out-Innovate the Competition
30 Minutes
I.D.# PD271714

Out-innovate the Competition, are inadvertently destroying it. Based on Stephen Shapiro’s bestselling book, Best Practices are Stupid: Ways to Out-Innovate the Competition, this online learning experience offers counterintuitive yet proven strategies for boosting innovation and making it a repeatable, sustainable, and profitable process. He teaches that innovation isn’t just about generating occasional new ideas; it’s about staying consistently one step ahead of the competition.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

The Pillars of Leadership
65 Minutes
I.D.# PD271716

This exciting new series focuses on the extensive research, CEO interviews and corporate engagements of Jason Jennings and Laurence Houghton. Their team has observed and documented the lives of successful leaders. Now these ideas, and valuable practices, have been converted to high-impact elearning as a “Front Row Seat” for managers and leaders – especially new managers and leaders who have great knowledge and technical ability but have not had the opportunity to learn “first hand” from the best in the world.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

Instructor: Eric Timmis
Fee $1895 2.0 CEUs

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Patent Litigation in the U.S.: What You Need to Know

4 Hours
Web Seminar: I.D.# WB0940

In today’s economic environment, patents have become an increasingly important asset for both individuals and corporations. More and more, individuals and corporations, including those in the automotive and aerospace industries, are recognizing the economic importance of patent rights, whether those rights consist of a single patent, a family of patents or an entire portfolio. Indeed, some companies do not make or sell products; their entire revenue is derived from the licensing of their patents. Suffice it to say, licensing revenue has become a significant source of value in the global intellectual property economy.

This web seminar focuses on the intricacies of patents, patent infringement litigation, and patent licensing. Participants will explore the important subjects of obtaining U.S. and foreign patents, maintaining U.S. and foreign patent rights, enforcing patent rights, defending against patent rights asserted by competitors, and licensing patent rights for revenue. After this course, you will effectively understand patents and ways to protect and monetize your company’s valuable inventions. Your new knowledge will help your company maintain and enhance its position in the an increasingly competitive marketplace.

Learning Objectives

By connecting with this web seminar, participants will be able to:
- Explain U.S. patent rights, including how patents are obtained and maintained
- Provide an overview of U.S. patent litigation, including recent changes under the The Leahy-Smith America Invents Act (AIA)
- Anticipate the scope of discovery in and avoid the potential business disruption arising from a U.S. patent case
- Explain the basic legal principles for liability and damages in patent cases
- Describe how patent disputes are resolved
- Predict the fees and expenses associated with bringing and/or defending a patent case in the U.S.
- Peek into the future of potential patent law reform

Who Should Attend

This course is geared toward executives, in-house counsel, in-house patent agents, and senior managers across industries, including automotive and aerospace. Participants may be both U.S. and non-U.S. -- anyone who needs help in understanding what to expect and what the practical realities are should they become involved in U.S. patent litigation.

This course complements the Patent Litigation Risk Management Toolkit web seminar (#WB1525, page 79), which provides practical guidance to help keep businesses out of patent infringement litigation.

Topical Outline

Session 1
- Overview of Patent Litigation
  - Recent headlines
  - Scope of patent protection
  - Issues the patent-owner has to prove
  - Issues the accused infringer has to prove
- What is the Scope of Discovery?
  - Documents, including e-documents
  - Depositions
  - Third parties (e.g. customers, suppliers)
  - Confidentiality of discovery materials
- Who Decides Liability and Damages?
  - Jury
  - Judge
  - Mediator/Arbitrator

Session 2
- How Long Does it Take from Filing to Trial?
  - District Courts
  - ITC
- How Much Does it Cost?
  - Fees and expenses
  - Contingency fees
  - Recovery of fees and expenses
- Practical Issues in Patent Licensing
  - Exclusivity considerations
  - Other permissible limitations
  - Royalty calculations
- What Changes are on the Horizon?
  - Supreme Court
  - Patent law reform

Instructor: William Cory Spence
Fee $425 .4 CEUs
MANAGEMENT

**Patent Law for Engineers**

1 Day  
I.D.# 88007

This information-packed seminar focuses on the intricacies of patents, patent infringement litigation and patent licensing. Attendees will explore the important subjects of obtaining U.S. and foreign patents, maintaining U.S. and foreign patent rights, enforcing patent rights, defending against patent rights asserted by competitors, and licensing patent rights for revenue. After this seminar, participants will effectively understand patents and ways to protect your company’s valuable inventions. Knowledge gained will help the company maintain and enhance its position in the marketplace.

**Learning Objectives**

By attending this seminar, participants will be able to:

- Obtain an overview of U.S. patent litigation
- Understand the basic legal principles for liability and damages in patent cases
- Gain insights into how patent disputes are resolved
- Predict the fees and expenses associated with bringing and/or defending a patent case in the U.S.
- Anticipate the scope of discovery in, and/or business disruption arising from, a U.S. patent case
- Peek into the future of potential patent law reform

**Who Should Attend**

Participants should have a mid- to upper-level managerial role. Research and development, in-house legal staff members such as in-house lawyers, patent agents, or patent liaisons will especially benefit.

**Topical Outline**

- Overview of Patent Litigation  
  - Issues the Patent-Owner Has to Prove  
  - Issues the Accused Infringer Has to Prove
- Who Decides Liability and Damages  
  - Jury  
  - Judge  
  - Mediator/Arbitrator
- How Long Does it Take From Filing to Trial  
  - District Courts  
  - ITC
- How Much Does It Cost  
  - Fees and expenses  
  - Contingency Fees  
  - Recovery of fees and expenses
- What is the Scope of Discovery  
  - Documents, including e-documents

**Instructor:**  
William Cory Spence

**Fee**  
$810  
.7 CEUs

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**Principled Negotiation**

1 Day  
I.D.# C1602

This highly interactive workshop focuses training on negotiation strategy and skills. This is not the manipulative, win-lose negotiation approach frequently taught today, where the “winner” eventually spends time and effort protecting his negotiated advantage against erosion, while the “loser” continually exploits loopholes and shortcuts to recover lost ground. Traditional negotiation is a wary dance based on mistrust, the true cost of which is lost in quality and brain fatigue – usually for someone other than the negotiator – over the life of the agreement.

Successful negotiations occur when all parties want the agreement to stay in force and when everyone has a vested interest in making things work. There is no desire to find loopholes or shortcuts, there is little time given to supervising the agreement, and both product and relationship quality is enhanced. When the Principled Negotiation guidelines are followed, negotiated outcomes simply cost less.

**Learning Objectives**

By attending this seminar, participants will be able to:

- Assess your current approach to negotiation
- Utilize a principled approach when preparing for negotiations
- Practice principled negotiation techniques
- Develop a personal action plan for changem

**Who Should Attend**

This course is particularly useful for front-line employees in manufacturing, design, and customer liaison – those who manage daily human interactions with both suppliers and customers. It also easily applies to procurement, estimating, sales, testing, and business development.

**Topical Outline**

- Principled Negotiation Overview
- Setting the stage
• Exploring where we are today
• Principles, Guidelines, and Techniques
• Negotiation: Operational Definition
• Three General Negotiation Approaches – Soft, Hard, “Win-Win”
• Personal Goals and Expectations
• Paradigm Stretcher
• Key Elements of Principled Negotiation
  • Interests
  • Options
  • Standards
  • People
  • Alternatives
• Emotional Intelligence (E.I.) - the Pre-requisite 21st Century Leadership Skill Set for Principled Negotiation
• Explore Practical Ways to Enhance the E.I. Skills You Will Need
  • Self-Awareness
  • Self-Regulation
  • Self-Motivation
  • Empathy
  • Social skill
• Positional Bargaining vs. Principled Negotiation
  • Using role play scenarios to assess and select strategies for each key element that fits your particular situation
• Action Planning – Using a Proven 10 Step Approach
  • Putting it to work for you
  • What do you want to do better, stop doing or do differently?

Instructor: Eric Timmis
Fee $810 .7 CEUs

Principles of Cost and Finance for Engineers
3 Days
I.D.# C0828

In today’s corporate environment of shrinking budgets, required structural cost reductions, sharing of global designs/services, and pricing pressures, it is critical that engineers possess a working knowledge of engineering economics principles. To fully understand the economic viability of engineering decisions, engineers need to find the appropriate balance between design alternatives, resulting costs, and impact on their enterprise. This seminar introduces participants to the cost, finance and economic concepts and their applications to products and services. This three-day course provides you with practical information normally obtained through university level economics and business management courses and will help you to maximize efficiencies from both an engineering and business perspective.

Note: Attendees are requested to bring with them a business or scientific calculator capable of doing exponential calculations.

Learning Objectives
By attending this seminar, participants will be able to:
• Understand the hierarchy of economics, finance and cost in making financial decisions
• Review financial statements and ratios in assessing the financial state of a business
• Select the best decision-making criteria in making project decisions and allocating capital
• Implement a benchmarking plan to establish a competitive market position
• Determine the enterprise costs of raising capital through debt and equity offerings
• Analyze make-buy and buy-lease options and other alternative decisions based on the best financial strategies
• Understand the financial sensitivity of project decisions and the use of decision tools for integrating business requirements
• Determine and optimize all costs in the production process
• Select the optimum cost accounting strategy and inventory plan
• Identify the appropriate cost estimation methodology for metallic, electronic & plastic components
• Select cost control alternatives from marketing, engineering, commercial & geographic options

Who Should Attend
This seminar will benefit engineers having responsibilities in manufacturing, maintenance, research, design, product and process development, program and project management, troubleshooting, and materials management. Additionally, individuals in non-engineering disciplines, including marketing and general management, will benefit from an introduction to the engineering perspective.

Topical Outline
DAY ONE - Principles of Economics & Finance
• Process & Responsibility for Determining Cost
• Economics, Finance & Cost Principles
  • Macroeconomics and Growth
  • Microeconomics, Supply & Demand
  • International Economics & Comparative Advantage
• Finance & Accounting: Corporate
• Finance
  • Financial Statements & GAAP
  • Financial Analysis & Ratios, Case Analysis
  • Capital Sources & Allocation
• Time Value of Money and Decision Making
  • Interest: simple and compounded
  • Inflation
  • Worth: present and future values
MANAGEMENT

- Decision Making
  - Net Present Value, Payback Period
  - AAR, Internal Rate of Return, Profitability Index
  - Case Analysis
- Benchmarking Module

DAY TWO - Cost Impact & Enterprise Decisions
- Cost Impact on the Enterprise
  - Cost of capital, cost of equity and debt, WACC, Case Analysis
  - Cost of Ownership, Depreciation; Accelerated cost recovery; Depletion
  - The influence on tax obligations
- Alternative Financial Decisions Using Case Analysis
  - Make-Buy
  - Buy-Lease
  - Repair-Replace
  - Investments of Unequal Life
- Sensitivity & Scenario Analysis
- Matrix Priority Rating Systems

DAY THREE - Cost Management
- Production Cost Relationships
  - Break-even Point
  - Marginal Costing
- Elements of the Production Process
  - Pricing influences - Quality; Competition
  - Elasticity of Demand
- Cost Principles & Definition
  - Accounting, Opportunity, Estimating
  - Fixed, Variable, Cost Function, Transfer Pricing
  - Economies of Scale
- Managerial & Cost Accounting
  - Cost Volume Profit Analyses
  - Standard Costing
  - Throughput Costing & Case Analysis
  - Activity-based
- Inventory Management
  - Types
  - Accounting
- Cost Estimating Methodology
  - Activity-based costing
  - Cost analysis process examples (metallic, electronic, plastic)
- Cost Control Alternatives
  - Marketing & content evaluation
  - Engineering & redesign (DFSS, DFMA, VE, Benchmarking)
  - Commercial Decisions (Purchasing, Economies of Scale)
- Regions of manufacture & transportation

Instructor: James Masiak
Fee $1745 2.0 CEUs

Strategic Leadership
3 Days
I.D.# C0620

As a strategic leader, it is your responsibility to ensure that your organization is moving in the right direction. Executives and high-level managers must have the practical insight necessary to address competitive business challenges. Each segment of this three day course is designed to impart simple, but powerful lessons that will equip participants to more fully engage in strategic discussions, ask pertinent questions, facilitate critical decisions and shape high performing organizations. In addition, the course provides students with a personal leadership profile that illustrates their strengths and potential limitations. Participative exercises assist emerging executives with practical and effective methods of gaining organizational credibility and avoiding common errors in strategic leadership.

Learning Objectives
By attending this seminar, participants will be able to:
- Describe the role and responsibilities of strategic leadership
- Manage the critical factors that drive the success and failure of business strategies
- Anticipate the longer term impact of strategic initiatives
- Attain credibility and support as you assume the helm of a new operation
- Avoid common errors made by leaders in transitioning to higher levels of responsibility
- Select the most effective approaches when framing strategic decisions
- Think strategically and systemically as you plan organizational change
- Influence the emergence of a more positive and functional corporate culture
- Eliminate turf battles, dropped balls and organizational duplication of effort
- Analyze and correct dysfunctional organizational dynamics
- Manage the strengths and limitations of your personal leadership style

Who Should Attend
This seminar is designed for executives, senior level managers, and engineering managers or technical specialists who are called upon to formulate or provide input into strategic decisions and business strategies.

Topical Outline
- Introduction to Strategic Leadership
  - What exactly do we mean by leadership?
  - Who is and is not a leader?
  - At what point do we become leaders?
• Critical elements of leadership support
• Managing versus leading - is there really a difference?
• Critical factors in assessing leadership performance
• The relationship between leadership, strategy, human behavior, decision-making and organizational systems

• Understanding the Human Dimension
• Similarities between animal behavior and human behavior
• Influence of brain structure on human behavior
• Creating long term employee motivation
• Rules of thumb for predicting human behavior in organizations
• Recognizing the symptoms of pathological leadership
• Managing and defusing dysfunctional behavior

• Assuming the Helm
• Managing the transition to a new workgroup
• Common and avoidable errors of leadership
• Developing and maintaining the support of your workgroup
• Simple, but effective steps to improve workgroup performance

• Shaping Corporate Culture
• Understanding the critical components of corporate culture
• Forming productive organizational norms
• How leaders contribute to dysfunctional cultures
• Establishing a high performance work environment

• Creating Organizations that Work
• Creating an organizational charter
• Selecting an effective management team
• Thinking systematically
• Importance of managing image and expectations
• Creating meaningful performance indicators
• Eliminating turf battles and duplication
• Limitations on the application of common systems

• Facilitating Strategic Decisions
• Critical distinctions between problems, decisions and polarities
• How to properly frame a decision
• Selecting the decision makers
• Common errors in decision making process
• Essential elements of effective decision making process
• Knowing when the decision has been made

• The Leader’s Role in Creating Effective Strategies
• What exactly is a strategy?
• Why business strategies fail
• Internal and external considerations
• What constitutes effective strategy?
• Anticipating the impact of adaptive responses
• Framing strategic initiatives
• Barriers to strategy implementation

• Leading Strategic Change
• Planning a change initiative
• Critical variables in organizational change
• The leader’s role in fostering change
• Anticipating and dealing with resistance
• Culture as a barrier to change

• Political Reality versus Dysfunctional Idealism
• Gaining credibility in executive circles
• Sources of leadership power
• How power is gained and lost
• The importance of building networks and relationships
• How to avoid getting derailed

• Lessons of History for Strategic Leaders
• Developing a Leadership Profile
• Charting your personal leadership profile
• Identifying your leadership assets and liabilities
• Creating a plan of action

Instructor: Joseph Doyle
Fee $1745 2.0 CEUs

Success Strategies for Women in Industry and Business
1 Day I.D.# C1202

It is a well-known fact that the number of women in science, engineering and business fields is growing, yet men continue to outnumber women, especially at the upper levels of these professions. Many women appear to encounter a series of challenges at early or midcareer stages that contribute to them leaving their careers prematurely due to feelings of isolation, an unsupportive work environment, extreme work schedules, and unclear rules about advancement and success.

This program serves as a unique opportunity to obtain both formal and informal mentoring tips from a successful woman engineer who spent over 25 years in the petrochemical/specialty chemical industry. She has seen and has experienced significant changes in the number of professional women active in the technical/scientific field and is convinced that more positive change can happen in the future. This seminar will provide detailed guidance, based on real life examples, on how female professionals can become proactive in creating career opportunities via self-assessment, self-motivation, an objective view of one’s own abilities, and continuous steps in self-improvement. The program will take participants beyond theory to case studies and real life examples exemplifying potential for immediate use.

Learning Objectives
By attending this seminar, participants will be able to:
• Identify obstacles and common challenges that hold you back in your career
• Develop and utilize critical communication skills
MANAGEMENT

- Develop focused and well defined criteria for processional progress
- Define your professional relationships with clear boundaries and respect
- Create a flexible career plan
- Handle criticism and difficult situations with composure

Who Should Attend

This seminar will benefit professional women who want to positively impact their careers. Recent engineering graduates, as well as experienced female engineers and/or scientists will learn skills to help them navigate these male-dominated fields. Additionally, individuals working in non-engineering disciplines, including general management, human resources, academia, business, and law as well as current engineering students, will benefit from this unique perspective.

Topical Outline

- Course Motivation: Why are you here?
- Historical Perspective - Women in Engineering and Scientific Professions
  - Dr. Ewa Bardasz - personal story
  - Survey data - status of women professionals: tenure, promotions, salary trends, recognitions, etc
- Case Study #1: What holds you back in your career?
- Common Challenges
- Case Study #2: Career Goals: Success Defining Questions
- Work Climate Changes
- Definition of Professional Success
  - Technical know-how
  - Leadership skills
- Refining Critical Verbal Communication Skills
  - Presentations/ public speaking
  - Negotiations/ conflict communications
  - Getting your points across
  - How to speak up without coming across as too aggressive
  - How to find balance between “being too nice” and “coming on too strong”
  - How you can say “no” without feeling guilty
- Case Study #3: How can you successfully negotiate with a group of aggressive men?
- Refining Critical Written Communication Skills
  - Reports, technical papers
  - Email, social media
- Networking
- Behaviors and Relationships
  - Handling emotions at work
  - Mentors/Advisors - pros and cons
- Work-Life Balance
- Key Resources
  - Professional organizations
  - Community activities
- Reflections and Final Thoughts
- Take Away Message
- Case Study #4: What will I do next?

Instructor: Ewa Bardasz
Fee $610 .7 CEUs

MANAGING PRODUCT DEVELOPMENT

Aerospace Product Support: Sustainment Throughout the Life Cycle

2 Days
I.D.# C0945

In today’s aerospace industry, product life-cycles are often being extended far beyond a product’s original design expectations. With fewer and fewer new aerospace products being introduced into the marketplace, there is a dramatic need for increased emphasis on supporting these products in the most efficient and effective manner possible throughout the entire product life-cycle. In addition to the initial product acquisition cost, customers are becoming more aware and sensitive to the product’s total life-cycle cost. The long-term costs to operate, maintain, and otherwise sustain these products are often a determining factor in the initial product acquisition.

This two day seminar is intended to introduce participants to the various approaches, technologies, and tools available to support a product throughout the product’s total life-cycle in the most efficient manner possible. Major topics presented and discussed during this seminar include The Elements of Logistics, Performance Based Logistics, Product Support Integration, and regulatory requirements. Collectively, the information presented in this seminar will equip attendees with the skills and techniques needed to help them comfortably and confidently develop the best tailored support package, satisfying the needs of both the customer and the provider.
Learning Objectives
By attending this training program, participants will be able to:
- Identify and apply basic concepts of Product Support, including Contractor Logistics Support, Total System Performance Requirements, Performance-Based Logistics, and Primary Support Integration
- Evaluate elements of cost associated with life-cycle support/sustainment opportunities
- Compare and contrast the different approaches that may be taken to provide total life-cycle support in aerospace programs
- Assess relative risks to both the provider and the customer in the various approaches
- Determine how to best integrate sustainment activities within the OEM as well as after-market provider business plans

Who Should Attend
Technical professionals, as well as current and prospective Program/Project managers, Product Support Managers, and Sustainment Specialists will benefit by attending this seminar. This seminar will also be of value to individuals in other disciplines, including marketing and general management, that require an understanding of the concepts and strategies of effective life-cycle sustainment programs.

Topical Outline
DAY ONE
- Introduction to Aerospace Product Support
  - Developing the class definition of product support -- Attributes; Shared experiences
  - Setting expectations
- Elements of Product Support Offerings
  - Characteristics of Product Support
  - Compare and Contrast -- Logistics Support; Product Support; Customer Support
  - “Bits and pieces” of product support
  - What constitutes success?
- Support Integration
  - How Support Integration works
  - Primary Support Integrator -- How PSI works
  - Third-Party Logistics Provider -- Definition; How 3PL works
DAY TWO
- Contractor Logistics Support
  - How CLS works
  - Customer and contractor roles
  - Constructing a CLS proposal -- Estimating costs
- Performance-Based Logistics
  - How PBL works
  - Customer and contractor roles
  - Constructing a PBL proposal -- Estimating costs
- Development and use of metrics
- Notification of problems and re-plans to stakeholders
- Seminar Review and Open Dialog

Creating and Managing a Product Compliance Program
2 Days
I.D.# C1213
Around the world, and more often than not, government bodies require formal certification of products. As product developers expand into new markets, they will be confronted with new standards, regulations, and customer expectations that may require new compliance processes. A properly run compliance program improves your product’s quality and safety, broadens your product’s market, ensures compliance with regulations and laws, and helps provide protection from future product liability issues.

This two-day seminar presents a process development methodology that can be used repeatedly as new compliance requirements emerge. Participants will learn best practices in creating a compliance program for your products and markets, and how to use this program at all stages of product development and production. Sample spreadsheets will be used to demonstrate tailoring the program to your product, your markets, and your organization. A properly managed compliance program simplifies the certification or approval of your product, and ensures that you regularly apply and document good engineering practices for product safety and reliability.

Learning Objectives
By attending this training program, participants will be able to:
- Summarize how a formal compliance program adds value to your goods and services
- Develop a compliance checklist
- Identify effective strategies for researching compliance requirements
- Describe how to manage the ongoing compliance process
- Explain the importance of documenting compliance and retaining records

Who Should Attend
This seminar is designed for managers with implementation authority for product safety and compliance; product development engineers, designers and managers; new business development managers; risk managers and compliance or certification...
MANAGEMENT

managers. Companies considering expanding or modifying their product line, or attempting to enter new export markets, will especially benefit. Suppliers who are involved in product development and compliance, regulatory agency representatives, industry safety organization representatives, and corporate compliance lawyers will also benefit.

Topical Outline

DAY ONE
• Introduction to Compliance
  • What do we mean by compliance
  • The 3 basic forms of compliance
  • Why we need to show compliance: Legal requirements in different countries; Commercial advantages; Product liability risks
  • What is a formal compliance program
• Creating a compliance checklist - getting started
  • An introduction to the compliance process
  • Defining your markets in terms of compliance requirements
  • Finding applicable regulations, standards, and guidelines
  • Documenting best practices in the compliance checklist

DAY TWO
• Completing the compliance checklist
  • Extracting relevant requirements from the regulations, standards and guidelines
  • Selecting methods of compliance
  • Sorting and presenting the blank checklist
• Applying the checklist to a development project
  • Introducing the checklist within your organization: Integrating the checklist process into existing policies and procedures; Identifying key players, and getting them on your side
  • When and how to start the product specific checklist
  • Sidebar: discoverable documents and document retention
• Managing the compliance program over a product’s life
  • Storing and sharing the final checklist
  • Using the checklist as the product grows and develops
  • How the checklist gives your product a unique identity: Learning from the checklist for your next project; the checklist as “corporate memory”; identifying and retaining best practices beyond minimum compliance requirements
  • The standards development process

Aerospace Program Management - It’s More than Scheduling and Delivery

3 Days
I.D.# C0818

Effective and efficient management of today’s complex and integrated programs requires both the refinement of interpersonal and basic leadership skills as well as the application of appropriate technologies and tools. This seminar is intended to introduce basic program management skills and techniques to first-line and mid-level leaders to help them comfortably and confidently assume their role and to aid in assuring program success.

Areas of special concentration will include: role of project management, communication, interpersonal skills, schedule management, interfacing with other units, Task Scoping (Estimating, Pricing, Financial Measures, etc.), project management software use, compliance reporting, risk management and more. This seminar will include lecture, dialog, and case-study approaches. Active participation of the class attendees will ensure a dynamic baseline for learning and honing valuable skills.

Learning Objectives

By attending this seminar, participants will be able to:
• Communicate more effectively in all media - verbal, written, and electronic modes
• Refine interpersonal skills as they relate to dealing with diverse personal perspectives, attitudes, and motivational techniques
• Develop and utilize task schedules
• Demonstrate effective management of all resources (people, tools, and budgets)
• Apply techniques for scoping programs/projects (resource needs, schedules, level of tasking, etc.) and effectively monitor and measure progress
• Identify critical milestone events and how to develop alternate schedule recovery plans
• Utilize basic project management tools and techniques more effectively

Who Should Attend

This course is designed for current and prospective Program/Project Managers with a level of experience ranging from in-training to mid-level program management leadership.

Topical Outline

DAY ONE
• Introduction to Program/Project Management
  • Clarifying and Giving Identity to Tasks
  • Who are the stakeholders? What do they want?
  • What are the resource allocations? (budgets, tools, facilities, personnel)
• What constitutes program/project success?
• Communication Skills Essentials
  • Elements of effective presentations (verbal, e-mail, internet)
  • Appreciation of differing perspectives and how to integrate them
• Interpersonal skills
• Interfacing with Other Units
  • Use of integrator personnel
  • Importance of shared goals as well as shared responsibilities

DAY TWO
• Establishing and Developing of Performance Schedules
  • Ensuring dependencies are identified and commitments are defined
  • Determining critical milestones and potential impacts
  • Introduction to use of commercial software tools
• Creating Meaningful Performance Metrics and Monitoring Techniques
  • The “critical life signs” of a program/project (cost, schedule, quality)
  • Role of program/project integrator and methods of in-process performance monitoring
  • Keeping all stakeholders informed and satisfied
• Compliance Reporting, Test Plans, and Contingencies
  • Regulatory documents and reports
  • Test plans and configuration control
  • FAA certification
  • Use of “critical life signs”, milestones, and monitoring
  • Notification of problems and re-plans to stakeholders
  • Refining the art of asking for and receiving help

DAY THREE
• Managing the Individual Components of the Program/Project
  • Financial aspects (pricing, ROI, ROIC, etc.)
  • Marketing coordination, warranties, and after-market support
  • Using metrics to correct “critical life sign” deficiencies
  • Risk - assessment, abatement, and management
• Motivation and Rewards
  • Effective use of non-financial rewards for team members
  • Ensuring full participation and best contribution from each team member
  • Valuing others and letting them know it

Workshop
• Using program/project management techniques and tools, perform trial tasks as assigned
• Discuss and critique workshop tasks
• Conclusion
  • Importance of “unlearned” leadership attributes (integrity, honesty, people sensitivity)
  • Business and personal ethics

Instructor: Rutledge, Drexel L.
Fee $1745  2.0 CEUs

Managing Programs and Associated Risks

2 Days
I.D.# C0409

This course presents a proven eight-step method for program planning and control, including: definition of customers’ requirements, roles of the program team, determination and flowcharting of program tasks, scheduling and costing, quality aspects of critical tasks, and risk management. Easy to grasp, each of the eight steps evolve from common-sense questions that should be answered for any program, regardless of size or complexity.

With shortened development cycles and greater reliance on information in programs, this course emphasizes the value of communication within a program team, between the team and functional areas, and between the team and the program customer. Since the appropriateness of communication vehicles vary depending on purpose and audience, alternative modes of communication and change control are discussed.

Learning Objectives
By attending this seminar, participants will be able to:
• Explain the eight-step method for program planning and control
• Implement the eight-step method to improve program outcomes as measured by cost, schedule and quality
• Make plans and progress visible to team members and to the program customer

Who Should Attend
Engineers and business people involved in various product development team activities will find the subject matter practical and useful. The content is of particular value to professionals from engineering, manufacturing, purchasing, quality, marketing, and finance functions in ground vehicle OEMs and suppliers.

Topical Outline
• Program and risk management overview
  • Process approach to planning programs
  • Competition drives us to perform better
  • Why programs sometimes fail
  • Reference materials and website
• Defining program outcomes and measurables
  • Building quality and performance targets into program planning
  • Financial impact of poor planning
  • Roles and responsibilities of project team members
  • Design reviews
  • Product performance measurement
  • Program/project metrics
• Team formation and task planning
  • Team development
ENGINEERING PROJECT MANAGEMENT

2 Days
I.D.# 99003

Project Management and Advanced Product Quality Planning (APQP) are two critical techniques used in product development in the mobility industry today. This seminar will bring these techniques together in an easy to understand format that goes beyond the typical concept of constructing timelines and project planning, by exploring not only the AIAG APQP process, but also specific aspects of PM processes. Participants will gain a solid foundation in the essential principles of Project Management and APQP.

Participants will immediately apply learned skills by taking a sample project through all phases of the Project Plan using actual industry documents. Realistic issues, problems and time constraints are introduced throughout the exercise to stimulate actual project concerns. Each workshop exercise uses documents specific to the particular areas of study such as Statement of Requirements and Statement of Work, Timeline development and reacting to changing situations such as time crash. Discussion of the major milestones of typical OEM APQP processes, to include PPAP. The workshop is structured so that students must operate in teams and the time constraints allow students to see firsthand the effects of improper delegation of work assignments.


Learning Objectives
By attending this seminar, participants will be able to:

• Define the importance of each of the ten (10) Bodies of Project Management Knowledge and the essential components of APQP by Phase
• Recognize the minimum essential elements of a Robust Project Plan
• Properly evaluate and differentiate between Statement of Requirement, Statement of Work and Work Breakdown structures
• Understand the application of different timeline methodologies: Milestone, Gantt, Network (PERT) and Critical Path
• Utilize different types of meeting and conflict resolution strategies, formulate an effective meeting summary and action list, and conduct an actual Design Review
• Recognize the pitfalls common to most mobility projects due to Voice of the Customer (VOC) collection, current U.S. and international legislation and directives, improper application of limited resources, and others.
• Beyond the Checklist! - Advanced techniques for Risk Management

Who Should Attend
Account Managers and those requiring refresher training or desiring to learn how to properly apply more advanced project management techniques. Other individuals who are involved with projects such as functional managers and support staff will benefit by attending.

Topical Outline

• The Project Management Process
  • Project constraints
  • The ten (10) bodies of Project Management Knowledge
  • Project Management and ISO
• Project Plan Life Cycle
  • Three types of life cycles: Product, Project, Project Management
  • Differentiating between project management and the
APQP process
• Major elements of each APQP phase
• Project Management Techniques
  • Principles of Integration Management
  • Managing project Stakeholders and Sponsors
  • Defining, constructing, and recognizing the differences between Letter of Intent, Statement of Requirements, Statement of Work and Work Breakdown structures
  • Developing scope of work for conceptual-based (R&D) customers
  • Defining and Developing a task-based Work Breakdown Structures (WBS)
  • Various types of WBS structures and Levels
  • Structure of effective Phase and Design Reviews
  • Beyond lessons learned - Project Best Practices and the TGR/TGW database
  • Documentation requirements necessary to support the PM/APQP/PPAP processes
• Resource Planning
  • Choosing an organizational structure to support effective Project Management
  • Roles and responsibility matrix (RASIC)
  • Tangible versus Intangible resources
  • Developing and managing an effective Staffing and Resource Plan Surviving as the “multi-hatted” project leader
  • Special considerations for small projects
• Sequence Planning
  • Milestone Charts
  • Gantt Charts
  • Network Diagrams and Critical Path Method (CPM)
  • Understanding and applying float/slack time
  • Techniques to address Fast Tracking and Crashing
• Project Costing and Tracking
  • Project cost analysis methods and estimating methods
  • Recognizing and dealing with Scope Creep
  • Control techniques - Requirements for an effective Change Management System; Negotiating the difference between Phase and Design Reviews; Earned Value Analysis (EVA); Effective meeting techniques; Forming and leading project teams; Structure of effective Phase and Design Reviews; Recognizing and resolving internal and external conflict
• Project Risk Management
  • Components and construction of an effective Risk Management Plan
  • Addressing product liability using the FMEA and HAZOP
  • Risk qualification quantification techniques - Developing effective checklists; Risk Register/Quadrant Mapping, Expected Values Matrix; Probability and Impact Matrix;
• Procurement Management
  • Understanding partner supplier relationships
  • Suppliers rating techniques
  • Suppliers skill requirements

Instructor: Angelo E. Mago or Curt Pawloski
Fee $1595 1.3 CEUs

Patent Litigation Risk Management Toolkit

4 Hours
I.D.# WB1525

In recent years, total annual United States patent grants have increased to over 300,000, while patent infringement lawsuit filings have exceeded 6,000 per year. Only a small fraction of granted patents ever end up in litigation. Of the many causes for the disparity is the growing awareness and sensitivity of companies to patent infringement risk management practices. This course addresses a number of those practices (and tools for implementing the practices), placing them into context, and providing a practical overview for how to implement them to help reduce the prospect of patent infringement litigation.

Participants will receive a basic working knowledge of various common, but most misunderstood, practices for reducing the risk of patent infringement litigation. The course will teach the role and significance of patent claims, address pragmatic record keeping practices, reveal ways to monitor competitive patent filings, explain common practical pitfalls in analyzing a patent landscape, and illustrate alternative ways that risk can be managed (e.g., by use of contracts).

Learning Objectives
By participating in this web seminar, participants will be able to:
• Identify causes why many companies end up in litigation
• Discover ways to help avoid poor patent litigation outcomes
• Expand existing practices to help avoid the risk of litigation in the first place

Who Should Attend
Small to mid-size company CFO’s, as well as technology officers, engineering managers, patent liaisons, and in-house counsel for companies of all sizes will benefit from this course. These people will typically have at least five years of industry experience, and some may have two or three decades of experience.

This course complements the Patent Litigation in the U.S.: What You Need to Know web seminar (#WB0940, page 69), which focuses on what engineers and business managers need to know to effectively manage patent procurement, patent infringement litigation, and patent licensing.
### Management

#### Topical Outline

**Session 1**

- **Infringement: The Theme that Brings Us Together?**
  - Patent statistics
  - Glossary of terms
  - Infringement and its consequences
- **Hypothetical Case: Fact Review**
  - The market generally
  - The patent landscape for the market
  - The product sought for market entry
  - Perspective
- **The Tools in the Kit: For the Market Entrant and Existing Participants**
  - Internal policies and practices
  - Prior art
  - Contracts
  - Patent applications/patents
  - Design arounds
- **Internal Policies and Practices**
  - Intellectual property policy of company
  - Confidentiality obligations
  - IP Ownership obligations
  - Invention disclosures
  - Patent searches and competitive patent watches
  - Product clearance
  - Archiving internal activities
  - Sending and receiving accusations of infringement
- **The Role of Prior Art in Defining Boundaries in the World of Patents**
  - Patents and non-patent literature
  - First inventor to file
  - Public accessibility requirement
  - Public use
  - Possible relevance of prior invention activities

**Session 2**

- **Contracts**
  - Employment agreements
  - Nondisclosure agreements
  - Joint development agreements
  - License agreements
- **Patent Applications/Patents**
  - Overview of patents
  - Utilitarian features
  - Ornamental features
  - International filings
  - Continuation/Divisional/Broadening Reissue Applications
- **Design Arounds**
  - Lawful
  - Precautions
- **Toolkit Laboratories**
  - The marketplace

#### Product Liability and The Engineer

**1.5 Days**

**I.D.# 82001**

In the past few decades, product liability law has dramatically changed the manufacturer’s outlook in the design and manufacture of product. The concept of safety and reliability has been altered from a purely engineering/manufacturing concept to a legal/manufacturing approach. This new approach requires an understanding of legal concepts as related to the manufacturing and design process. The engineer’s role has shifted to include a safety audit analysis to minimize the existence of a product defect and/or to defend the product in a way that is responsive to the legal concerns. An overnight assignment will be made by the instructor. It will consist of problems drawn from actual cases and a group project that examines the design, instructions, and warnings of a product.

**Learning Objectives**

By attending this seminar, participants will be able to:

- Relate legal concepts as they apply to the manufacturing/design process
- Use safety audit analysis techniques to minimize or eliminate product defects during design, thus reducing product liability
- Discuss defense of product from a legal perspective
- Recognize the importance of potential liability as it relates to the manufacturer

**Who Should Attend**

Persons responsible for product design, including managers and designers; corporate risk managers; persons responsible for developing and approving product instructions and warnings; marketing personnel; production and quality assurance managers and personnel; personnel responsible for product safety and those persons, including lawyers, who oversee and manage product liability issues.

#### Topical Outline

- **Legal Concepts**
  - Negligence: elements, defenses
  - Strict liability: section 402A (elements, defenses)
  - Warranties: express, implied
- **Analysis of Defect**
The Role of the Expert Witness in Product Liability Litigation

1.5 Days  
I.D.# 92054

According to the Federal Rules of Evidence, an expert witness is anyone who can assist the trier of fact (the jury) in understanding any issue in dispute at trial. The witness’ ability to give this assistance can be derived from any specialized training, education, background, or experience. To be effective in providing this assistance, however, requires that the expert witness understand the true role that he or she is to play both before and at the trial.

This seminar will address the critical issues that every person who may be, has been, or is, an expert witness must understand to assist both the attorney and the product manufacturer, regardless of which side the expert serves.

Learning Objectives
By attending this seminar, participants will be able to:
• Employ the risk/utility balancing process necessary for effectively addressing the issue of design defect
• Recognize the critical elements that govern the interaction between human behavior and product behavior
• Apply the technical/legal elements that will enhance your effectiveness as an expert witness

Who Should Attend
This seminar is intended for anyone who is or may become an expert witness in product liability litigation. In-house experts typically have engineering, engineering management or field technician responsibilities. In addition, insurers, risk managers, corporate product safety personnel, attorneys and those who manage product liability litigation will benefit from insight into selecting and using expert services and witnesses more effectively and efficiently.

Topical Outline
(Day two ends at 1:00 p.m.)
• The Legal Framework of Negligence and Strict Liability
• The Relationship Between the Attorney and the Potential Expert Witness
• Investigation of an Accident Years After an Occurrence
• Developing the Background Necessary to Understand the Product and its Environment
• Understanding How to Alleging or Refute the Existence of a Product Defect
• Analyzing the Role of Human Behavior and its Relationship to the Cause of an Accident
• Guidelines for Effective Presentation Before Trial and on the Witness Stand
• The seminar will also include overnight problem assignments and a demonstration of direct and cross-examination of an expert witness.

Instructor: Charles F. Seyboldt
Fee $1370 1.0 CEUs
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Automated Systems for Aerospace and Space Applications

2 Days
I.D.# C1313

The rapidly evolving demand for cost reductions and shrinking budgets makes the application and use of automated processes within the aerospace and space industries a necessity. While some view aerospace automation as the solution to reducing costs, others view automation technologies and processes as something that should be avoided when possible. Misunderstandings and assumptions about these complex systems can result in the improper selection and application of these systems, often leading to undesirable interactions with other elements of the assembly process and potentially, project failure.

This two-day seminar introduces participants to the critical components of automation necessary to be informed and knowledgeable about the acquisition, installation, and maintenance of automated systems for aerospace and space applications. The instructor will guide participants through the types, components, operation, application, cost benefits, laws, strengths, and limitations of automation. The information presented in this seminar will cover the breadth and scope necessary for participants to be an effective participant in the decision process when automation has become a consideration to replacing tasks previously done by hand.

Attendees will receive a copy of the textbook, Automated/Mechanized Drilling and Countersinking of Airframes, by instructor George (Nick) Bullen.

Learning Objectives
By attending this seminar, participants will be able to:
• Understand the function of automation in an aerospace factory
• Decide if automation is right for your factory or application
• Select the right automation for your application
• Install, transition to production, and maintain the selected automation
• Perform a feasibility analysis and an Return on Investment (ROI) for factory automation

Who Should Attend
This course is designed for all personnel interested in acquiring an understanding of the power and pitfalls of automation before purchase and how to select and install the right automation.

Topical Outline
DAY ONE
• Historical Perspective: Why Airframes Have Holes
  • The Airframe
  • Aluminum
  • Rivets
  • Assembly Tooling
  • Titanium
  • Hand Tools and Drills
  • Composites
  • Tooling and Composites
  • On-Assembly Drilling
• Airframe Manufacturing Cost Drivers
  • Why Reduce Cost
  • Defining Cost
  • Identifying Manufacturing Related Costs
• Incentives and Disincentives to Automate
  • Military Automation Disincentive
  • Military Producers Incentives to Automate
MANUFACTURING

- Commercial Disincentives
- Commercial Incentives
- Types of Automation
  - Motion
  - Action
  - Controller
  - Calibration
  - Sustainability
- Considerations before Replacing Hand operations with Mechanization or Automation
  - Before the Decision to Automate
  - “Go- Ahead” Decision Criteria
- How to Choose the Right Automation
  - Three Don'ts
  - References
  - Requirements Document

Day Two
- Installation Steps
  - Mapping the Existing Process
  - Mapping the New Process
  - Requirements Document
  - Platform Specification
  - Request for Proposal
  - Manufacturing Readiness level (MRL) Consideration
  - Performance Measurement Tools
  - Factory Acceptance
  - Installation and Test
- Test Procedures
  - Unique Tests
  - Volatile Organic Compounds (VOC)
- Transition To Production
  - TTP Document and Transfer of Responsibility, Accountability, and Authority.
  - TTP Technology Readiness Levels
  - TTP Manufacturing Readiness Level
  - TTP and Product Delivery Team Composition and Selection
  - TTP Document
  - TTP Risk Identification and Assessment
  - Validation of System to Production Requirements: Exit Criteria
- Training - Who to Train
- Maintenance
  - Complexity-New Normal
  - Impact Prevention
  - Predictive Maintenance (PdM)
  - Prognostic Health Monitoring (PHM)
  - Maintenance
  - Buying Maintenance
  - Troubleshooting
- Social Impact
  - Pacifying the Human Capability-Machine Experience

- Perception of ubiquitous automation
- Safe, secure, and ethical automation
- Management for Automated Systems
- Organizations
- Customers
- Future State of Airframes and Automation Summary
  - Economics
  - Manufacturing Exodus
  - Exit the autoclave
  - Automation or Labor
  - Fastener alternatives

Instructor: George (Nick) Bullen
Fee $1233 1.3 CEUs

Introduction to Composites Fabrication and Assembly in Aerospace, Space, and Transportation

1 Day
I.D.# C1311

The challenges associated with using composites as a replacement for aluminum reside primarily in the complex manufacturing processes and technologies for fabricating composite parts. The high cost of composites material and its manufacturing complexity have been inhibitors to the wide transfer of this technology to the non-aerospace market. The search for solutions to high manufacturing costs and efficient manufacturing processes have resulted in intense research by government, aerospace industry companies, and space agencies worldwide.

This one day seminar will introduce participants to composites technologies that have applications beyond aerospace, including such markets as trucks, automobiles, and wind turbines. The instructor will define, illustrate, and describe the innovative manufacturing processes and technologies that have been used to solve the “composite challenge” for aerospace and space vehicles. The information presented in this seminar, derived from the successful application and demonstration of these technologies and processes on flight hardware, will serve to provide solutions for the manufacturing processes and technology challenges that have slowed the migration of this technology beyond the aerospace and space industries.

Attendees will receive a copy of the textbook, Automated/Mechanized Drilling and Countersinking of Airframes, by instructor George (Nick) Bullen.
MANUFACTURING

Learning Objectives
By attending this seminar, participants will be able to:
• Define the current state of composites manufacturing
• Evaluate critical emerging technologies that will enable expansion of composites
• Identify innovative manufacturing processes that enable low cost composite manufacturing
• Determine the critical features for successful composite part assembly
• Evaluate the key characteristics of various composites manufacturing processes

Who Should Attend
This seminar is intended for individuals looking for information related to efficient solutions for composites manufacturing and includes engineering disciplines from manufacturing, design, industrial, tooling, quality, and mechanical. In addition, non-engineering management and staff will benefit from information presented in this seminar.

Topical Outline
• Composites in Aerospace and Space Launch Vehicles
  • Introduction
  • Advantages
  • Disadvantages
  • Design Considerations
  • Manufacturing Considerations
• Composites in Inhabited and Uninhabited Aerial and Space Vehicles
  • Introduction
  • Advantages
  • Disadvantages
  • Design Considerations
  • Manufacturing Considerations
• Max Launch Abort System (MLAS): An Example of Innovation
  • Concept of Operations
  • Major Structural Components
  • Innovative Manufacturing of Structural Components
• Quality Assessment (Parts)
  • Introduction
  • Forensic Engineering
  • MLAS Forensic Engineering
  • Collecting Data
  • Defect Determination (Cause)
  • Defect Resolution (Corrective Action)
• Vehicle Assembly
  • Innovative Assembly Process
  • Mass Properties Alignment
  • Assembly Fit and Function
• Vehicle Flight or Launch
  • Transport
  • Launch Stand
  • Performance
• Recovery
  • Retrieval
  • Forensics
  • Composites Performance Assessment
• Future Applications
  • Unified Structure
  • In-situ Manufacturing
  • In-flight and In-Space Composite Concerns and Considerations
  • ALTAIR
• Extensibility
  • Road Vehicles
  • Wind Turbines
  • Lifting and Support Devices

Instructor: George (Nick) Bullen
Fee $855 .7 CEUs

Design for Additive Manufacturing: Towards End-Part Production Web Seminar
10 Hours
I.D.# WB1705
Additive manufacturing (AM), with origins in the 1980s, has only more recently emerged as a manufacturing process of choice for functional part production, adding to the suite of choices a designer has available when designing a part for manufacturing. Like other traditional processes like casting and machining, AM has its set of constraints. An added layer of complexity comes from the fact that there are several different AM processes, and some of the design constraints are process-specific. On the other hand, AM offers a range of opportunities in design freedom and mass customization as well as in cost and lead time reduction in some cases. Today, it is essential for designers to embrace AM as a possible manufacturing method to ensure their products are competitive and also to unlock the design innovation that AM enables.

The goal of this 10-hour course is to give designers the information needed to start designing for AM at all levels – identifying and justifying use of AM technology for a particular part, selecting the right process and material for the application and ensuring it is designed with the advantages and considerations of AM in mind. The course is not intended to serve as a software-training class or as a deep dive into any specific AM process, but rather to draw connections between design and AM from a designer’s perspective.
MANUFACTURING

Learning Objectives
By connecting to this web seminar, participants will be able to:
• List the different polymer and metal AM process technologies and materials and identify which of these are being used for functional part production
• Select the optimum AM material and process for a particular application
• Predict how design decisions impact manufacturability for the selected AM process and apply design rules and guidelines to your design process
• Quantify the expected properties of the AM parts you are designing
• Discover how topology optimization, cellular structures and other disruptive design techniques can be leveraged with AM and associated software tools
• Identify the different drivers for adopting AM for a particular part, with regard to cost, lead time, supply chain and performance risks
• Relate to the challenges and ongoing research efforts to be able to move forward with AM implementation in the presence of rapid change in the field
• Develop a comprehensive strategy to bring AM for functional part production into your organization that addresses both the benefits and impacts

Who Should Attend
This training is relevant to and needed by designers that work in aerospace and automotive companies and are chartered with either designing next generation solutions, or even with designing for cost, replacement parts or tooling used in the manufacturing process. Designers that can use existing design tools but need to learn enough about AM so they can use these tools to design parts suitable for these manufacturing processes will especially benefit from this course.

Topical Outline
Session 1: Additive Manufacturing Process
• Polymer AM
  • Fused Deposition Modeling (FDM)
  • Selective Laser Sintering (SLS)
  • Other processes and trends
  • Functional parts case studies
• Metal AM
  • Powder Bed Fusion (PBF): laser and electron beam
  • Directed Energy Deposition (DED)
  • Other processes and trends
  • Functional parts case studies
• Material Options and Selection
• Key Process Concepts
  • Build sizes
  • Part orientation
  • Support management
  • Post processing
Session 2: Introduction to Design for AM
• The Need for New Design Thinking with AM
• Four Levels of AM Design
  • Prototypes and tooling
  • Direct part replacement
  • Part consolidation
  • Design for AM optimized
• Introduction to Software Tools for AM
  • Solid modeling (CAD)
  • Topology optimization
  • Lattice materials design
  • Build preparation
  • Process simulation
• Support Fundamentals
  • Purpose of supports
  • Process dependence
  • Self-supporting design concepts
  • The importance of orientation
• Build Preparation SW Demos
  • Demo with Insight (FDM)
  • Demo with Magics (Metal)
Session 3: Topology Optimization
• Motivation: The Case for Sustainable Design
• Case Studies with AM
• Introduction to Optimization Concepts
• Material Models
• Demo with ANSYS
  • Problem setup
  • Optimization
  • Smoothing
  • Validation
• Manufacturability
Session 4: Lattice Materials Design
• Biometric Underpinnings
• Classification of Cellular Materials
  • Volume/space-filling
  • Surface
• Functions and Performance Gains
  • Structural
  • Transport
• Case Studies with AM
• Modeling Approaches
• Demo with nTopology
• Manufacturability
Session 5: Implementing AM - A Practical Guide for Designers
• Part Selection for AM
  • Purdue scorecard for part evaluation for AM
  • Cost considerations
• Challenges and Open Questions  
  • Environment, health and safety  
  • Process, supplier, equipment selection  
  • Material properties and modeling  
  • Process variation: repeatability, reproducibility and tool-to-tool matching  
  • Design software choices  
  • Data handling & traceability  
  • Standards  
• Successful AM Adoption Transition Strategies  
  • Polymer to metal  
  • Prototype to end-use part  
  • Outsourcing to in-house  
• Resources

Instructor: Dhruv Bate  
Fee $720 1.0 CEUs

Additive Manufacturing Course Bundle  
1 Hour  
I.D.# PD530908ON

These courses explain the fundamental concepts of additive manufacturing, including the main principles behind AM and the safety precautions to take during the process. They also introduce the basic steps in additive manufacturing and discuss the variety of methods and materials used to create AM products.

On-demand course bundles provide a cost-effective and convenient means of securing knowledge in a specific technology or topic area.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

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RELATED TRAINING SOLUTIONS

Some of our courses apply to more than one technology category. Consider these related courses described in other sections of this resource guide.

Understanding the FAA Parts Manufacturer Approval Process  
This two-day course covers the crucial subjects and steps of the FAA-PMA approval process. Throughout this course the instructor will combine classroom lecture with real-world examples to provide participants both a formal as well as practical learning experience.

Read more about this course on page 154.

RFID Selection, Application, and Use in Aerospace, Space, and Transportation  
This one-day seminar introduces participants to the technology of RFID and how it can be properly integrated into the aerospace, space, and transportation industries.

Read more about this course on page 6.

Instructors Wanted...  
To shape the future of mobility engineering, SAE International Professional Development is seeking experienced engineering professionals with industry and/or academic backgrounds to develop and teach live classroom or online courses.

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Kevin Perry: Kevin.Perry@sae.org, +1.724.772.7502
MATERIALS

Corrosion Engineering and Prevention

2 Days
I.D.# C1217

The transportation industry, including motor vehicles, aircraft, rail, marine, commercial, off-road and defense vehicles, as well as infrastructures, energy sectors, raw materials, manufacturing, health and food industries all experience significant issues with corrosion which results in billions of dollars of loss each year. Corrosion education and prevention is essential to improve and increase the service life of parts and components which may have a significant impact on the economy of various industries and nations.

The focus of this course will be on the fundamentals of corrosion engineering and corrosion prevention of metallic and alloy structures as well as on non-metallic composites and hybrid materials. Recent challenges and opportunities in corrosion of advanced composites used in the automotive, aerospace, and marine industries as well as for underground structures for oil, gas, geothermal and tidal wave technologies will also be included. Different types of corrosion, methods of corrosion protection and prevention, optimum engineering design of corrosion resistance parts and components, standard corrosion tests, responsibilities of corrosion engineers, and a process for setting-up an advanced corrosion laboratory will be discussed. This course also covers most traditional and non-traditional tests for corrosion studies, including real-time characterization techniques and analysis of corrosion phenomenon and corrosion monitoring principles.

Learning Objectives

By attending this seminar, participants will be able to:
• Describe the basic electrochemical concepts of various corrosion processes
• Articulate and utilize corrosion prevention strategies and estimate corrosion behavior of materials and components
• Describe the role of ion-diffusion, crystal structure, and grain size on corrosion of metals and alloys
• Design and engineer corrosion resistive components for different industries
• Define methods of corrosion protection and interpret corrosivity maps
• Perform standard corrosion tests, in-depth analyses of test results
• Define anodic/cathodic protections and coatings specifications for various components
• Formulate corrosion prevention coatings materials for metallic and non-metallic structures

Who Should Attend

This course is designed for engineers working in automotive, commercial vehicle, off-road, aerospace, marine, rail, energy sectors, electronics and related industries who are interested in corrosion and corrosion prevention. Engineers working for chemical companies on the production of corrosion resistive materials and chemicals and scientists working for government and national laboratories working in the area of conservation, national infrastructures, and advanced energy technologies, as well as academicians will benefit from this course.
Topical Outline

DAY ONE
• Fundamentals of Corrosion and Corrosion Prevention
  • Overview of corrosion problems and their economic impacts
  • Basic electrochemical principles of corrosion and corrosion prevention
  • Types of corrosion and role of electromotive force, ion diffusion, crystal structure, and grain size
  • Corrosion of composite materials and impact of combined cyclic loading and corrosion
  • Standard corrosion tests, and recent software and hardware for corrosion testing
• Mechanisms and Prevention of Corrosion
  • Automotive components
  • Aerospace components
  • Marine and underwater infrastructures
  • Electronics and energy related systems
• Corrosion Engineering and Coating Technologies
  • Design principles to minimize corrosion
  • Passive and active coating technologies

DAY TWO
• Surface Coating Technologies for Corrosion Prevention
  • In-situ surface coating and coating optimization
  • Anodic and cathodic protections and engineering principles
  • Application of metal oxides, carbides, nitrides and composite coating
• Supply and Manufacturing of Corrosion Prevention Materials
  • Inorganic base coating materials and their applications
  • Organic based coating materials and mode of operation
  • Composite coatings and their applications in auto and aerospace industries
• Corrosion and Corrosion Prevention of EVs and HEVs with Batteries, Supercapacitors and Fuel Cells
  • Corrosion prevention and role of high voltage, electromagnetic sources
  • Corrosion in fuel cells and component design to optimize corrosion
  • Corrosion in renewable alternative energy sectors

Instructor: Gholam-Abbas Nazri
Fee $1370 1.3 CEUs

Metal Forming
2 Days
I.D.# 85012

This seminar covers metal forming and related manufacturing processes, emphasizing practical applications. From forged or P/M connecting rods to tailor-welded blank forming, metal parts are integral to the automotive industry. As a high value adding category of manufacturing, metal forming is increasingly important to the core competency of automobile manufacturers and suppliers. A thorough survey of metal forming processes and metal forming mechanics will be performed, including bulk deformation, sheet-metal, and powder metallurgy operations. Design considerations are fully integrated into the course and are presented with every process. A large number of real-world case studies are presented to the attendees to emphasize course content. Attendees will receive a copy of the book Manufacturing Engineering Technology, co-written by instructor Steven R. Schmid.

Learning Objectives
By attending this seminar, participants will be able to:
• Identify the unique characteristics of metals that lead to plastic deformation as a processing strategy
• Explain the processes involved in metal forming mechanics, materials, and tribology
• Analyze the interrelationships between various factors that influence the quality of manufactured products
• Describe sheet metal characteristics and forming
• Describe the wide variety of processes used to shape and deform metals, including forging, rolling and extrusion; sheet metal forming, shearing and stamping; powder metallurgy processes and assorted other processes

Who Should Attend
This course is designed for engineers who are involved in metal forming and other related manufacturing processes.

Topical Outline
DAY ONE
• Overview of Solid Mechanics and Materials Science Topics of Importance to Metal Forming
• Tribology of Metal Forming: Friction, Lubrication and Wear
• Bulk Deformation Processes
  • Forging: open die and closed-die (impression) forging; machinery description and capabilities; forging process layout and die design; heading, coining, piercing and upsetting operations; swaging
  • Rolling: flat rolling process, including Orowan model; control of product quality including surface finish and gage control; rolling equipment and capabilities; shape rolling; ring rolling
MATERIALS

- Extrusion and drawing: direct, indirect and hydrostatic extrusion; cold and hot extrusion; die design; defects in extrusion; drawing equipment and mechanics; limiting drawing ratio

DAY TWO

- Sheet Metal Forming Processes
  - Sheet metal shearing: mechanics of shearing, burr formation, blanking operations, fine blanking
  - Sheet metal bending: types of bending operations and equipment; springback calculation and control; tube bending
  - Sheet forming operations: deep drawing and ironing; stretch forming; bulging, rubber forming and hydroforming; roll forming of sheet; spinning; incremental forming; explosive, peen and other specialty forming processes; stamping operations and die design
  - Sheet metal formability: limiting drawing ratio for deep drawing; sheet metal formability; forming-limit diagrams
- Powder Metallurgy Processes
  - Compaction through pressing, cold and hot isostatic pressing and metal injection molding; sintering mechanics and processes; coining and finishing

Learning Objectives

By attending this seminar, participants will be able to:
- Identify various descriptors that are used in NVH and sound quality while working with sound package materials
- Recognize various noise sources and paths in a vehicle
- Identify three different classes of acoustical materials
- Describe ways that acoustical materials work and how they differ from each other
- Road map for vehicle sound package development
- Distinguish test methods used to evaluate the acoustical performance of material

Who Should Attend

Designed for OEM or supplier employees responsible for various noise activities, such as design, evaluation, trouble-shooting, procuring, supplying, and/or manufacturing noise control treatments and parts, this seminar will also benefit those with responsibilities including the areas of manufacturing, design, engineering, process, noise and release engineering, supervision or management. Attendees should have an undergraduate engineering degree and/or a working knowledge of noise control and automotive acoustics.

Topical Outline

- Fundamentals of NVH and Sound Quality
  - Defining acoustical performance of acoustical parts
  - Definition of terms
  - Human response to sound
  - Various noise and vibration instrumentation
- Vehicles Noise Sources and Solutions
  - The noise system
  - Vehicle noise sources
  - Road and wind noise
  - Miscellaneous noise sources
  - Noise control solution - source, path, receiver
  - Noise control system using sound package materials
- Materials for Vehicle Noise Control
  - Absorber, including case studies and test methods
  - Barrier, including case studies and test methods and the effect of holes
  - Damper, including case studies and test methods
  - Isolator
- Different Automotive Measurements
  - Vehicle
  - Component
  - Material

Sound Package Materials for Vehicle Noise Control

2 Days
I.D.# 92032

A similar course is available as a live, online Web Seminar - Vehicle Sound Package Materials Web Seminar - see course description below.

The sound package materials for vehicle noise control seminar provides a detail and thorough analysis of three different classes of acoustical materials – namely absorbers, barriers, and dampers, how they are different from each other, and acoustical properties that materials should possess for optimum vehicle noise control. The seminar addresses new advances in acoustical materials, primarily in absorption materials that impact the vehicle acoustics. The seminar covers ways to evaluate the acoustical performance of these materials using different test methods, including material, component, and vehicle level measurements. The two day seminar starts with the fundamentals of NVH and sound quality related to sound package materials and discusses the importance of various noise sources that impact the development of sound package treatments in a vehicle.

Instructor: Steven R. Schmid
Fee $1370 1.3 CEUs

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Instructor: Pranab Saha
Fee $1370 1.3 CEUs
Vehicle Sound Package Materials Web Seminar and Web Seminar RePlay

8 Hours
Web Seminar I.D.# WB1204
Web Seminar RePlay I.D.# PD331204ON

A similar course is available as a classroom seminar - Sound Package Materials for Vehicle Noise Control - see course description above.

This four-session web seminar provides a detailed understanding of the source – path-receiver relationship for developing appropriate sound package treatments in vehicles, including automobiles, commercial vehicles, and other transportation devices. The course provides a detailed overview of absorption, attenuation (barrier), and damping materials and how to evaluate their performances on material, component, and vehicle level applications. A significant part of this course is the case studies that demonstrate how properly designed sound package materials successfully address vehicle noise issues.

Learning Objectives
By connecting with this web seminar, participants will be able to:
• Identify various descriptors that are used in acoustics while working with sound package materials
• Identify three fundamentally different sound package materials that are used in the industry
• Explain how these materials work and how to improve their performance
• Describe how various measurements are made and why they are necessary on a material level, component level, and vehicle level
• Prescribe appropriate sound package materials for specific NVH issues
• Construct proper protocols for combining different sound package materials for different components so that the final vehicle meets the required acoustic target

Who Should Attend
This web seminar will be especially valuable for those new to the vehicle sound package area and those interested in how absorbers, barriers, and dampers work, how they are different from each other, how they interact with each other in an application, and what one needs to be aware of while making measurements so the results are meaningful. The course is also designed for OEM or supplier engineers and those in roles involved with design, evaluation, trouble-shooting, procuring, releasing, supplying, and/or manufacturing noise control materials and parts for passenger cars and light trucks, heavy trucks, off-highway vehicles, farm machinery, and other transportation systems including aircraft, watercraft and rail transit. An undergraduate degree and familiarity with basic acoustics and vibration, or acoustical materials would be beneficial.

Topical Outline
Session 1
• Vehicle Noise Sources and Solutions
  • The noise system – sources
  • Ranking noise paths
  • Source-path-receiver relationship
  • The noise control system using sound package materials
  • Calculating Onboard Energy Storage Needs
• Sound Package Material – Absorber
  • Application
  • Primary function
  • Effect of various parameters
Session 2
• Sound Package Material – Absorber (cont’d)
  • How it works
  • How to improve performance
  • Case studies
  • Measurements
Session 3
• Sound Package Material – Barrier
  • Application
  • Primary function
  • How it works
  • How to improve performance
  • Case studies
  • Measurements
Session 4
• Sound Package Material – Damper
  • Application
  • Primary function
  • How it works
  • How to improve performance
  • Case studies
  • Measurements
• Component and Vehicle Level Noise Measurements
  • Why
  • How
  • The need for standards and and targets for NVH studies

Instructor: Pranab Saha
Fee $640 .8 CEUs
Introduction to Advanced High Strength Steel Applications and Manufacturing

2 Days
I.D.# C1416

Advanced High Strength Steels (AHSS) are now commonly used in automotive body structural applications. The high strength of this grade classification is attractive to help reduce mass in the automotive body through reduction in thickness. Strength also supports improvements in safety requirements so that mass increases are minimized. In some specific grades of AHSS, energy absorption is possible in addition to the high strength. This course will review the definition and properties of AHSS and cover several common applications in automotive body structures. In addition, key manufacturing areas including stamping and welding will be addressed to demonstrate the increased challenges as compared to lower strength steel grades. Troubleshooting of typical engineering and production problems will round out the seminar leaving attendees with tools to help design more robust engineering solutions to AHSS applications.

Learning Objectives
By attending this seminar, participants will be able to:
• Define AHSS grades and describe general properties of AHSS
• Identify potential applications for AHSS
• Describe key manufacturing processing issues
• Assimilate tools for trouble shooting part issues

Who Should Attend
This course is designed for Automotive Body Engineers, Die Engineers, Designers, Manufacturing Plant Personnel, New Hires in the Steel Industry, Supervisors, Planners, and others who would like to decrease vehicle weight through the use of AHSS.

Topical Outline
DAY 1
• Background/Overview of AHSS
  • Definition
  • Types of AHSS
  • Typical chemistry and properties
  • Comparison to High Strength Low Alloy (HSLA) Steels
  • Thermo-mechanical processing
  • Coatings
  • Material call-outs
  • Availability of grades/gauges/coatings/coil widths
• Product Applications and Design Considerations
  • Typical automotive body and chassis applications
  • Crash performance advantages
  • Design for manufacturability

Day Two
• Stamping Tooling
  • Formability
  • Springback
  • Effect of material variation
  • Press tonnage
  • Edge fracture
  • Lubrication
  • Die design standards
  • Die materials and surface treatments
  • Die maintenance
• Die Try-Out
  • Proof tooling
  • Trouble shooting
  • Lessons learned
• Hot Stamping Overview
• Roll Forming
• Welding / Joining
  • Other assembly considerations
• Types of Welding
  • Key elements of resistance welding
  • Weld Quality Testing
  • Difference in RSW of AHSS versus Mild Steels
• Other automotive assembly joining
• Case Studies

Instructor: Jody N. Hall
Fee $1370 1.3 CEUs

Materials Degradation in Mechanical Design: Wear, Corrosion, Fatigue and their Interactions Web Seminar

10 Hours
Web Seminar: I.D.# WB1722

Materials degradation from environmental conditions is a common factor that will often occur in mechanical equipment used in every type of environment. These processes can frequently materialize in unpredicted and harmful ways, especially when they interact and lead to early component damage or failure. This five-session course will summarize the mechanisms that cause materials and mechanical components to degrade in service through exposure to deleterious mechanical and environmental conditions. The course is designed to develop knowledge of issues of material degradation in service and the effect upon the performance and reliability in the process of mechanical design. These processes include wear, corrosion, fatigue, and their interactions. The instructor will take a practical approach to the topics to allow participants to cite the causes of performance reduction. Potential
solutions will be covered including material selection and material or design modifications that would improve component life and performance in a range of harmful environments or operating conditions. The review of each mechanism will include a presentation of the fundamental basis for these failure mechanisms, followed by practical examples of how they occur in reality.

**Learning Objectives**
By connecting with this web seminar, students will be able to:
• Cite the typical wear mechanisms that occur in mechanical equipment and their causes
• Cite the basic corrosion mechanisms and their causes
• Identify the interactions that occur between wear, corrosion and fatigue
• Suggest practical material or design solutions to those damage mechanisms

**Who Should Attend**
Engineers who design and process mechanical equipment; applications engineers involved in equipment or component design specific to an industrial application; materials, process and equipment development engineers; plant engineers; test engineers responsible for product or component testing and analysis of failed mechanisms; and quality engineers who establish methods and procedures for component reliability and analysis of failed components will benefit most from this course.

**Topical Outline**
Session 1: Corrosion
• Electrochemical cell
• Galvanic series
• Corrosion mechanisms:
  • Galvanic corrosion
  • Uniform attack
Session 2: Corrosion (cont.)
• Corrosion mechanisms (cont.)
  • Crevice corrosion/pitting
  • Stress corrosion cracking
• Effects of corrosion on component life
• Corrosion solutions and prevention
Session 3: Wear
• Adhesion
• Abrasion
Session 4: Wear (cont.)
• Fretting
• Tribo-corrosion
• Fatigue wear
• Erosion
Session 5: Lubrication
• Theory and application and the effects on friction and wear

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**Principles of Metallurgy**
4 Hours  
I.D.# PD261322ON
This on demand course teaches the basic microscopic structures present inside of metals, how these structures and metal composition influence metal strength, and how these structures can be modified using common manufacturing processes to obtain specific mechanical properties. Several examples are presented to demonstrate how common alloying and manufacturing methods are used to modify the microscopic structures and properties of metals. It includes twelve modules followed by a quiz.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

Quantity discounts and Site License options are available. Call the SAE Corporate Learning Solutions hotline at +1.724.772.8529 for a quote.

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**Failure Analysis of Metals**
5 Hours  
I.D.# PD261505ON
Quickly getting to the bottom of a metal failure is critical for preventing future failures, keeping customers happy, and keeping manufacturing lines running. This course will teach you how to perform failure analysis of fracture, corrosion, and manufacturing failures.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

Quantity discounts and Site License options are available. Call the SAE Corporate Learning Solutions hotline at +1.724.772.8529 for a quote.

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Instructor: Michael Kim  
Fee $720  
1.0 CEU

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Catalog Key  
Classroom  
Live, Online  
On Demand  
Certificate
Hardness Testing

30 Minutes  
I.D.# PD261331ON

This on demand course focuses on Rockwell and Brinell hardness testing and Vickers and Knoop microhardness testing. Participants will learn about how the tests are performed, test sample requirements, test parameter selection, and testing requirements. The course can be completed in 30 minutes.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

Metallurgy of Steel Case Hardening

1 Hour  
I.D.# PD261333ON

This on demand course discusses common steel case hardening processes and how they are used to modify the surface layers of steels to obtain specific mechanical properties. Participants will learn about the process parameters and how they affect case composition, depth, microstructure, and properties. The course takes one hour to complete.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

Metallurgy of Precipitation Strengthening

2 Hours  
I.D.# PD261329ON

This on demand course teaches about the microscopic changes that take place in a precipitation strengthened alloy and their effects on the properties of the alloy. The effects of the different heat treating steps (solution treatment, quench, and aging) and heat treating process parameters (solution treatment temperature and time, quench rate, and aging temperature and time) on the alloy microstructure and the effects on alloy strength are discussed. The course is divided into five modules followed by a quiz.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

Metallurgy of Steel Through Hardening

1 Hour  
I.D.# PD261330ON

This on demand course teaches about the metallurgy of the following steel through hardening processes: quench and temper, martempering, and austempering. Participants will learn about the effects of heat treating temperature and cooling rate on steel microstructure and properties, and the effects of the interaction between heat treating process parameters and steel composition on through hardened steel microstructure and strength. This course takes one hour to complete.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

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**MATERIALS**

**Metallurgy of Steel: Principles**
3 Hours  
I.D. # PD261326ON

This on demand course teaches the phases and microstructures that form in steels, their effects on steel properties, the microstructure changes that occur when steel is heated and cooled, and the effects of carbon content and cooling rate on the microstructures that form. Also, how to read the iron-carbon phase diagram will be discussed. All this information is applicable to understanding the effects of steel heat treating processes and heat treating process parameters on the microstructure and properties of heat treated plain carbon, low-alloy, and tool steels. The course is divided into six modules followed by a quiz.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

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**Tensile Testing**
30 Minutes  
I.D. # PD261308ON

This on demand course teaches about tensile testing of metals with a focus on how the testing is performed and tensile properties are measured. It includes one module followed by a quiz.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

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**Wrought Aluminum Metallurgy**
1 Hour  
I.D. # PD261734ON

There are a wide variety of wrought aluminum alloys, each developed to provide specific properties. Getting the strength you need in an aluminum alloy requires knowledge of the effects of alloy composition, cold-working, and heat treating on aluminum metallurgy and properties. A good understanding of how aluminum alloys behave and what can be done to modify their properties is critical for being more productive and profitable. The course takes about one hour to complete and consists of one module and a final exam. Also, quizzes and problems give you opportunities to apply the concepts taught.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

**Electroplating**
3 Hours  
I.D. # PD261735ON

Electroplating involves the deposition of thin layers of metal on metal components and metal stock. There are several uses for electro deposited coatings including cosmetic, corrosion resistance, and wear resistance. Knowledge about electroplating and electroplated coatings is important for product design, preventing and solving quality problems, and evaluating supplier capabilities and quality.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

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**Corrosion of Metals**
5 Hours  
I.D. # PD261328ON

This online course teaches about corrosion of metals. The physics of corrosion is explored as a background for the discussion of seven common types of corrosion (uniform, galvanic, crevice, pitting, intergranular, stress corrosion cracking, and dealloying). Students will learn why and how corrosion occurs and methods for controlling corrosion. It includes eleven modules followed by a quiz.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

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CATALOG KEY

You will see the following icons alongside the course descriptions. These icons indicate:

- delivery formats available for the course
- the course is part of an SAE certificate
- that it is an ACTAR approved course

This catalog contains information on the on-demand courses available from SAE. For information on live learning, visit training.sae.org

On Demand - indicates the course is available online anytime the participant would like to access the course through the internet

Certificate - indicates the course is part of an SAE International curriculum-based, multi-course certificate. See a list of the multi-course certificates on page XII
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**NOISE, VIBRATION, & HARSHNESS**
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ENGINEERING TOOLS & METHODS

Accelerated Test Methods for Ground and Aerospace Vehicle Development

10 Hours  I.D.# PD130624ON

This is an electronically delivered seminar featuring full-motion video illustrated with synchronized presentation slides. This course is based on the highly-rated classroom seminar.

Engineers and managers involved with product development are constantly challenged to reduce time to market, minimize warranty costs, and increase product quality. With less and less time for testing, the need for effective accelerated test procedures has never been greater.

This course covers the benefits, limitations, processes, and applications of several proven accelerated test methods including accelerated reliability, step stress, FSLT (Full System Life Test), FMVT* (Failure Mode Verification Testing), HALT (Highly Accelerated Life Testing), and HASS (Highly Accelerated Stress Screening). It is designed for anyone involved in product design, life testing, reliability testing and validation for passenger cars, light trucks, heavy duty, off-highway or aerospace vehicles, including reliability engineers, validation engineers, design engineers and their managers. Users or purchasers of testing or engineering services will also find this course to be valuable. There are no prerequisites although a technical background is helpful.

Based on the popular classroom seminar, this course offers more than 10 hours of instruction divided into fourteen modules; a coordinated handbook; and an electronic copy of the instructor’s book, Accelerated Testing and Validation, which includes numerous hands-on exercises and analytical spreadsheets.

Learning Objectives

By connecting with this course, participants will be able to:

• Choose the accelerated test method for a given application
• Analyze accelerated testing results
• Explain how to accelerate your current test methods
• Explain how to accelerate your validation program
• Adjust accelerated test programs for business situations
• Describe how product development cycles can be reduced from 18 to six months

Is this Course for You?

This on-demand course is designed for anyone involved in product design, life testing, reliability testing and validation for passenger cars, light trucks, heavy duty, off-highway or aerospace vehicles, including reliability engineers, validation engineers, design engineers and their managers. Users or purchasers of testing or engineering services will also find this course to be valuable. There are no prerequisites although a technical background is helpful.

Topical Outline

• Statistical Limitations and Innovation vs. Commodity
• Product Availability and Supply Chain Effects
• Terms and Definitions for Accelerated Testing
• Full Life System Testing
• Step Stress
• Accelerated Reliability
• Highly Accelerated Life Testing (HALT)
• Failure Mode Verification Testing (FMVT)
• Reliability, Warranty and Maturity
• Data Analysis Techniques
• Overcoming Life Prediction Limitations in HALT and FMVT
• Program Acceleration
• Hybrid Test Methods
• Synthesis

Instructor:  Alexander J. Porter
Fee $595  1.0 CEU
Design of Experiments (DOE) for Engineers
Web Seminar RePlay

12 Hours
I.D.# PD330932ON

Web Seminar RePlays are captures of the live web seminar. The course sessions are unedited and include interactions between the instructor and live participants. A learning assessment is available at the end of the course to reinforce learning and retention and gauge your understanding of the topic.

Design of Experiments (DOE) is a methodology that can be effective for general problem-solving, as well as for improving or optimizing product design and manufacturing processes. Specific applications of DOE include, but are not limited to, identifying root causes to quality or production problems, identifying optimized design and process settings, achieving robust designs, and generating predictive math models that describe physical system behavior. This competency-based course utilizes a blend of reading, discussion and hands-on to help you learn the requirements and pre-work necessary prior to DOE execution, how to select the appropriate designed experiment to run, DOE execution, and analysis of DOE results. You will experience setting up, running, and analyzing simple-to-intermediate complexity Full Factorial and Partial Factorial experiments both by hand and using computer software. You will also set-up and analyze Robust/Taguchi and Response Surface experiments utilizing computer software.

Each participant will receive a 30 day Minitab™ product trial copy for use while completing the course.

Learning Objectives
Upon successful completion of this course, participants will be able to:
• Determine when DOE is the correct tool to solve a given problem or issue
• Select the appropriate DOE experiment type (DOE Goal) for a given application
• Set up simple Full Factorial DOEs by hand, using cube plots
• Set up and analyze any Full Factorial DOE using Minitab
• Select the appropriate partial factorial design(s) based on one’s application
• Set-up and analyze Partial Factorial DOEs, simple Robust Design (Taguchi) DOEs, and simple Response Surface DOEs using Minitab
• Identify and execute the structured process steps recommended when executing a DOE project

Who Should Attend
This course will benefit: engineers involved in problem-solving such as product design or product formulation (e.g., fluid/material composition, prepared food recipes/preparation, etc.) and/or optimization; process design and/or optimization; quality improvement efforts such as defect elimination, warranty avoidance or similar initiatives; test engineers who wish to maximize learning of system behavior with a minimum number of tests; and technicians, analysts and managers who support engineers in the above efforts, so they may be effective participants in DOE activities. There are no specific prerequisites, however participants are expected to have some math background, including the ability to calculate elementary statistics parameters such as an average and a range. Since the course includes demonstration and hands-on use of Minitab, participants should have some familiarity with Windows-based personal computer applications.

Topical Outline
Session 1
• Introduction
• What is DOE (with Initial Data Collection Exercise)
• Full Factorial Experiments using Cube Plots
  • Identifying main effect and interaction terms
  • Determining effects for all terms
• Estimating How Much Experiment Data is Enough
• Assignment for Session 2: Hands-on Exercise in the use of Minitab using Simulator to Generate Data

Session 2
• Review of Exercise Assigned at the end of Session 1
• Set up and Analysis of a Full Factorial Experiment using Minitab
• Review of Minitab’s DOE Results
• Review of Methods for Determining Significance
• ANOVA and Regression Overview
• Assignment for Session 3: Hands-on Exercise using Minitab to Analyze Data and Interpreting Statistical and Graphical DOE Results

Session 3
• Review of Exercise Assigned at the end of the Session 2
• The Confounding Principle
• The Benefits and Disbenefits of Confounding and of Partial Factorial Experiments
• How Confounding Occurs in a DOE, including Generators and ‘Design Resolution’ Importance of the ‘Alias String’
• Minitab Demonstration: Setting up Partial Factorial Experiments using Default Generators and by Specifying Generators
• Assignment for Session 4: Partial Factorial Exercise using Minitab and a Simulator to Generate Data for the DOE
Session 4
• Review of Exercise Assigned at the end of the Session 3
• When Robust/Taguchi DOE is Appropriate
• How Robust/Taguchi DOE is Different
  • Two-Step Optimization Concept
  • Control vs. Noise
  • Importance of Control-by-Noise Interactions
  • Studying Robustness with Classical DOE vs. Taguchi
  • Taguchi's Robustness Statistics: Signal-to-Noise (S/N) and Loss
• Applications of Taguchi DOE (incl. Set-up and Analysis in Minitab)
• Minitab Demonstration: Setting Up a Taguchi DOE
• Assignment for Session 5: Robust/DOE Exercise using Minitab
  and a Simulator to Generate Data for the DOE

Session 5
• Review of Exercise Assigned at the end of the Session 4
• When Response Surface DOE is Appropriate
• How Response Surface DOE is Different
  • Box-Behnken Concepts (with Demonstration of Minitab Set-up)
  • Central-Composite Concepts (with Demonstration of Minitab Set-up)
• Overview of Other Designs/Application: Plackett-Burman and Mixture
• Minitab Demonstration: Response Surface Set-up and Analysis
• Assignment for Session 6: Response Surface DOE Exercise using Minitab
  and a Simulator to Generate Data for the DOE

Session 6
• Review of Exercise Assigned at the end of the Session 5
• Best Practices: The Problem Solving Process
• Best Practices: The Structured DOE Process
  • The Multi-Step Process for Ensuring Effective DOE Execution and Meaningful Results
  • Discussion "Exercises": Selecting Factors, Responses, Measurement Systems, etc. for Sample Situations
• In-class Exercise: How to Conduct a DOE to Evaluate the Quality of a Gauge (Measurement System Assessment or "MSA")
• FAQ Review and Question and Answer
• Summary

Instructor: Kevin Zielinski
Fee $835 1.2 CEUs

Finite Element Analysis for Design Engineers

8 Hours
I.D.# PD531241

This is a highly interactive on-demand course featuring video, demos, and knowledge checks designed to reinforce learning.

Finite Element Analysis (FEA) is a computer-aided engineering (CAE) tool used to analyze how a design reacts under real-world conditions. Useful in structural, vibration, and thermal analysis, FEA has been widely implemented by automotive companies. It’s used by design engineers as a design tool during the product development process because it allows them to analyze their own designs while they are still in the form of easily modifiable CAD models, providing quick turnaround times and ensuring prompt implementation of analysis results in the design process. While FEA software is readily available, successful use of FEA as a design tool still requires an understanding of FEA basics, familiarity with the FEA process and commonly used modeling techniques, and an appreciation of inherent errors and their effect on the quality of results. When used properly, the FEA becomes a tremendous productivity tool, helping design engineers reduce product development time and cost. Misapplication of FEA, however, may lead to erroneous design decisions, which are very expensive to correct later in the design process.

This online on-demand course provides the skills necessary for proper use of FEA in the design process and ensures that the powerful tool is implemented in the most efficient and productive way. Participants will begin with the foundational FEA process, observe expert demonstrations showing how FEA is conducted using real models, study different types of typically performed analysis, discuss common misconceptions and errors made, and explore how FEA can be implemented within the design environment. Hands-on exercises focusing on FEA fundamentals, different types of analysis, and proper modeling techniques are included.

All topics are illustrated by hands-on examples using FEA software, SolidWorks® Simulation, for which participants will be provided a Student License (compatible with Windows XP, 7; IE 7, 8, 9; MS Excel and Word 2007 or 2010). Acquired skills, however, are not software-specific and no prior exposure to FEA software is required. The eBook, *Engineering Analysis with SolidWorks® Simulation* by Paul Kurowski, is also included in the course materials. In-class, hands-on exercises and between-session assignments will provide an opportunity to put what is learned into practice.

While the course modules are approximately eight hours in length, the estimated time to completion, including knowledge checks and the learning assessments is 12 hours.
An introduction module and various bundling options are available for this topic. Contact Corporate Learning Solutions to discuss the course options that best fit your need.

Learning Objectives
By participating in this on-demand course, the student will be able to:
• Identify the purpose of using FEA in the design process
• Identify and avoid errors inherent to FEA results
• Identify FEA advantages and shortcomings
• Recognize and avoid common FEA mistakes
• Produce reliable results on time
• Interpret and use FEA results
• Explain an effective approach to FEA project management
• Ensure quality and cost-effectiveness of FEA projects

Major topics include:
• Introduction to Finite Element Analysis
  • FEA Definition and Process
  • Discretizing and Characteristics of Finite Elements
  • Degrees of Freedom
  • Common FEA Assumptions
  • Mesh Concerns
  • Discretization Error and the Convergence Process
• Conducting the FEA Process
  • FEA Preparation Using SOLIDWORKS
  • Model Setup
  • Analysis of Displacement, Strain, and Stress Results
  • Analysis of Convergence Results
  • Types of Convergence Analysis
• Avoiding the FEA Errors
  • Singularities
  • Verification and Validation of Results
  • Control of Modeling Error
  • Useful Modeling Techniques
  • Types of Boundary Conditions
• Common Types of FEA
  • Modal Analysis
  • Buckling Analysis
  • Thermal Analysis
• Conducting Nonlinear Analysis
  • Classifications of Nonlinear Behavior
  • Nonlinear Geometry Analysis
  • Nonlinear Material Analysis
  • Contract Stress Analysis
• Implementation of FEA into the Design Process
  • FEA and the Product Design Process
  • Interfacing between CAD and FEA
  • Project Management of an FEA Project

Is this Course for you?
This course addresses the needs of design engineers using Finite Element Analysis on a new product during the design process. Non-specialized analysts and FEA users, R&D engineers and managers, and project and product engineers can benefit from this introduction to FEA concepts.

What You Will Receive
• 90 days of online single-user access (from date of purchase) to the eight hour presentation
• The eBook, Engineering Analysis using SolidWorks® Simulation by Paul Kurowski (loaded into My SAE Library)
• Student License to SolidWorks® 2015
• Job Aids (included in each module of published course)
• SolidWorks® Models
• Integrated knowledge checks to reinforce key concepts
• Instructor follow-up to your content questions
• 1.2 CEUs*/Certificate of Achievement (with satisfactory learning assessment score)

Fee $720 1.2 CEUs

FMEA for Robust Design: What, Why, When and How Web Seminar RePlay
12 Hours
I.D.# PD331422ON
Web Seminar RePlays are captures of the live web seminar. The course sessions are unedited and include interactions between the instructor and live participants. A learning assessment is available at the end of the course to reinforce learning and retention and gauge your understanding of the topic.

Failure Modes and Effects Analysis (FMEA) is an integral part of product design activity applicable to any type of product or service. It is a qualitative and quantitative step-by-step approach for identifying and analyzing all actual and potential points of failure in a design, product or service. A successful team-based FMEA activity can use their collective experience with similar products to dramatically improve not only product performance but also reduce manufacturing issues at both a component and system and processing level.

This course introduces the five basic types of FMEAs with emphasis on constructing a Design FMEA. Each column of the FMEA form is clearly explained using a typical FMEA example. This example can be a provided sample or a company sample provided candidate. The course covers various methods for clearly identifying product function at three levels, and associating distinct
failure modes, effects and causes related to each function level. Special attention is given to Severity, Occurrence, and Detection and how to develop effective Risk Priority (RPN) strategies and Recommended Actions for significant RPNs.

All material is in conjunction with current industry standards.

Learning Objectives
Upon completion, the participant should be able to:
• State the relationship between Product Development, Voice of the Customer (VOC) and the FMEA process
• Recognize why and when to use the five types of FMEAs, specifically Systems and Design
• Apply the FMEA process as a risk management technique
• Organize an effective FMEA team and conduct FMEA work sessions
• Adapt the steps to generate a FMEA process to your specific company needs
• Develop and manipulate Risk Priority and Detection Strategies and customize Risk Ranking tables
• Assign effective Recommended Actions

Is this Course for You?
This training option is designed for individuals who are involved in the development of new products and who seek to improve that process. Product development team members including, but not limited to, project and program managers, design and development, process, product, quality, and application engineers will find the course valuable. It is aimed primarily at these managers and engineers who will be facilitating or leading such FMEA activities. Directors, marketing and purchasing personnel will also benefit by understanding why the FMEA process is important to developing a safe and effective product.

Topical Outline
Session 1
• FMEA Introduction
  • Background and History
  • The FMEA Standards - MIL-STD_1629, SAE J1739, AIAG
  • Relationship of Design and Process FMEA in a design & manufacturing environment
Session 2
• Five Types of FMEAs
Session 3
• FMEA and Risk Management
  • Defining Risk Management
  • FMEA and Robust Design
  • FMEA as part of Design to Cost
  • FMEA as Product Liability Protection
Session 4
• Managing the FMEA Process
  • Assembling the FMEA Team
  • Facilitator Role during the FMEA Process

Instructor: Angelo E. Mago
Fee $835 1.2 CEUs

Introduction to FMEA: What, Why, When and How
25 Minutes
I.D.# PD531422ON

This highly interactive on-demand course featuring video, demos, and knowledge checks designed to reinforce learning. Failure Mode and Effects Analysis (FMEA) is an essential part of any product design or redesign activity. FMEA is a proactive, quantitative, qualitative, step-by-step approach for identifying and analyzing all potential points of failure in any product or service. This team-based activity can dramatically improve product performance. It can also reduce manufacturing issues at the component, system, and processing level.

This module gives a high-level overview of FMEA facts: WHAT an FMEA is, WHY they are used, WHEN an FMEA is created, WHO is on the FMEA development team, and HOW the FMEA form is completed. The history of FMEAs, standards, and team responsibilities are also discussed.

Additional modules are being planned for release to provide a comprehensive FMEA curriculum. You may also consider the Web Seminar RePlay FMEA for Robust Design: What, Why, When and How.
How, with instructor Angelo Mago. Find the course description on page 103.

All material is in conjunction with current industry standards. While the course module is approximately 25 minutes in length, the estimated time to completion, including knowledge checks and the learning assessment is one hour.

A more in-depth on-demand option for the FMEA topic is in development. Contact Corporate Learning Solutions to discuss availability and learning options that best fit your need.

Learning Objectives
By participating in this on-demand course, students will be able to:
• Describe the FMEA history, terms, standards and types
• State the benefits and advantages of using an FMEA
• Describe the composition and responsibilities of an FMEA team
• Explain when an FMEA is needed and the timing involved
• Describe the basic information and inputs required in each column of an FMEA form

Major topics include:
• Lesson 1: Introduction
• Lesson 2: WHAT is Failure Mode and Effects Analysis?
• Lesson 3: WHY should we use FMEA?
• Lesson 4: WHO is on an FMEA team?
• Lesson 5: WHEN should we develop an FMEA?
• Lesson 6: HOW do we complete an FMEA form?
• Lesson 7: Summary

Is this On-demand Course for you?
This course is designed for individuals who need an overview of the Failure Mode and Effects Analysis process and tool including project and program managers, as well as design and development, process, product, quality, and application engineers.

What You Will Receive
• 90 days of on line, on-demand single-user access to the 60 minute course
• A printable summary of the key takeaways from each lesson
• Integrated knowledge checks to reinforce key concepts
• Instructor follow-up to your content questions
• .1 CEUs/Certificate of Achievement (with satisfactory learning assessment score)

Fee $85 .01 CEUs

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**Introduction to Design Review Based on Failure Modes (DRBFM) Web Seminar RePlay**

6 Hours
I.D.# PD331047ON

Web Seminar RePlays are captures of the live web seminar. The course sessions are unedited and include interactions between the instructor and live participants. A learning assessment is available at the end of the course to reinforce learning and retention and gauge your understanding of the topic.

Design Review Based on Failure Modes (DRBFM) is a methodology focused on change management and continuous improvement. It centers on early prevention and engineering knowledge, eliminating time spent debating ranking systems, waiting for lead engineers to document and list their concerns, identifying what types of concerns are open for discussion and resolution, and brainstorming without any actionable closure.

This course explains all phases of the DRBFM methodology and provide details on how to accomplish the specific steps. With the Design Review Based on Failure Modes (DRBFM) and Design Review Based on Test Results (DRBTR) Process Guidebook that is bundled with the course, the instructor provides specific information on each step. Formats, examples, notes and homework slides will be used to illustrate the defined steps of the new SAE J2886 DRBFM Recommended Practice. Similarities in content between DRBFM and FMEA will be discussed, however the focus will be on conducting DRBFM methodology.

This DRBFM Web Seminar RePlay provides roles and responsibilities of management, design engineers, manufacturing engineers, facilitators and technical experts. Those interested in DRBFM will benefit from understanding the rationale behind this methodology and learn to guide teams through the paradigm shifts and mindset that are needed.

Learning Objectives
By connecting with this course, participants will be able to:
• Outline the fundamental steps of DRBFM methodology, including:
  • DRBFM Plan and analysis requirements
  • Necessary preparation feeding DRBFM analysis
  • The two phases of DRBFM analysis
  • Documentation of design, validation and manufacturing actions
  • Feedback loop into engineering knowledge documents
• Explain the intent and format of the DRBFM worksheets
• Predict what it takes to gain and maintain proficiency and consistent application of the methodology
• Find answers to most DRBFM questions
ON DEMAND COURSES RESOURCE GUIDE

Who Should Attend
Product engineers, manufacturing engineers, quality engineers, supplier quality engineers, validation and test engineers, and facilitators, trainers and consultants in all industries. This Web Seminar RePlay will benefit beginning engineers, advanced and senior engineers and managers who must participate in FMEA’s and DRBFM.

Topical Outline
Session 1
- DRBFM Procedure, Forms, Planning and Preparation
  - Process Guide and Workbook Overview
  - Scope and Purpose
  - Process Map - General Requirements
  - Planning - Formats, examples, homework
  - Planning Results and Output
  - Preparation - Formats, examples, homework
  - Preparation Results and Linkage with DRBFM Format
  - Definition of Change Section

Session 2
- DRBFM - Forum 1, Design Review, Action Results and Follow Up
  - DRBFM Forum 1 - Engineer analysis
  - Change Point definition
  - Identification of concerns
  - Identification of causes and influences on the vehicle
  - Identification of effects
  - Identification of severity/priority
  - Actions to gain engineering knowledge - evidence

Session 3
- DRBFM - Forum 2, Design Review, Action Results and Follow Up
  - DRBFM Forum 2 - Design Review introduction
  - Change Point overview
  - Identification of additional concerns
  - Identification of additional causes and influences on the product
  - Identification of effects
  - Identification of severity/priority
  - Actions taken to eliminate concerns
  - Design actions to gain engineering knowledge - evidence
  - Validation actions to gain evidence of reliability
  - Manufacturing, assembly, and supplier actions
  - Action results and feedback to design guidelines
  - Roles and responsibilities

Instructor: Bill Haughey
Fee $615 .6 CEUs

Introduction to Weibull Solution Methods
1.25 Hours
I.D.# PD530946ON

This is a highly interactive on-demand course featuring video, demos, and knowledge checks designed to reinforce learning.

Weibull Analysis is the starting point for solving most issues related to product reliability, maintainability, supportability, quality, safety, test planning, and cost control. Weibull Analysis is popular worldwide as the best method for modeling and predicting variability and failure of designs, products, and systems. Instructor Wes Fulton will provide a solid overview of Weibull Solution Methods including an explanation of 16 additional Weibull Analysis capabilities, or Weibull Extensions. This introductory short course should be considered a prerequisite for participation in a Weibull project or for attending additional SAE training that covers advanced Weibull applications.

While the course module is just over 75 minutes in length, the estimated time to completion, including exercises, job aids and the learning assessment is two hours.

Learning Objectives
Upon successful completion, the participant will be able to:
- Determine whether or not the available data is appropriate for a Weibull solution
- Discuss the background and explain the benefits of Weibull solution methods
- Create, interpret and evaluate the correctness of a Weibull plot
- Distinguish between an infant mortality failure issue and a wearout failure issue
- Forecast events under different maintenance strategies
- Determine pass/fail criteria in designing a test program
- Explain 16 additional Weibull analysis capabilities, called Weibull Extensions and locate additional resources

Major topics include:
- Introduction and Background
- Basic Plotting
- Basic Interpreting
- Case Studies
- Variations
- Extensions and Summarys

Is this Course for You?
The Introduction to Weibull Solution Methods on-demand course is designed for technical personnel and engineers who want to discover the best toolset for continuous improvement at their organization or business. Those in any industry including automotive, aerospace, electrical/electronic, transportation, design, manufacturing, test planning, warranty, reliability, quality, liability,
value engineering, and management will benefit. This course is appropriate for anyone who needs an awareness of Weibull’s basic premises and benefits as well as those who need this foundational knowledge as a prerequisite for additional training toward becoming an expert Weibull practitioner.

What You Will Receive

- 90 days of online single-user access (from date of purchase) to the course
- Integrated knowledge checks to reinforce key concepts
- Online learning assessment (submit to SAE)
- Job aid for practical application of the topics covered
- Instructor follow up to your content questions
- .2 CEUs*/Certificate of Achievement (with satisfactory learning assessment)

Instructor: Wes Fulton
Fee $160 .2 CEUs

Root Cause Problem Solving: Methods and Tools

8 Hours
I.D.# PD530931
This is a highly interactive on-demand course featuring video, demos, and knowledge checks designed to reinforce learning.

How do you solve a problem? Do you find yourself using quick and easy solutions or a structured methodology? Too often, organizations tend to seek quick solutions to a problem without adequately addressing its underlying cause. These decisions often result in solutions that don’t work or aren’t sustainable, often wasting time, effort, and money. To combat these issues and adopt a fresh approach, teams can use the methods and tools of Root Cause Problem Solving. By first viewing a problem as an opportunity for improvement, the team can then identify the problem’s root cause or causes, and implement solutions to prevent the problem’s recurrence.

This six module course introduces the Root Cause Problem Solving approach. It explains how using Root Cause analysis can help improve operational and financial performance by identifying root causes and implementing solutions to significant or recurring problems. This methodology is used by many major automotive manufacturers to improve quality and customer satisfaction, reduce operation costs, and provide greater employee knowledge of work processes.

Participants will become familiar with the eight steps of the Root Cause Problem Solving approach, learning the key actions completed in each step and interacting with examples and scenarios that demonstrate how each step functions to solve problems and keep them from reoccurring in an organization. Participants will also be supplied with tools that assist with the completion of each step that they can use in their own problem-solving efforts on-the-job.

While the course is approximately eight hours in length, the estimated time to completion, including knowledge checks and the learning assessment is ten hours.

An introductory module and and other purchasing options are available for this topic. Contact Corporate Learning Solutions to discuss the course options that best fit your need.

Learning Objectives

Upon successful completion, the participant will be able to:

- Explain why root cause analysis using the 8-Step Problem Solving Methodology is more effective than non-structured problem solving efforts
- Define the difference between a problem, symptom, cause, and root cause
- Use tools and techniques to solve problems
- Evaluate effectiveness of problems solving efforts
- Describe the role of problem solving in continuous improvement

Major topics include:

- Module 1: Foundations for Adopting Root Cause Analysis
  - Identifying Problems
  - How to Approach Problem Solving Using a Process Approach
  - Methods and Tools for Problem Solving: An 8 Step Approach
  - Roles and Responsibilities in Problem Solving
  - Setting Up a Problem Solving Team
- Module 2: Describing the Problem and Implementing Containment
  - How to Describe a Problem
  - Symptoms vs. Causes
  - Methods for Collecting and Analyzing Data
  - Problem Statements
  - Methods for Protecting the Customer
- Module 3: Discovering Root Causes
  - Recognizing Potential Causes
  - Methods for Identifying Causes and Root Causes (cause-effect diagram, 5-why)
  - Validating Potential Root Cause
Module 4: Designing a Solution and Implementing Permanent Corrective Action
  • Strategies for Planning and Designing Effective Solutions
  • Methods for Evaluating Potential Solutions
  • Error Proofing Strategies
  • Planning Implementation
  • Project Management Strategies
  • Completing System Changes
  • Measuring and Verifying Effectiveness
Module 5: Preventing Reoccurrence
  • Ensuring the Problem is Eliminated
  • Holding the Solution in Place
  • Leveraging What is Learned
  • FMEA and Problem Solving
Module 6: Recognizing Efforts
  • Methods of Team and Individual Recognition
  • Capturing Lessons Learned and Moving the Forward
  • Problem Solving and Continuous Improvement

Is this On-demand Course for you?
This course is applicable to those directly working in or responsible for performance improvement of any definable, repetitive process, e.g. manufacturing, design, logistics, purchasing, sales, or distribution, including:
• Manufacturing managers, supervisors and team leaders
• Manufacturing engineers
• Design engineers
• Quality engineers and technicians
• Technical managers
• Project team leaders
• Problem solving and quality improvement facilitators
• Anyone whose role includes problem solving

What You Will Receive
• 90 days of online single-user access (from date of purchase) to the course
• Integrated knowledge checks to reinforce key concepts

Fee $640 (full course) 1.0 CEU (full course)

Vibration Analysis Using Finite Element Analysis (FEA) Web Seminar RePlay

12 Hours
I.D.# PD331401ON

Web Seminar RePlays are captures of the live web seminar. The course sessions are unedited and include interactions between the instructor and live participants. A learning assessment is available at the end of the course to reinforce learning and retention and gauge your understanding of the topic.

Finite Element Analysis (FEA) has been used by engineers as a design tool in new product development since the early 1990’s. Until recently, most FEA applications have been limited to static analysis due to the cost and complexity of advanced types of analyses. Progress in the commercial FEA software and in computing hardware has now made it practical to use advanced types as an everyday design tool of design engineers. In addition, competitive pressures and quality requirements demand a more in-depth understanding of product behavior under real life loading conditions. This course will enable participants to expand the scope of FEA to vibration analysis to simulate product behavior under those conditions.

This course introduces vibration analysis performed with Finite Element Analysis (FEA). By considering time-dependent loads and inertial and damping effects, vibration analysis allows for a more in-depth product simulation thus reducing product development cost and time. The course reviews basic concepts of vibration analysis and illustrates how they are implemented in FEA to simulate product behavior. The most common types of vibration analysis such as modal, time response, and frequency response will be covered.

All topics are illustrated using FEA software, SolidWorks® Simulation, for which participants will be provided a student license (compatible with 64-bit Windows 7 SP1, 8.1, 10; IE 10,11; MS Excel and Word 2010, 2013, 2016) and opportunity to practice skills learned. Acquired skills, however, will not be software specific and no prior exposure to FEA software is required. The eBook, Vibration Analysis with SolidWorks® Simulation by Paul Kurowski, will also be included in the course materials. In-class, hands-on exercises and between-session assignments will provide an opportunity to put what is learned into practice.

Learning Objectives
By connecting with this course, participants will be able to:
• Evaluate the importance of dynamic effects in product simulation
• Analyze inertial and damping effects in structural response
• Perform modal analysis, time response analysis and frequency response analysis

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ON DEMAND COURSES RESOURCE GUIDE

- Apply proper FEA modeling techniques to model system vibration
- Use vibration analysis as a design tool

Is this Course for You?
The course will be of interest to design, R&D, project, and product engineers who already use Finite Element Analysis (FEA) as a design tool and would like to explore if and how vibration analysis with FEA may benefit the design process. It builds on participants' experience with static FEA and on knowledge of mechanical vibrations common to any mechanical engineer.

Prerequisites
Participants should have a degree in mechanical engineering and have some experience with FEA either by participating in the SAE Finite Element Analysis for Design Engineers web seminar (I.D.# WB1241) or through equivalent work experience. Familiarity with Windows OS and some CAD is helpful. The textbook, Engineering Analysis with SolidWorks® Simulation by Paul Kurowski, is recommended reading.

Topical Outline
Session 1
- Structure vs. Mechanism
- Simulation Process with the FEA
- Verification and Validation of FEA Results
- Discrete and Distributed Systems
- Mode of Vibration
- Modal Analysis
- Eigenvalues and eigenvectors
- In-class Exercises/Homework Assignment
Session 2
- Modal Analysis
- Convergence of Frequencies
- Rigid Body Modes
- Properties of Lower and Higher Modes
- Modes of Vibration of Single Degree of Freedom Oscillator (1DOF) and Two Degrees of Freedom Oscillator (2DOF)
- In-class Exercises/Homework Assignment
Session 3
- Modal Analysis
- Modeling Techniques in Modal Analysis
- Modes Separation
- Modal Analysis as a Tool to Find “Weak Spots”
- Modal Analysis as a Diagnostic Tool
- In-class Exercises/Homework Assignment
Session 4
- Modal Analysis with Pre-Stress
- Buckling Analysis
- Analogies between Modal Analysis and Buckling Analysis
- Modes of Vibration
- Modal Superposition Method
- In-class Exercises/Homework Assignment
Session 5
- Time Response Analysis
- Load Excitation and Base Excitation
- Impulse Load
- Static vs. Dynamic Response
- Time Response of a 1DOF and 2DOF Systems Time Response of a Distributed System
- In-class Exercises/Homework Assignment
Session 6
- Frequency Response Analysis
- Steady State Harmonic Response
- Force and Base Excitation
- Resonance
- Modal Damping
- Frequency Response of a 1DOF and 2DOF Systems
- Frequency Response of a Distributed System
- Linear vs. Non-linear Vibration Analysis
- Summary for Post-Course Learning Assessment

Instructor: Paul Kurowski
Fee $870 1.2 CEUs

Tolerance Stack-up Fundamentals Web Seminar RePlay
6 Hours
I.D.# 330842ON

Web Seminar RePlays are captures of the live web seminar. The course sessions are unedited and include interactions between the instructor and live participants. A learning assessment is available at the end of the course to reinforce learning and retention and gauge your understanding of the topic.

Analysis of tolerance stacks varies widely. This Web Seminar Re-Plan introduces the basic tools to create a common methodology for tolerance stack-ups, and ensure seamless documentation. Participants will create 1-D tolerance stacks for parts and assemblies that use geometric dimensioning and tolerancing using a tolerance stack spreadsheet. This simple, manual spreadsheet method produces an easily interpreted and checked documentation trail, and is easily adaptable to common electronic spreadsheet programs. Multiple examples will be provided to assist engineers in applying tolerance stack-up fundamentals to Y14.5 issues.
Learning Objectives
By connecting with this course, participants will be able to:
• Perform and develop a tolerance stack-up analysis
• Correctly enter geometric feature control frame data into a tolerance stack
• Apply a common step-by-step methodology to tolerance stack analysis

Who Should Attend Engineers familiar with concepts and practices contained within Y14.5 and who are looking for a fundamental step-by-step process for getting geometric dimensioning and tolerancing (GD&T) into a tolerance stack will benefit from this course. A basic understanding of GD&T symbols and concepts is required.

Topical Outline
Session 1
• Introduction and review
  • Introduction and tolerancing review
  • Tolerancing strategies; Review of GD&T

Session 2
• Stack fundamentals
  • How to identify the stack path
  • The two-column stack spreadsheet
  • Entering dimensions into the spreadsheet
  • Examples with coordinate dimensions

Session 3
• Factoring GD&T into a Stack
  • Location and runout tolerances
  • Profile tolerances
  • Form and orientation tolerances

Session 4
• Bonus and shift tolerance in a stack
  • Overview of bonus and shift tolerance
  • Part vs. assembly stacks

Instructor: John-Paul Belanger
Fee $640 .8 CEUs
ON DEMAND COURSES RESOURCE GUIDE

• Basic dimensions
• How to read the feature control frame

Session 2
• Rules and the Form Symbols
  • Rule #1: Size controls form
  • Rule #2: Assume RFS
• Flatness
• Surface straightness
• Circularity
• Cylindricity

Session 3
• Bonus Tolerance
  • GD&T applied to a feature of size
  • Bonus and the MMC modifier
  • Virtual condition
  • Gaging and inspection of GD&T

Session 4
• Datums
  • Datum vs. datum feature
  • The datum reference frame
  • Primary, secondary, and tertiary datums

Session 5
• Profile and Orientation
  • General definition of profile
  • Profile of a line
  • Profile of a surface
  • Use of datums with profile
  • Perpendicularity; Angularity
  • Parallelism

Session 6
• Position Tolerance I
  • True position; Position tolerance RFS
  • Using MMC or LMC
  • The “boundary” concept
  • The pitch diameter rule

Session 7
• Position Tolerance II
  • Projected tolerance zone
  • Inspecting parts for position
  • Calculating tolerance values
  • Composite position tolerance

Session 8
• Symmetry and Coaxial Controls
  • Concentricity
  • Symmetry
  • Circular runout
  • Total runout

Instructor: John-Paul Belanger
Fee $995 1.6 CEUs

Advanced GD&T Competencies: Datum Usage
Web Seminar RePlay

1.5 Hours
I.D.# PD331319ON

Web Seminar RePlays are captures of the live web seminar. The course sessions are unedited and include interactions between the instructor and live participants. A learning assessment is available at the end of the course to reinforce learning and retention and gauge your understanding of the topic.

While the basics of datums are covered in a standard Geometric Dimensioning & Tolerancing (GD&T) course, those discussions often overlook the variations that enable datums to be used in complex ways. This advanced course will detail the proper use of datums, showing their full potential to make your drawings as effective as possible. Most people who use GD&T are familiar with traditional datums derived from flat surfaces, and have adequate knowledge of the principle of establishing 3-2-1 contact points. In this web seminar, participants will learn to select, identify, simulate, and describe datums and datum features for special uses such as irregular shapes, flexible parts, and datum references that use the maximum material modifier. Also covered are several new modifiers and options given in the ASME Y14.5-2009 standard. Learning these advanced techniques will allow designers to better communicate certain requirements.

Learning Objectives
By connecting with this course, participants will be able to:
• Explain the difference between a datum and a datum feature
• Select appropriate datums for irregularly shaped parts such as body or interior panels
• Properly simulate given datums
• Explain effects of a modified datum on a geometric tolerance
• Interpret new datum tools such as translation and custom degrees of freedom

Who Should Attend
This advanced-level course is intended for designers, product engineers, manufacturing engineers, manufacturing personnel, and quality/gaging inspectors with a basic knowledge of GD&T concepts. It is a companion to the Advanced GD&T Competencies: Composite Positioning and Advanced GD&T Competencies: Profile of a Surface Web Seminar RePlays. See course descriptions on the following pages.

Prerequisites
For those new to GD&T, the Fundamentals of Geometric Dimensioning & Tolerancing web seminar or Web Seminar RePlay is a recommended prerequisite. See the course description for the on-demand Web Seminar RePlay on page 110.
ON DEMAND COURSES RESOURCE GUIDE

Topical Outline

- Brief review of traditional datum usage
- Selecting datums: surface vs. feature of size
- Use of the MMB modifier (formerly MMC)
- Using a pattern as a single datum
- The new translation modifier
- Applying the “M” modifier to a surface
- Customized degrees of freedom
- Irregular feature of size datums
- Moveable datum targets

Instructor: John-Paul Belanger
Fee $215
.15 CEUs

Is this Course for You?
This advanced-level course is intended for designers, product engineers, manufacturing engineers, manufacturing personnel, and quality/gaging inspectors with a basic knowledge of GD&T concepts. It is a companion to the Advanced GD&T Competencies: Composite Positioning and Advanced GD&T Competencies: Profile of a Surface Web Seminar RePlays. See course descriptions just before and just after this description.

Prerequisites
For those new to GD&T, the Fundamentals of Geometric Dimensioning & Tolerancing web seminar or Web Seminar RePlay is a recommended prerequisite. See the course description for the on-demand Web Seminar RePlay on page 110.

Topical Outline

- Review of profile of a surface and profile of a line
- Using profile without datums
- All around and all over
- Locating a profile zone with toleranced dimensions
- Using the MMB modifier with profile
- Composite profile
- The “U” modifier
- Nonuniform tolerancing

Instructor: John-Paul Belanger
Fee $215
.15 CEUs

Advanced GD&T Competencies: Profile of a Surface Web Seminar RePlay

1.5 Hours
I.D.# PD331320ON

Web Seminar RePlays are captures of the live web seminar. The course sessions are unedited and include interactions between the instructor and live participants. A learning assessment is available at the end of the course to reinforce learning and retention and gauge your understanding of the topic.

While the topic of profile is covered in a basic Geometric Dimensioning & Tolerancing (GD&T) course, those discussions often ignore the variations allowed with these symbols that enable them to be used in complex ways. This advanced course will clarify the proper use of the profile tolerances in GD&T and uncover the nuances of these two symbols. Since profile of a surface is arguably the most powerful GD&T symbol, its full potential will be explored. It can be used to control size, form, orientation, and location and its relationship to datums can be varied. Learning these advanced techniques will allow designers to better communicate certain requirements. The examples given in this session will also illustrate several of the new options for profile that were introduced in the ASME Y14.5-2009 standard.

Learning Objectives
By connecting with this course, participants will be able to:
• Explain when profile tolerances require a datum reference
• Determine which aspects of GD&T a given profile tolerance controls
• Interpret unilateral, bilateral, and nonuniform tolerances
• Describe how to properly measure profile tolerances

Advanced GD&T Competencies: Composite Positioning Web Seminar RePlay

1.5 Hours
I.D.# PD331321ON

Web Seminar RePlays are captures of the live web seminar. The course sessions are unedited and include interactions between the instructor and live participants. A learning assessment is available at the end of the course to reinforce learning and retention and gauge your understanding of the topic.

While the basics of position are covered in a standard Geometric Dimensioning & Tolerancing (GD&T) course, and sometimes a lone example of composite position is given, those discussions often overlook the variations allowed that enable more accurate control based on part function. This advanced course will clarify the proper use of “double-decker” position controls in GD&T. There are two distinct types: composite position (one symbol) and two single-segment position controls (two symbols). These are commonly used to locate patterns of features (bolt circles, etc.), but they are rarely taught in any depth. In this course,
participants will learn the difference in showing one vs. two position symbols and the importance of the datum references in understanding each meaning, per the ASME Y14.5-2009 standard. Many samples will be shown of the proper tolerancing of patterns of holes and pins that use each method. Examples and exercises will be provided to allow participants to practice several calculations. Learning these advanced techniques will permit better communication of part and assembly requirements between designers and manufacturers.

Learning Objectives
By connecting with this course, participants will be able to:
• Explain composite positioning tolerancing
• Explain two single-segment tolerancing
• Apply the appropriate callout based on functional requirements
• Describe gages for each and calculate gage sizes

Who Should Attend
This advanced-level course is intended for designers, product engineers, manufacturing engineers, manufacturing personnel, and quality/gaging inspectors with a basic knowledge of GD&T concepts. It is a companion to the Advanced GD&T Competencies: Profile of a Surface And Advanced GD&T Competencies: Datum Usage Web Seminar RePlays immediately before this course.

Prerequisites
For those new to GD&T, the Fundamentals of Geometric Dimensioning & Tolerancing web seminar or Web Seminar RePlay is a recommended prerequisite. See the course description for the on-demand Web Seminar RePlay on page 110.

Topical Outline
• Brief review of position and bonus tolerance
• Explanation of composite tolerancing
• The need to control orientation vs. location
• Adding secondary and tertiary datums to the lower tolerance
• Two single-segment position tolerancing
• Functional gaging and CMM gaging perspectives

Instructor: John-Paul Belanger
Fee $215 .15 CEUs

MANAGEMENT: LEADERSHIP

Doing the Right Things Right
30 Minutes
I.D.# PD271715

This is a highly interactive on-demand course featuring video, demos, and knowledge checks designed to reinforce learning.

Are you spending your work time where you should? To be effective and efficient requires thinking, teaming, and tactical skills. How are you using your skills and building those you need to successfully execute in your leadership role? Based on the book by bestselling author and award-winning speaker Laura Stack, Doing the Right Things Right: How the Effective Executive Spends Time, this course focuses on how today’s leaders and managers can obtain profitable, productive results by managing the intersection of two critical values: effectiveness and efficiency. Stack describes her 3T Leadership model which offers twelve practices that will enable executives to apply these values, grouped into three areas where leaders spend their time: Strategic Thinking, Teamwork, and Tactics.

Following an assessment of personal productivity practices, you will learn how to build and apply these practices to situations that require making tough choices about managing your time. With her expert advice, you’ll get scores of new ideas on how you, your team, and your organization can boost productivity. The learning experience is fun and challenging, as you move beyond learning what to do into practicing how to do it when faced with today’s time management complexities.

Learning Objectives
• Fulfill the role of an executive who makes strategic decision, focuses on team efforts, and performs tactical work on behalf of an organization
• Leverage the intersection between efficiency and effectiveness
• Identify your assets and liabilities related to thinking, teaming and tactics
• Model best practices of productivity pros who get the right things done right
• Build skills in strategic thinking, team focus and tactical work

Is this Course for You?
Managers, supervisors, team leaders, HR and benefits professionals, project managers, business owners and executives who wish
to enhance their leadership skills for the betterment of themselves and their organizations.

**Content Highlights**
- Part one—How the Effective Executive Spends Time
- Part two—The Three T Leadership Assessment
- Part three—Become a Productivity Pro

**Out Innovate the Competition**

25 Minutes  
I.D.# PD271714

This is a highly interactive on-demand course featuring video, demos, and knowledge checks designed to reinforce learning.

Well-intentioned leaders, in their attempts to boost innovation, are inadvertently destroying it. Based on Stephen Shapiro’s bestselling book, Best Practices are Stupid: Ways to Out-Innovate the Competition, this online learning experience offers counterintuitive yet proven strategies for boosting innovation and making it a repeatable, sustainable, and profitable process. He teaches that innovation isn’t just about generating occasional new ideas; it’s about staying consistently one step ahead of the competition. Shapiro shows that non-stop innovation is attainable and vital to building high-performing teams, improving financial outcomes, and staying competitive with peer organizations. Using self-assessment, the goal is to challenge you to think differently about how you approach innovation.

**Learning Objectives**

- Recognize the importance of attracting, keeping, and growing your people
- The power of focusing on better futures by reinvesting in customers
- Why giving back and growing communities reinforces growth for your company
- Create a meaningful purpose that truly engages today’s workers
- Build a strong purpose into the fabric of the organization
- Build healthier, more focused, and harder working teams
- Find and select the right people for your company culture
- Learn to deeply connect with team members for a long term relationship
- Learn the power of discovery conversations
- Understand the four things you have to let go of
- Let go of the habits, and bureaucracy which slow us down
- Learn how to change, innovate, and grow faster, by letting go
- Learn the four keys to Steward Leadership: sharing power, putting others first, caring, and preserving resources
- Learn how to build team alignment toward growth

**Is this Course for You?**

Managers, supervisors, team leaders, HR and benefits professionals, project managers, business owners and executives who wish to enhance their leadership skills for the betterment of themselves and their organizations.

**Instructor:**  
Stephan Shapiro  
Fee $75  
There are no CEUs offered for this course.
Topical Outline
Part 1: Growth
• Introduction
• About Growth
• Why Growth?
• People Want and Make Growth
• Benefits of Growth
• Commit to Growth
• Final Assessment
Part 2: Purpose
• Introduction
• About Purpose
• People with Purpose
• Self-Check
• A Better Life for Many
• Companies with Purpose
• Purpose: Bold and Authentic; Not What but Why
• Purpose: It’s Not Financial; Fixes and Injustices
• Purpose: A Journey; Gives Meaning to Life
• Self-Check
• Your Purpose Statement
• Final Assessment
Part 3: Communication
• Introduction
• Connect with People
• Be Interested, Not Interesting
• Self-Check
• Discovery Conversation
• Get Started on the Discovery
• Take the Journey
• The Discovery Destination
• Discovery and Staffing
• Summary
• Final Assessment
Part 4: Letting Go
• Introduction
• About Letting Go
• Catching Monkeys
• Let Go of Four Things
• The Leader’s Challenge
• Letting Go Planner
• Final Assessment
Part 5: Stewardship
• Introduction
• Case Scenario
• About Stewardship
• The Personality of Stewards
• Closing Questions
• Your Leadership Charter
• Final Assessment

Instructor: Jason Jennings
Fee $199 0.1 CEUs

The Art of Leadership Presence
40 Minutes
I.D.# PD271738
This is a highly interactive on-demand course featuring video, demos, and knowledge checks designed to reinforce learning.

Stuff happens. Maybe your team responds to an idea in a way you never expected. Maybe the people who were supposed to show up didn’t. Maybe a colleague expresses concern with your leadership style. Maybe someone finds a serious error in the report.

We all experience surprises. What if you could meet these surprises with ease and confidence? And what if you could create, through your own personal presence, space for more positive, collaborative engagements between people?

You can when you adopt the mindset of an improv actor! This means learning and practicing how to show up and be ready – ready to lead, to influence, and to contribute whether things go the way you expected or not. And to have leadership presence: something that builds the trust we need to work together through good times and bad.

Learning Objectives
• Identify how leadership presence can benefit your work situation
• Recognize the value of different types of leadership presence
• Create a skill development plan for increasing trust and influence at work
• Acknowledge the power of non-verbal communication and how to use body language and eye contact to demonstrate leadership confidence
• Practice techniques to exude confidence when speaking to others
• Build trust through preparation and follow-through
• Enhance respectful and accountable behavior when playing a team leadership role
• Expand capabilities to use body and mind when dealing with chaos
• Recognize how to acknowledge, deal, and move on from difficult situations

Is this Course for You?
Emerging leaders, managers, and individual contributors whose effectiveness would be enhanced through confidence, consistency and remaining calm in chaos. Participants who want to build trust, influence others and deliver strong presentations will benefit from this course.
ON DEMAND COURSES RESOURCE GUIDE

Content Highlights
- Part 1: Develop Leadership Presence
- Part 2: Build Leadership Confidence
- Part 3: Practice and Promote Consistency
- Part 4: Remain Calm in Chaos

Instructor: Karen Hough
Fee $199 0.1 CEUs

MANAGEMENT: PRODUCT DEVELOPMENT

Patent Litigation in the U.S.: What You Need to Know Web Seminar RePlay

4 Hours
I.D.# PD330940N

Web Seminar RePlays are captures of the live web seminar. The course sessions are unedited and include interactions between the instructor and live participants. A learning assessment is available at the end of the course to reinforce learning and retention and gauge your understanding of the topic.

In today’s economic environment, patents have become an increasingly important asset for both individuals and corporations. More and more, individuals and corporations, including those in the automotive and aerospace industries, are recognizing the economic importance of patent rights, whether those rights consist of a single patent, a family of patents or an entire portfolio. Indeed, some companies do not make or sell products; their entire revenue is derived from the licensing of their patents. Suffice it to say, licensing revenue has become a significant source of value in the global intellectual property economy.

This course focuses on the intricacies of patents, patent infringement litigation, and patent licensing. Participants will explore the important subjects of obtaining U.S. and foreign patents, maintaining U.S. and foreign patent rights, enforcing patent rights, defending against patent rights asserted by competitors, and licensing patent rights for revenue. Upon completion, you will effectively understand patents and ways to protect and monetize your company’s valuable inventions. Your new knowledge will help your company maintain and enhance its position in the an increasingly competitive marketplace.

Learning Objectives
By connecting with this course, participants will be able to:
- Explain U.S. patent rights, including how patents are obtained and maintained
- Provide an overview of U.S. patent litigation, including recent changes under the The Leahy-Smith America Invents Act (AIA)
- Anticipate the scope of discovery in and avoid the potential business disruption arising from a U.S. patent case
- Explain the basic legal principles for liability and damages in patent cases
- Describe how patent disputes are resolved
- Predict the fees and expenses associated with bringing and/or defending a patent case in the U.S.
- Peek into the future of potential patent law reform

Who Should Attend
This course is geared toward executives, in-house counsel, in-house patent agents, and senior managers across industries, including automotive and aerospace. Participants may be both U.S. and non-U.S. -- anyone who needs help in understanding what to expect and what the practical realities are should they become involved in U.S. patent litigation.

This course complements the Patent Litigation Risk Management Toolkit web seminar or Web Seminar RePlay, which provides practical guidance to help keep businesses out of patent infringement litigation.

Topical Outline
Session 1
- Overview of Patent Litigation
  - Recent headlines
  - Scope of patent protection
  - Issues the patent-owner has to prove
  - Issues the accused infringer has to prove
- What is the Scope of Discovery?
  - Documents, including e-documents
  - Depositions
  - Third parties (e.g. customers, suppliers)
  - Confidentiality of discovery materials
- Who Decides Liability and Damages?
  - Jury
  - Judge
  - Mediator/Arbitrator

Session 2
- How Long Does it Take from Filing to Trial?
  - District Courts
  - ITC

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- How Much Does it Cost?
  - Fees and expenses
  - Contingency fees
  - Recovery of fees and expenses
- Practical Issues in Patent Licensing
  - Exclusivity considerations
  - Other permissible limitations
  - Royalty calculations
- What Changes are on the Horizon?
  - Supreme Court
  - Patent law reform

Instructor: William Cory Spence
Fee $425 .4 CEUs

QUALITY ASSURANCE

Principles of ISO 9001, ISO/TS 16949, and AS9100

.35 Hours
I.D.# PD530824ON

This is a highly interactive on-demand course featuring video, demos, and knowledge checks designed to reinforce learning.

Understanding the purpose and intended use of standards, directives and requirements sets the foundation for developing a functional management system. This 35-minute, online short course is intended to present ISO 9001, ISO/TS 16949 and SAE AS9100 as purpose driven management systems that are necessary for companies to survive in our fast-moving economy.

The Principles of ISO 9001, ISO/TS 16949, and AS9100 on-demand course provides those in the automotive and aerospace industries with a high-level overview of these quality management system standards. It is designed to explore the history that lead to the development of the standards. The course also highlights the need for organizations to determine the necessary competence for personnel performing work affecting product quality, provide training or take other actions to satisfy these needs, evaluate the effectiveness of the actions taken, to ensure that personnel are aware of the relevance and importance of their activities and how they contribute to the achievement of the quality objectives, and maintain appropriate records of education, training, skills and experience.

A more in-depth on-demand option for the FMEA topic is in development. Contact Corporate Learning Solutions to discuss availability and learning options that best fit your need.

Learning Objectives
By participating in this on-demand course, students will be able to:
- Recognize the need for international, imposed quality management systems and standards
- Describe the history leading up to the ISO 9001
- Explain why the Automotive and Aerospace industries need specific supplements to the ISO 9001
- Identify key elements of a quality management system incorporated in the quality management standards, including configuration management and continuous improvement
- Describe the Plan, Do, Check, Act process and summarize how it can be applied to all processes to increase production and reduce waste
- Define key terms used with the quality standards and summarize key elements included in sections 1-10 of ISO 9001:2015

Major topics include:
- The Cost of Poor Quality
- History and Development of the ISO 9001, ISO/TS 16949 and AS9100
- Quality Management System Principles and the Process Approach
- Terms and Definitions
- Overview of the Sections in ISO 9001:2015

Is this On-Demand Course for you?
In all three standards, paragraph 6.2.2 states the need for competence, awareness and training. Management and personnel in all departments from sales and marketing to engineering, purchasing, production, customer service, receiving, packaging, storage, shipping, and beyond will benefit from the purpose driven management systems that are necessary to deliver customer satisfaction and survive in the global economy.

What You Will Receive
- 90 days of on line, on-demand single-user access to the .35 hour course
- A printable summary of the key takeaways from each lesson
- Integrated knowledge checks to reinforce key concepts
Introduction to Advanced Product Quality Planning (APQP)

1 Hour
I.D. # PD530908ON

This is a highly interactive on-demand course featuring video, demos, and knowledge checks designed to reinforce learning.

To become a preferred supplier in the automotive industry, organizations must demonstrate high-level engineering and organizational capabilities that will meet customers’ needs today and tomorrow. Because the outcome of a product development project may determine whether or not an organization procures a purchase order or contract from a global automotive customer, Introduction to Advanced Product Quality Planning provides an overview of the best practices / methodologies for planning and managing the successful launch of a new product.

The benefits of a successful new product launch are recognized by both global automotive customers and suppliers. There are thousands of great inspirations and great ideas each year, but the difficult task that so many organizations struggle with is how to take those ideas and develop them into a viable product design, and then manufacture the designed product, and then distribute and sell the product. An understanding of the Advanced Product Quality Planning (APQP) process, the management of the process, and the implementation of the process is critical to the product development multi-disciplinary team which includes top management, the project manager, product engineering, process engineering, design and development, manufacturing, quality, and purchasing personnel.

While the course module is approximately one hour in length, the estimated time to completion, including knowledge checks and the learning assessment, is one hour, 30 minutes.

Learning Objectives

By connecting with this course, participants will be able to:

• Explain what APQP is, including its purpose and the goals of an effective APQP process
• Identify the impacts and benefits that an effective APQP process has on both the customer and the supplier
• Describe how an APQP process can be integrated into an organization’s business management system

Major topics include:

• What is APQP
• Purpose of APQP
• APQP Integration
• Developing a Master Plan for New Products
• APQP Benefits

Is this Course for You?

Participants in the Introduction to Advanced Product Quality Planning (APQP) on-demand course will gain a ‘common-sense’ perspective for successful new product launches and what needs to be done to comply with automotive customer specific requirements. Participants will also understand how to apply the concepts of ‘front-end’ planning (via the APQP process) that will result in continual improvement of products and services for both the customer and the supplying organization. This course is relevant to individuals with limited or general knowledge of the APQP process and some experience with introducing new products or new manufacturing processes.

What You Will Receive

• 90 days of online single-user access (from date of purchase) to the one hour presentation
• A printable summary of the key takeaways from each lesson
• Integrated knowledge checks to reinforce key concepts
• Instructor follow-up to your content questions
• 0.1 CEUs/Certificate of Achievement (with satisfactory learning assessment score)

Instructor: Larry Bissell
Fee $90 .1 CEUs

Instructor follow-up to your content questions
Proof of Participation

<table>
<thead>
<tr>
<th>Instructor</th>
<th>Joseph Sorrentino</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fee $60</td>
<td>There are no CEUs offered for this course.</td>
</tr>
</tbody>
</table>

Instructor follow-up to your content questions
Proof of Participation

4 Hours  
I.D.# PD331617ON

Web Seminar RePlays are captures of the live web seminar. The course sessions are unedited and include interactions between the instructor and live participants. A learning assessment is available at the end of the course to reinforce learning and retention and gauge your understanding of the topic.

In a global economy, aviation, space and defense organizations are presented the challenge of producing and delivering safe and reliable products across a wide range of customer requirements and expectations. In an effort to address diverse quality requirements and expectations while also reducing costs throughout the supply chain, the SAE AS9100 family of standards was developed by international aerospace industry representatives to standardize international aerospace quality management system requirements.

This on-demand course offers insights into the SAE AS9100D:2016 and ISO 9001:2015 significant changes as they adopt the common management system structure. It will include material on the standard’s development process including timelines, new Common Management System Structure, AS9100D:2016 and ISO 9001:2015 Requirement Review and reference material for gap analysis and successful implementation.

Learning Objectives

Upon completion, the participant should be able to:

• Recognize the impact to new Quality Management Principles on the revision to the standards
• De-mystify the new 10-clause Common Management System structure and understand the impact on your organization
• Grasp the new language like organization and its context, interested parties, documented information, and risk-based thinking
• Realize the Aviation, Space & Defense proposed additions to understand benefits
• Gain an understanding of the SAE AS9100D:2016 and ISO 9001:2015 requirements and intent
• Define the timeline for AS9100D:2016 transition period

Is this Course for You?

The course is designed for quality managers, management representatives, auditors, engineers, supply chain managers and other professionals. AQMS Implementers will comprehend SAE AS9100D:2016 requirements for application at your organization. AQMS Internal Consultants will understand the intent to apply value-added implementation of the requirement. AQMS Auditors will comprehend requirements to confidently audit requirements at your organization. AQMS Executives and Management Represen-
tatives will better understand how to use AS9100D:2016 requirements to drive cost savings improvement. Individuals wanting an improved AQMS process understanding to integrate AS9100D:2016 requirements into company processes will also benefit.

Topical Outline

• Standards Development Process
• New Common Management System Structure and Language
• ISO 9001:2015 and AS9100D:2016 New Requirements
  • Introduction of additions to the standard
  • Impact of new AS9100D and ISO 9001:2015 requirements to your business
  • Context of the Organization
  • Leadership
  • Planning
  • Support
  • Session 2
  • Operation
  • Performance Evaluation
  • Improvement
• Summary
  • Techniques to ensure the QMS is effective in meeting customer expectations
  • Reference resources for gap analysis and successful implementation

Instructor: Buddy Cressionnie

Fee $425 .4 CEUs

CALISO COURSES FOR INTERNATIONAL STANDARDS

Good Laboratory Practices (GLP) Training – CALISO On-Demand Course

8 Hours  
I.D.# GLP

GLP refers to a Quality Systems of management controls for laboratories and research organizations to ensure the consistency and reliability and reproducibility of results. The original regulatory enforcement was first published by FDA and then a few years later by EPA. It is also outlined in the Organization for Economic...
Co-operation and Development (OECD) Principles of GLP in 1992 and has since been added to many national regulations. Your company, and all who partake in the daily activities of running a laboratory or a research and testing center, will benefit from this course. This 8-hour GLP (.8 CEU) overview is particularly adapted for training all levels of an organization on the requirements of this standard.

**Major topics include:**
- Scope
- Definitions
- Inspection of a testing facility
- Personnel
- Testing facility management
- Quality assurance unit
- General
- Animal care facilities

**This SAE/CALISO course is for you if you:**
- Want to quickly and efficiently get a comprehensive training of GOOD LABORATORY PRACTICES (GLP)
- Want to improve your CV and career opportunities with qualifications in quality assurance

This is an internet-delivered course featuring graphical presentation screens with text-based instruction, videos, and on-going quizzes to reinforce learning and retention and gauge your understanding of a topic before you move forward. An online training certificate will be issued upon successful completion of the course and obtaining 70% or above on the final average of the ongoing quizzes.

Fee: $195.95 0.8 CEUs

**ISO 9001 Overview – CALISO On-Demand Course**

4 Hours
I.D.# ISO9001OVERVIEW

ISO 9001 is a quality management standard developed by the International Organization for Standardization (ISO). The ISO 9001 standard is generic and can be used for any organization, whether it provides physical products or services. The requirements must be carefully interpreted to make sense within a particular organization. Developing automotive products is not like producing food products or offering consulting services; yet the ISO 9001 standard, because it is business and management oriented, can be applied to any activity. It is the most widely used quality management standard in the world. This four-hour ISO 9001 overview is particularly adapted for training top management on the high level requirements.

**Major topics include:**
- General Requirements of ISO 9001
- Management Responsibility
- Resource Management
- Product Realization (summary)
- Measurement, Analysis and Improvement

This SAE/CALISO course is for you if you:
- Want to quickly and efficiently get a comprehensive overview of ISO 9001:2008
- Want to improve your CV and career opportunities with qualifications in ISO 9001
- Want to upgrade your expertise from auditing ISO 9001:2000 to ISO 9001:2008
- Want to upgrade your expertise from auditing with ISO 10011-1 to ISO 19011:2002

This is an internet-delivered course featuring graphical presentation screens with text-based instruction, videos, and on-going quizzes to reinforce learning and retention and gauge your understanding of a topic before you move forward. An online training certificate will be issued upon successful completion of the course and obtaining 70% or above on the final average of the ongoing quizzes.

Fee: $159.95 0.4 CEUs

**ISO 9001:2008 Training – CALISO On-Demand Course**

8 Hours
I.D.# ISO9001TRAINING

ISO 9001 is a quality management standard developed by the International Organization for Standardization (ISO). Your company and all who partake in the daily activities of running the business will benefit from taking ISO 9001 training. This eight-hour ISO 9001 (.8 CEU) overview is particularly adapted for training all levels of an organization on the requirements of this standard.

**Major topics include:**
- General Requirements of ISO 9001
- ISO 9001 Vocabulary
- Management Responsibility
- Resource Management
- Product Realization
- Measurement, Analysis and Improvement

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This SAE/CALISO course is for you if you:

- Want to quickly and efficiently get a comprehensive training of ISO 9001:2008
- Want to improve your CV and career opportunities with qualifications in quality assurance
- Want to upgrade your expertise from ISO 9001:2000 to ISO 9001:2008

This is an internet-delivered course featuring graphical presentation screens with text-based instruction, videos, and on-going quizzes to reinforce learning and retention and gauge your understanding of a topic before you move forward. An online training certificate will be issued upon successful completion of the course and obtaining 70% or above on the final average of the ongoing quizzes.

Fee: $229.95 0.8 CEUs

ISO 9001:2008 Auditor Training – CALISO On-Demand Course

8 Hours
I.D.# ISO9001AUDITOR

ISO 9001 is a quality management standard developed by the International Organization for Standardization (ISO). Your company and all who partake in the daily activities of running the business will benefit from taking ISO 9001 training. The eight-hour (.8 CEU) ISO 9001 Auditor course provides training on the standard itself and on how to lead or conduct internal audits and supplier audits using ISO 19011, the guideline standard on how to audit management systems.

Major topics include:

- General Requirements of ISO 19011
- Auditing techniques
- QMS Auditing Case Studies

This SAE/CALISO course is for you if you:

- Want to quickly and efficiently learn how to lead an ISO 9001:2008 audit
- Want to quickly and efficiently be trained on ISO 9001 (the standard), and ISO 9000 (the vocabulary for the standard)
- Want to be a lead auditor to conduct internal audits and supplier audits for your company
- Want to improve your CV and career opportunities with qualifications in quality assurance and leading 1st part audits
- Want to upgrade your expertise from auditing ISO 9001:2000 to ISO 9001:2008

This SAE/CALISO course is for you if you:

- Want to upgrade your expertise from auditing with ISO 10011-1 to ISO 19011:2002

This is an internet-delivered course featuring graphical presentation screens with text-based instruction, videos, and on-going quizzes to reinforce learning and retention and gauge your understanding of a topic before you move forward. An online training certificate will be issued upon successful completion of the course and obtaining 70% or above on the final average of the ongoing quizzes.

Fee: $249.95 0.8 CEUs

ISO 9001:2008 Lead Auditor – CALISO On-Demand Course

22 Hours
I.D.# ISO9001LEADAUDITOR

As described in the previous ISO 9001 Overview description, ISO 9001 is a quality management standard developed by the International Organization for Standardization (ISO). Your company and all who partake in planning, leading and conducting the audit activities of running the business will benefit from taking ISO 14001 Auditor training. The 22-hour (2.2 CEU) ISO 9001 Auditor course provides training on the standard itself and on how to lead or conduct internal audits and supplier audits using ISO 19011, the guideline standard on how to audit management systems.

Major topics include:

- General Requirements of ISO 9001
- Management Responsibility
- Resource Management
- Product Realization
- Measurement, Analysis and Improvement
- General Requirements of ISO 19011
- Auditing techniques
- QMS Auditing Case Studies

This SAE/CALISO course is for you if you:

- Want to quickly and efficiently learn how to conduct an ISO 9001:2008 audit
- Want to quickly and efficiently be trained on ISO 9001 (the standard), and ISO 9000 (the vocabulary for the standard)
- Want to conduct internal audits and supplier audits for your company
- Want to improve your CV and career opportunities with qualifications in quality assurance and leading 1st part audits
- Want to upgrade your expertise from auditing ISO 9001:2000 to ISO 9001:2008

This SAE/CALISO course is for you if you:

- Want to upgrade your expertise from auditing with ISO 10011-1 to ISO 19011:2002
This is an internet-delivered course featuring graphical presentation screens with text-based instruction, videos, and on-going quizzes to reinforce learning and retention and gauge your understanding of a topic before you move forward. An online training certificate will be issued upon successful completion of the course and obtaining 70% or above on the final average of the ongoing quizzes.

**ISO 9001:2015 Overview – CALISO On-Demand Course**

4 Hours  
I.D.# ISO-9001-2015-OVERVIEW

ISO 9001:2015 is a quality management standard developed by the International Organization for Standardization (ISO). The ISO 9001:2015 standard is generic and can be used for any organization, whether it provides physical products or services. The requirements must be carefully interpreted to make sense within a particular organization. Developing automotive products is not like producing food products or offering consulting services; yet the ISO 9001:2015 standard, because it is business and management oriented can be applied to any activity. It is the most widely used quality management standard in the world.

**Major topics include:**
- Process Approach
- Risk-based Thinking
- General Requirements of ISO 9001:2015
- Context of the organization
- Leadership
- Planning
- Support
- Performance Evaluation
- Improvement

**This SAE/CALISO course is for you if you:**
- Want to quickly and efficiently get a comprehensive overview of ISO 9001:2015
- Want to improve your CV and career opportunities with qualifications in ISO 9001
- Want to upgrade your expertise from auditing ISO 9001:2008 to ISO 9001:2015
- Do NOT have time to allocate a full day to take an ISO 9001:2015 overview class
- Want to train more of your staff on auditing economically and without having to immobilize them in a class for a full day

**Fee:** $199.95  
0.4 CEUs

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- Want to upgrade your expertise from ISO 9001:2008 to ISO 9001:2015
- Do NOT have time to allocate a 2 full days to take an ISO 9001:2015 class
- Want to train more of your staff on auditing economically and without having to immobilize them in a class for a full day

This is an internet-delivered course featuring graphical presentation screens with text-based instruction, videos at certain stages of the course delivery, and on-going quizzes are incorporated throughout the course to reinforce learning and retention and gauge your understanding of a topic before you move forward. Convenient and portable, this course provides instruction without the expense of travel and time away from the workplace. An online training certificate will be issued upon successful completion of the course and obtaining 70% or above on the final average of the ongoing quizzes, or in a final exam provided for trainees with a score inferior of 70%. You can take this course using a laptop or PC with an internet connection, at your own pace, and at times convenient to you.

Fee: $289.95 0.8 CEUs

ISO 9001:2015 Auditor Training – CALISO On-Demand Course
1.8 Hours
I.D.# ISO-9001-2015-AUDITOR

ISO 9001:2015 is a quality management standard developed by the International Organization for Standardization (ISO). The ISO 9001:2015 standard is generic and can be used for any organization, whether it provides physical products or services. The requirements must be carefully interpreted to make sense within a particular organization. Developing automotive products is not like producing food products or offering consulting services; yet the ISO 9001:2015 standard, because it is business and management oriented can be applied to any activity. It is the most widely used quality management standard in the world.

Major topics include:
- General Requirements of ISO 19011
- Auditing techniques
- QMS Auditing Case Studies

This SAE/CALISO course is for you if you:
- Want to quickly and efficiently learn how to lead an ISO 9001:2015 audit
- Want to quickly and efficiently be trained on ISO 9001:2015 (the standard), and ISO 9000 (the vocabulary for the standard)

Fee: $319.95 0.8 CEUs

ISO 9001:2015 Lead Auditor – CALISO On-Demand Course
32 Hours
I.D.# ISO 9001-2015-LEAD-AUDITOR

ISO 9001:2015 is a quality management standard developed by the International Organization for Standardization (ISO). The ISO 9001:2015 standard is generic and can be used for any organization, whether it provides physical products or services. The requirements must be carefully interpreted to make sense within a particular organization. Developing automotive products is not like producing food products or offering consulting services; yet the ISO 9001:2015 standard, because it is business and management oriented can be applied to any activity. It is the most widely used quality management standard in the world.

Major topics include:
- General Requirements of ISO 9001:2015
- Management Responsibility
- Resource Management
ON DEMAND COURSES RESOURCE GUIDE

- Product Realization
- Measurement, Analysis and Improvement
- General Requirements of ISO 19011
- Auditing techniques
- QMS Auditing Case Studies

**This SAE/CALISO course is for you if you:**
- Want to quickly and efficiently learn how to conduct an ISO 9001:2015 audit
- Want to quickly and efficiently be trained on ISO 9001:2015 (the standard), and ISO 9000 (the vocabulary for the standard)
- Want to conduct internal audits and supplier audits for your company
- Want improve your CV and career opportunities with qualifications in quality assurance and leading 1st part audits
- Do NOT have time to allocate a 2-5 days to take an ISO 9001:2015 Lead Auditor class
- Want to train more of your staff on auditing economically and without having to immobilize them in a class for a full day

This is an internet-delivered course featuring graphical presentation screens with text-based instruction, videos at certain stages of the course delivery, and on-going quizzes are incorporated throughout the course to reinforce learning and retention and gauge your understanding of a topic before you move forward. Convenient and portable, this course provides instruction without the expense of travel and time away from the workplace. An online training certificate will be issued upon successful completion of the course and obtaining 70% or above on the final average of the ongoing quizzes, or in a final exam provided for trainees with a score inferior of 70%. You can take this course using a laptop or PC with an internet connection, at your own pace, and at times convenient to you.

**Fee:** $399.95 2.2 CEUs

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**ISO 14001:2004 Training – CALISO On-Demand Course**

8 Hours
I.D.#ISO14001

ISO 14001 is an environmental management standard (EMS) developed by the International Organization for Standardization (ISO). The ISO 14001 standard is generic and can be used for any organization, whether it provides physical products or services. The requirements must be carefully interpreted to make sense within a particular organization. Developing automotive products and the environmental impact of this activity is not like producing food products or offering consulting services; yet the ISO 14001 standard, because it is business and management oriented can be applied to any activity. It is the most widely used EMS standard in the world.

Your company and all who partake in the daily activities of running the business will benefit from taking ISO 14001 training. This eight-hour ISO 14001 (.8 CEU) overview is particularly adapted for all members of the organization.

**Major topics include:**
- General Requirements of ISO 14001
- ISO 14001 Vocabulary
- Environmental Policy
- Planning
- Implementation and Operation
- Checking
- Management Review

**This SAE/CALISO course is for you if you:**
- Want to quickly and efficiently get a comprehensive training of ISO 14001:2004
- Want to improve your CV and career opportunities with qualifications in EMS
- Do NOT have time to allocate two full days to take an environmental management class
- Want to train more of your staff on auditing economically and without having to immobilize them in a class for a full day

This is an internet-delivered course featuring graphical presentation screens with text-based instruction, videos, and on-going quizzes to reinforce learning and retention and gauge your understanding of a topic before you move forward. An online training certificate will be issued upon successful completion of the course and obtaining 70% or above on the final average of the ongoing quizzes.

**Fee:** $219.95 0.8 CEUs

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**ISO 14001:2004 Auditor Training – CALISO On-Demand Course**

8 Hours
I.D.#ISO14001AUDITOR

ISO 14001 is an environmental management standard (EMS) developed by the International Organization for Standardization (ISO). The ISO 14001 standard is generic and can be used for any organization, whether it provides physical products or services. The requirements must be carefully interpreted to make sense

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within a particular organization. Developing automotive products and the environmental impact of this activity is not like producing food products or offering consulting services; yet the ISO 14001 standard, because it is business and management oriented can be applied to any activity. It is the most widely used EMS standard in the world. Your company and all who partake in the daily activities of running the business will benefit from taking ISO 14001 training. This eight-hour (.8 CEU) ISO 14001 Auditor course provides training on the standards and how to conduct internal audits and supplier audits using ISO 19011, the guideline standard on how to audit management systems.

**Major topics include:**
- General Requirements of ISO 19011
- Auditing Techniques
- EMS Auditing Case Studies

**This SAE/CALISO course is for you if you:**
- Want to quickly and efficiently learn how to lead an ISO 14001:2004 audit
- Want to quickly and efficiently be trained on ISO 14001 (the standard) and ISO 14000 (the vocabulary for the standard)
- Want to be a lead auditor to conduct internal audits and supplier audits for your company
- Want to improve your CV and career opportunities with qualifications in EMS and leading first part and second party audits
- Want to upgrade your expertise from auditing with ISO 10011-1 to ISO 19011:2002
- Do NOT have time to allocate two full days to take an ISO 14001 auditor class
- Want to train more of your staff on auditing economically and without having to immobilize them in a class for a full day

This is an internet-delivered course featuring graphical presentation screens with text-based instruction, videos, and on-going quizzes to reinforce learning and retention and gauge your understanding of a topic before you move forward. An online training certificate will be issued upon successful completion of the course and obtaining 70% or above on the final average of the ongoing quizzes.

**Fee:** $249.95 .8 CEUs

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**ISO 14001:2004 Lead Auditor – CALISO On-Demand Course**

**22 Hours**

**I.D.#ISO14001LEADAUDITOR**

As described in the previous ISO 14001 course description, ISO 14001 is an environmental management standard (EMS) developed by the International Organization for Standardization (ISO). Your company and all who partake in planning, leading and conducting the EMS audit activities of your business and managing its environmental program will benefit from taking ISO 14001 training. The 22-hour (2.2 CEU) ISO 14001 Lead Auditor course is the most comprehensive training on the subject. It provides training on the standard itself but also on how to lead or conduct internal audits and supplier audits using ISO 19011, the guideline standard on how to audit management systems.

**Major topics include:**
- General Requirements of ISO 14001
- ISO 14001 Vocabulary
- Environmental Policy
- Planning
- Implementation and Operation
- Checking
- Management Review
- General Requirements of ISO 19011
- Auditing Techniques
- EMS Auditing Case Studies

**This SAE/CALISO course is for you if you:**
- Want to quickly and efficiently learn how to lead an ISO 14001:2004 audit
- Want to quickly and efficiently be trained on ISO 14001 (the standard), and ISO 14000 (the vocabulary for the standard)
- Want to be a lead auditor to conduct internal audits and supplier audits for your company
- Want to improve your CV and career opportunities with qualifications in EMS and leading first part and second party audits
- Want to upgrade your expertise from auditing with ISO 10011-1 to ISO 19011:2002

This is an internet-delivered course featuring graphical presentation screens with text-based instruction, videos, and on-going quizzes to reinforce learning and retention and gauge your understanding of a topic before you move forward. An online training certificate will be issued upon successful completion of the course and obtaining 70% or above on the final average of the ongoing quizzes.

**Fee:** $319.95 2.2 CEUs
ISO 14001:2015 Overview – CALISO
On-Demand Course
4 Hours
I.D.#ISO-14001-2015-OVERVIEW
ISO 14001:2015 is an environmental management standard (EMS) developed by the International Organization for Standardization (ISO). The ISO 14001 standard is generic and can be used for any organization, whether it provides physical products or services. The requirements must be carefully interpreted to make sense within a particular organization. Developing automotive products and the environmental impact of this activity is not like producing food products or offering consulting services; yet the ISO 14001 standard, because it is business and management oriented can be applied to any activity. It is the most widely used EMS standard in the world.

Your company and all who partake in the daily business activities will benefit from taking ISO 14001:2015 training. This overview course is particularly adapted for training top management on the high level requirements of this standard.

Major topics include:
• General Requirements of ISO 14001:2015
• Section 4. Context of the organization
• Section 5. Leadership
• Section 6. Planning
• Section 7. Support
• Section 9. Performance Evaluation
• Section 10. Improvement

This SAE/CALISO course is for you if you:
• Want to quickly and efficiently get a comprehensive overview of ISO 14001:2015
• Want to improve your CV and career opportunities with qualifications in ISO 14001
• Want to upgrade your expertise from auditing ISO 14001:2008 to ISO 14001:2015
• Do NOT have time to allocate a full day to take an ISO 14001:2015 overview class
• Want to train more of your staff on auditing economically and without having to immobilize them in a class for a full day

This is an internet-delivered course featuring graphical presentation screens with text-based instruction, videos, and on-going quizzes to reinforce learning and retention and gauge your understanding of a topic before you move forward. An online training certificate will be issued upon successful completion of the course and obtaining 70% or above on the final average of the ongoing quizzes.

Fee: $189.95 .4 CEUs

ISO 14001:2015 Training – CALISO
On-Demand Course
10 Hours
I.D.#ISO14001TRAINING
ISO 14001:2015 is an environmental management standard (EMS) developed by the International Organization for Standardization (ISO). The ISO 14001 standard is generic and can be used for any organization, whether it provides physical products or services. The requirements must be carefully interpreted to make sense within a particular organization. Developing automotive products and the environmental impact of this activity is not like producing food products or offering consulting services; yet the ISO 14001 standard, because it is business and management oriented can be applied to any activity. It is the most widely used EMS standard in the world.

Your company and all who partake in the daily activities of running the business will benefit from taking ISO 14001 training. This course is particularly adapted for all members of the organization.

Major topics include:
• General Requirements of ISO 14001
• ISO 14001 Vocabulary
• Environmental Policy
• Planning
• Implementation and Operation
• Checking
• Management Review

This SAE/CALISO course is for you if you:
• Want to quickly and efficiently get a comprehensive training of ISO 14001:2015
• Want to improve your CV and career opportunities with qualifications in EMS
• Do NOT have time to allocate two full days to take an environmental management class
• Want to train more of your staff on auditing economically and without having to immobilize them in a class for a full day

This is an internet-delivered course featuring graphical presentation screens with text-based instruction, videos, and on-going quizzes to reinforce learning and retention and gauge your understanding of a topic before you move forward. An online training certificate will be issued upon successful completion of the course and obtaining 70% or above on the final average of the ongoing quizzes.

Fee: $289.95 1.0 CEUs
ISO 14001:2015 Auditor Training – CALISO

On-Demand Course

12 Hours
I.D.#ISO-14001-2015-AUDITOR

ISO 14001:2015 is an environmental management standard (EMS) developed by the International Organization for Standardization (ISO). The ISO 14001 standard is generic and can be used for any organization, whether it provides physical products or services. The requirements must be carefully interpreted to make sense within a particular organization. Developing automotive products and the environmental impact of this activity is not like producing food products or offering consulting services; yet the ISO 14001 standard, because it is business and management oriented can be applied to any activity. It is the most widely used EMS.

Your company and all who partake in the audit activities of your business and managing its environmental program will benefit from taking ISO 14001 training. The ISO 14001 Auditor course is the most comprehensive training on the subject. It provides training on the standard itself but also on how to conduct internal audits and supplier audits using ISO 19011, the guideline standard on how to audit management systems.

Major topics include:
• General Requirements of ISO 114001
• Auditing techniques
• EMS Auditing Case Studies

This SAE/CALISO course is for you if you:
• Want to quickly and efficiently learn how to lead an ISO 14001:2015 audit
• Want to quickly and efficiently be trained on ISO 14001 (the standard), and ISO 14000 (the vocabulary for the standard)
• Want to be a lead auditor to conduct internal audits and supplier audits for your company
• Want to improve your CV and career opportunities with qualifications in EMS and leading first part and second party audits
• Want to upgrade your expertise from auditing with 19011:2002 to ISO 19011:2011
• Do NOT have time to allocate two days to take an ISO 14001 auditor class
• Want to train more of your staff on auditing economically and without having to immobilize them in a class for a full day

This is an internet-delivered course featuring graphical presentation screens with text-based instruction, videos, and on-going quizzes to reinforce learning and retention and gauge your understanding of a topic before you move forward. An online training certificate will be issued upon successful completion of the course and obtaining 70% or above on the final average of the ongoing quizzes.

Fee: $309.95 1.2 CEUs

ISO 14001:2015 Lead Auditor – CALISO

On-Demand Course

32 Hours
I.D.#ISO 14001-2015-LEAD-AUDITOR-TRAINING

ISO 14001:2015 is an environmental management standard (EMS) developed by the International Organization for Standardization (ISO). The ISO 14001 standard is generic and can be used for any organization, whether it provides physical products or services. The requirements must be carefully interpreted to make sense within a particular organization. Developing automotive products and the environmental impact of this activity is not like producing food products or offering consulting services; yet the ISO 14001 standard, because it is business and management oriented can be applied to any activity. It is the most widely used EMS.

Your company and all who partake in planning, leading and conducting the EMS audit activities of your business and managing its environmental program will benefit from taking ISO 14001 training. The ISO 14001 Lead Auditor course is the most comprehensive training on the subject. It provides training on the standard itself but also on how to lead or conduct internal audits and supplier audits using ISO 19011, the guideline standard on how to audit management systems.

Major topics include:
• General Requirements of ISO 14001:2015
• ISO 14001 Vocabulary
• Environmental Policy
• Planning
• Implementation and Operation
• Checking
• Management Review
• General Requirements of ISO 19011
• Auditing Techniques

This SAE/CALISO course is for you if you:
• Want to quickly and efficiently learn how to lead an ISO 14001:2015 audit
• Want to quickly and efficiently be trained on ISO 14001 (the standard), and ISO 14000 (the vocabulary for the standard)
• Want to be a lead auditor to conduct internal audits and supplier audits for your company
ON DEMAND COURSES RESOURCE GUIDE

- Want to improve your CV and career opportunities with qualifications in EMS and leading first part and second party audits
- Want to upgrade your expertise from auditing with ISO 19011:2002 to ISO 19011:2011
- Do NOT have time to allocate four days to take an ISO 14001 Lead Auditor class
- Want to train more of your staff on auditing economically and without having to immobilize them in a class for a full day

This is an internet-delivered course featuring graphical presentation screens with text-based instruction, videos, and on-going quizzes to reinforce learning and retention and gauge your understanding of a topic before you move forward. An online training certificate will be issued upon successful completion of the course and obtaining 70% or above on the final average of the ongoing quizzes.

Fee: $389.95 3.2 CEUs

ISO/TS 16949:2009 Training – CALISO On-Demand Course
8 Hours
I.D.# ISO16949

The ISO/TS16949 is an ISO technical specification for the automotive industry aiming to the development of a quality management system that provides for continual improvement, emphasizing defect prevention and the reduction of variation and waste in the supply chain. The requirements must be carefully interpreted to make sense within a particular organization.

Your company and all who partake in the daily activities of running the business will benefit from taking ISO/TS 16949 training. This eight-hour (.8 CEU) ISO/TS 16949 overview is particularly adapted for training all levels of an organization on the requirements of this standard.

Major topics include:
- General Requirements of ISO 16949
- ISO 16949 Vocabulary
- Management Responsibility
- Resource Management
- Product Realization
- Measurement, Analysis and Improvement

This SAE/CALISO course is for you if you:
- Want to quickly and efficiently get a comprehensive training of ISO 16949:2009
- Want to improve your CV and career opportunities with qualifications in quality assurance

Fee: $229.95 0.8 CEUs

ISO/TS 16949:2009 Auditor Training – CALISO On-Demand Course
8 Hours
I.D.# ISO16949AUDITOR

The ISO/TS16949 is an ISO technical specification for the automotive industry aiming to the development of a quality management system that provides for continual improvement, emphasizing defect prevention and the reduction of variation and waste in the supply chain. The requirements must be carefully interpreted to make sense within a particular organization.

Your company and all who partake in the QMS and supplier audit activities will benefit from taking ISO/TS 16949 training. The eight-hour (.8 CEU) ISO/TS 16949 Auditor course is the most comprehensive training on the subject. It provides training on the standard itself but also on how to lead or conduct internal audits and supplier audits using ISO 19011, the guideline standard on how to audit management systems.

Major topics include:
- General Requirements of ISO 19011
- Auditing techniques
- QMS Automotive Auditing Case Studies

This SAE/CALISO course is for you if you:
- Want to quickly and efficiently learn how to lead an ISO/TS 16949:2009 audit
- Want to quickly and efficiently be trained on ISO/TS 16949 (the standard), and ISO 9000 (the vocabulary for the standard)
- Want to be a lead auditor to conduct internal audits and supplier audits for your company
- Want to improve your CV and career opportunities with qualifications in quality assurance and leading 1st part audits
- Want to upgrade your expertise from auditing QS 9000 to ISO/TS 16949:2009
- Want to upgrade your expertise from auditing with ISO 10011-1 to ISO 19011:2002
This is an internet-delivered course featuring graphical presentation screens with text-based instruction, videos, and on-going quizzes to reinforce learning and retention and gauge your understanding of a topic before you move forward. An online training certificate will be issued upon successful completion of the course and obtaining 70% or above on the final average of the ongoing quizzes.

Fee: $259.95 0.8 CEU

ISO/TS 16949:2009 Lead Auditor Training – CALISO On-Demand Course
22 Hours
I.D.# TS16949LEADAUDITOR

The ISO/TS16949 is an ISO technical specification which forms the requirements or application of ISO 9001 for automotive production and relevant service part organizations. It is essentially ISO 9001 with additional automotive specific requirements and is required by most major automotive manufacturers. Once your company implements processes and procedures that comply with the requirements listed in ISO/TS 16949, you can be audited by a third party organization called a Registrar, which will certify your organization to this standard.

This lead auditor course provides management representatives, QA managers or supervisors and others not only the information needed to conduct an audit for ISO/TS 16949, but also to organize, implement and lead it. All audit teams need a leader, and the body of knowledge of this course covers all of the lead auditing aspects.

**Major topics include:**
- Statistical Process Control (SPC)
- APQP/CP: Advanced Product Quality Planning and Control Plans
- PPAP: Product Part Approval Process
- FMEA: Failure Mode and Effects Analysis
- MSA: Measurement Systems Analysis

**This SAE/CALISO course is for you if you:**
- Want to quickly and efficiently learn how to lead an ISO/TS 16949:2009 audit
- Want to quickly and efficiently be trained on the TS 16949 specification
- Want to be a lead auditor to conduct internal audits and supplier audits for your company
- Want to improve your CV and career opportunities with qualifications in quality assurance and leading 1st part audits
- Want to upgrade your expertise from auditing with ISO 19011:2002 to ISO 19011:2011

Fee: $369.95 2.2 CEUs

ISO 19011:2011 Auditor Training – CALISO On-Demand Course
4 Hours
I.D.#ISO19

ISO 19011 is a guideline developed by the International Organization for Standardization (ISO). The ISO 19011 standard is generic and can be used for auditing any type of management standard: quality, environmental, health and safety and others.

Your company and all who partake in the daily activities of running the business will benefit from taking ISO 19011 training for its auditing activities. The four-hour (.4 CEU) ISO 19011 course is the most comprehensive training on the subject. It provides training on the standard itself but also on how to lead or conduct internal audits and supplier audits using ISO 19011, the guideline standard on how to audit management systems.

**Major topics include:**
- General Requirements of ISO 19011
- Auditing techniques
- Auditing Case Studies

**This SAE/CALISO course is for you if you:**
- Want to quickly and efficiently learn how to audit management systems
- Want to be a lead auditor to conduct internal audits and supplier audits for your company
- Want to improve your CV and career opportunities with qualifications in quality assurance and leading 1st part audits
- Want to upgrade your expertise from auditing with ISO 10011-1 to ISO 19011:2002

This is an internet-delivered course featuring graphical presentation screens with text-based instruction, videos, and on-going quizzes to reinforce learning and retention and gauge your understanding of a topic before you move forward. An online training certificate will be issued upon successful completion of the course and obtaining 70% or above on the final average of the ongoing quizzes.

Fee: $199.95 .4 CEUs
ON DEMAND COURSES RESOURCE GUIDE

AS9100D Overview – CALISO On-Demand Course

4 Hours
I.D.# AS9100D-Overview

AS9100D is a quality management standard developed by SAE International. The AS9100D standard is primarily applicable for the aviation, space, and defense industry and incorporates the new clause structure and content of ISO 9001:2015. This standard can also be used in other industry sectors when a quality management system with additional requirements over an ISO 9001 system is needed.

This standard includes ISO 9001:2015 quality management system requirements and specifies additional aviation, space, and defense industry requirements, definitions, and notes as shown in bold, italic text.

Your company and all who partake in the daily business activities will benefit from taking AS9100D training. This four hour AS9100D overview is particularly adapted for training top management on the high level requirements of this standard.

Participants who complete this course will be able to:
• Understand the high level requirements and intent of this international standard
• Understand the process approach to managing an organization
• Understand how the requirements can be interpreted should be implemented within an organization

Major topics include:
• Process Approach
• Risk-based Thinking
• General Requirements of AS9100D
  • Context of the organization
  • Leadership
  • Planning
  • Support
  • Performance Evaluation
  • Improvement

This SAE/CALISO course is for you if you:
• Want to quickly and efficiently get a comprehensive overview of AS9100D
• Want to improve your CV and career opportunities with qualifications in AS9100D
• Want to upgrade your expertise from auditing AS9100C to AS9100D
• Do NOT have time to allocate a full day to take an AS9100D overview class

Fee: $199.95

AS9100D Training – CALISO On-Demand Course

10 Hours
I.D.# AS9100D

AS9100D is a quality management standard developed by SAE International. The AS9100D standard is primarily applicable for the aviation, space, and defense industry and incorporates the new clause structure and content of ISO 9001:2015. This standard can also be used in other industry sectors when a quality management system with additional requirements over an ISO 9001 system is needed.

This standard includes ISO 9001:2015 quality management system requirements and specifies additional aviation, space, and defense industry requirements, definitions, and notes as shown in bold, italic text.

Your company and all who partake in the daily activities of running the business will benefit from taking AS9100D training. This 10-hour AS9100D course is particularly adapted for training all levels of an organization on ALL the requirements of this standard.

Participants who complete this course will be able to:
• Understand the high specific requirements and intent of this international standard.
• Understand the process approach to managing an organization and risk-management requirements.
• Understand how the requirements can be interpreted should be implemented within an organization

Major topics include:
• Process Approach
• Risk-based Thinking
• General Requirements of AS9100D
  • Context of the organization
  • Leadership

Fee: $399.95

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- Planning
- Support
- Performance Evaluation

**Improvement** This SAE/CALISO course is for you if you:
- Want to quickly and efficiently get a comprehensive training of AS9100D
- Want to improve your CV and career opportunities with qualifications in quality assurance
- Want to upgrade your expertise from AS9100C to AS9100D
- Do NOT have time to allocate a 2 full days to take an AS9100D class
- Want to train more of your staff on auditing economically and without having to immobilize them in a class for a full day

This is an internet-delivered course featuring graphical presentation screens with text-based instruction, videos, and on-going quizzes to reinforce learning and retention and gauge your understanding of a topic before you move forward. An online training certificate will be issued upon successful completion of the course and obtaining 70% or above on the final average of the ongoing quizzes.

**Fee:** $289.95

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**AS9100D Auditor Training – CALISO On-Demand Course**

18 Hours  
I.D.# AS9100D-Auditor

AS9100D is a quality management standard developed by SAE International. The AS9100D standard is primarily applicable for the aviation, space, and defense industry and incorporates the new clause structure and content of ISO 9001:2015. This standard can also be used in other industry sectors when a quality management system with additional requirements over an ISO 9001 system is needed.

This standard includes ISO 9001:2015 quality management system requirements and specifies additional aviation, space, and defense industry requirements, definitions, and notes as shown in bold, italic text.

Your company and all who partake in the daily activities of running the business will benefit from taking AS9100D auditor training. The 18-hour Auditor online course is the most effective training on the subject. It provides training on how to conduct internal audits and supplier audits using ISO 19011, the guideline on how to audit management systems, and covers auditing all the requirements of the standard through various case studies.

**Participants who complete this course will be able to:**
- Master the auditing techniques per ISO 19011, which are used for quality, environmental, and safety management system audits
- Learn how to prepare and conduct an audit
- Be exposed to real auditing case studies covering many industries

**Major topics include:**
- General Requirements of ISO 19011
- Auditing techniques
- AS9100D Auditing Case Studies

This SAE/CALISO course is for you if you:
- Want to quickly and efficiently learn how to lead an AS9100D audit
- Want to quickly and efficiently be trained on AS9100D (the standard), and ISO 9001:2015.
- Want to be a lead auditor to conduct internal audits and supplier audits for your company
- Want improve your CV and career opportunities with qualifications in quality assurance and leading first part audits
- Want to upgrade your expertise from auditing AS9100C to AS9100D
- Want to upgrade your expertise from auditing with ISO 10011-1 to ISO 19011:2011
- Do NOT have time to allocate 2 days to take an AS9100D auditor class
- Want to train more of your staff on auditing economically and without having to immobilize them in a class for 2 days

This is an internet-delivered course featuring graphical presentation screens with text-based instruction, videos, and on-going quizzes to reinforce learning and retention and gauge your understanding of a topic before you move forward. An online training certificate will be issued upon successful completion of the course and obtaining 70% or above on the final average of the ongoing quizzes.

**Fee:** $319.95

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**AS9100D Lead Auditor Training – CALISO On-Demand Course**

32 Hours  
I.D.# AS9100D-Lead-Auditor

AS9100D is a quality management standard developed by SAE International. The AS9100D standard is primarily applicable for the aviation, space, and defense industry and incorporates the new clause structure and content of ISO 9001:2015.
ON DEMAND COURSES RESOURCE GUIDE

This standard can also be used in other industry sectors when a quality management system with additional requirements over an ISO 9001 system is needed.

This standard includes ISO 9001:2015 quality management system requirements and specifies additional aviation, space, and defense industry requirements, definitions, and notes as shown in bold, italic text.

Your company and all who partake in planning, leading and conducting the audit activities of running the business will benefit from taking AS9100D Lead Auditor training. The 32-hour AS9100D Auditor course is the most comprehensive training on the subject. It provides training on the standard itself but also on how to lead or conduct internal audits and supplier audits using ISO 19011, the guideline standard on how to audit management systems.

Participants who complete this course will be able to:

- Understand every requirement of this international standard
- Understand the process approach to managing an organization
- Understand how the requirements can be interpreted and implemented in various industries
- Master the auditing techniques per ISO 19011, which are used for quality, environmental, and safety management system audits
- Learn how to prepare and lead an audit
- Be exposed to real auditing case studies covering many industries

Major topics include:

- General Requirements of AS9100D
  - Context of the organization
  - Leadership
  - Planning
  - Support
  - Operation
  - Performance Evaluation
  - Improvement
  - General Requirements of ISO 19011
  - Auditing techniques
  - AS9100D Auditing Case Studies

This SAE/CALISO course is for you if you:

- Want to upgrade your expertise from auditing with ISO 10011-1 to ISO 19011:2011
- Do NOT have time to allocate a 3-5 days to take an AS9100D Lead Auditor class
- Want to train more of your staff on auditing economically and without having to immobilize them in a class for a full day

This is an internet-delivered course featuring graphical presentation screens with text-based instruction, videos, and on-going quizzes to reinforce learning and retention and gauge your understanding of a topic before you move forward. An online training certificate will be issued upon successful completion of the course and obtaining 70% or above on the final average of the ongoing quizzes.

Fee: $399.95

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Six Sigma Overview – CALISO On-Demand Course

8 Hours
I.D.#SIGMA

Six-Sigma is a systematic way to improve a product, process and/or service. This is the ideal course for employees or managers who want to get a basic training on Six-Sigma concepts, methodology and techniques.

Six-Sigma methodology can be used for any size organization, whether it provides physical products (i.e. hardware or software) or services. Developing and maintaining profitable products and services require continuous improvement in numerous key areas such as quality, performance and efficiency. Six-Sigma techniques can help any company achieve these goals.

This is the ideal course for individuals who you want improve their résumé and career opportunities in Six-Sigma, by adding this industry-wide recognized course to the education or training section of your CV.

The course covers Six-Sigma process improvement techniques; it is a stepping stone for Six Sigma Green and Black-belt certifications.

Major topics include:

- Six-Sigma, what is it?
- Six-Sigma, why use it?
- International quality standards and Six-Sigma
- Six-Sigma Core Concepts, How to use Six-Sigma
- Six-Sigma application example and Case Study “JFS”
- Another Case Study “BBB”
- Top steps to Six-Sigma
- Sigma Table, Spread Sheet Tips

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• Fill out the online quote request at sae.org/corplearning • Email us at Corplearn@sae.org
This SAE/CALISO course is for you if you:
• Want to quickly and efficiently become familiar with Six-Sigma to understand and launch Six-Sigma projects as an employee or a manager
• Want to improve your CV and career opportunities with Six-Sigma knowledge and qualifications
• Want to systematically improve the profitability and customer satisfaction of your product or service by improving numerous key areas such as quality, performance and efficiency

This is an internet-delivered course featuring graphical presentation screens with text-based instruction, videos, and on-going quizzes to reinforce learning and retention and gauge your understanding of a topic before you move forward. An online training certificate will be issued upon successful completion of the course and obtaining 70% or above on the final average of the ongoing quizzes.

Fee: $159.95 .8 CEUs

Is this Metallurgy On-Demand Course for You?
This course is targeted towards design, manufacturing, and quality engineers, and sales people and purchasing agents with technical backgrounds.

What You Will Receive
• 90 days (from date of purchase) of on-demand access to the four hour presentation
• Integrated knowledge checks to reinforce key concepts
• Course workbook (.pdf, downloadable)
• Proof of Participation (Transcript)

Author: Industrial Metallurgists, LLC
Fee $225

Corrosion of Metals
5 Hours
I.D.# PD261328ON
This online course teaches about corrosion of metals. The physics of corrosion is explored as a background for the discussion of seven common types of corrosion (uniform, galvanic, crevice, pitting, intergranular, stress corrosion cracking, and dealloying). Students will learn why and how corrosion occurs and methods for controlling corrosion. It includes eleven modules followed by a quiz.

Major topics include:
• Introduction to electrochemical corrosion
• Aqueous corrosion
• Uniform corrosion
• Galvanic corrosion
• Crevice corrosion
• Pitting corrosion
• Intergranular corrosion
• Stress corrosion cracking
• Dealloying

Is this Metallurgy On-Demand Course for You?
This course is targeted to design engineers, manufacturing engineers, and quality engineers. It is suggested that, as a prerequisite, you either take our Principles of Metallurgy online course (I.D.# PD261322, page 133) or have basic knowledge of the following topics: grains, grain boundaries, crystal lattice, substitutional solid solution, diffusion, phases, precipitation, precipitation hardening, microstructure, tensile testing.
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ON DEMAND COURSES RESOURCE GUIDE

What You Will Receive
- 90 days of on-demand access (from date of purchase) to the five hour presentation
- Integrated knowledge checks to reinforce key concepts
- Proof of Participation (Transcript)

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Failure Analysis of Metals

5 Hours
I.D.# PD261505ON

Quickly getting to the bottom of a metal failure is critical for preventing future failures, keeping customers happy, and keeping manufacturing lines running. This course will teach you how to perform failure analysis of fracture, corrosion, and manufacturing failures.

Major topics include:
- The relationship between failure analysis and root cause analysis
- How to select, collect, handle, and prepare samples for failure analysis
- The background information required to determine failure mechanism and root cause
- The common techniques used for failure analysis and the data obtained
- Which metallurgical analyses are appropriate for specific failures
- How to determine fracture mode based on the appearance of a fracture surface
- How to perform a failure analysis on fracture, corrosion, and manufacturing failures
- The categories of failure root causes for specific failures

Is this Metallurgy On-Demand Course for You?
This course is targeted towards design, manufacturing, supplier quality and quality control engineers, sales people and purchasing agents with technical backgrounds.

What You Will Receive
- 90 days (from date of purchase) of on-demand access to the approximately 5-hour presentation
- Integrated knowledge checks to reinforce key concepts
- Course workbook (.pdf, downloadable)
- Proof of Participation (Transcript)

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Hardness Testing

30 Minutes
I.D.# ON

This on-demand course focuses on Rockwell and Brinell hardness testing and Vickers and Knoop microhardness testing. Participants will learn about how the tests are performed, test sample requirements, test parameter selection, and testing requirements. The course can be completed in 30 minutes.

Major topics include:
- Rockwell hardness testing
- Brinell hardness testing
- Knoop and Vickers microhardness sample preparation and testing

Is this Metallurgy On-Demand Course for You?
This on-demand course is targeted to design, manufacturing, and quality engineers, and sales people and purchasing agents with technical backgrounds.

What You Will Receive
- 90 days (from date of purchase) of on-demand access to the thirty minute presentation
- Integrated knowledge checks to reinforce key concepts
- Course workbook (.pdf, downloadable)
- Proof of Participation (Transcript)

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Metallurgy of Precipitation Strengthening

2 Hours
I.D.# PD261329ON

This on-demand course teaches about the microscopic changes that take place in a precipitation strengthened alloy and their effects on the properties of the alloy. The effects of the different heat treating steps (solution treatment, quench, and aging) and heat treating process parameters (solution treatment temperature and time, quench rate, and aging temperature and time) on the alloy microstructure and the effects on alloy strength are discussed. The course is divided into five modules followed by a quiz.

Major topics include:
- Phase diagrams
- Precipitation strengthening heat treatment
- Heat treatment details
- Quality control and course review

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Is this Metallurgy On-Demand Course for You?
This course is targeted to design, manufacturing, and quality engineers. It is suggested that, as a prerequisite, you have knowledge of the concepts covered in our *Principles of Metallurgy* (I.D.# PD261322, page 133) online course.

What You Will Receive
- 90 days (from date of purchase) of on-demand access to the two hour presentation
- Integrated knowledge checks to reinforce key concepts
- Course workbook (.pdf, downloadable)
- Proof of Participation (Transcript)

Author: Industrial Metallurgists, LLC
Fee $140

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**Metallurgy of Steel Case Hardening**

1 Hour
I.D.# PD261333ON

This on-demand course discusses common steel case hardening processes and how they are used to modify the surface layers of steels to obtain specific mechanical properties. Participants will learn about the process parameters and how they affect case composition, depth, microstructure, and properties. The course takes one hour to complete.

Major topics include:
- Carburizing
- Carbonitriding
- Nitriding
- Nitrocarburizing Flame hardening; Induction hardening

Is this Metallurgy On-demand Course for You?
This course is targeted to design, manufacturing, and quality engineers. It is suggested that, as a prerequisite, you have knowledge of the concepts covered in our *Principles of Metallurgy* online course. (I.D.# PD261322, page 133).

What You Will Receive
- 90 days (from date of purchase) of on-demand access to the one hour presentation
- Integrated knowledge checks to reinforce key concepts
- Course workbook (.pdf, downloadable)
- Proof of Participation (Transcript)

Author: Industrial Metallurgists, LLC
Fee $80

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**Metallurgy of Steel Through Hardening**

1 Hour
I.D.# PD261330ON

This on-demand course teaches about the metallurgy of the following steel through hardening processes: quench and temper, martempering, and austempering. Participants will learn about the effects of heat treating temperature and cooling rate on steel microstructure and properties, and the effects of the interaction between heat treating process parameters and steel composition on through hardened steel microstructure and strength. This course takes one hour to complete.

Major topics include:
- Quench and temper
- Steel hardenability
- Common problems associated with quenching (distortion, cracking, retained austenite)
- Martempering; Austempering

Is this Metallurgy On-demand Course for You?
This course is targeted to design, manufacturing, and quality engineers, and sales people and purchasing agents with technical backgrounds. It is suggested that, as a prerequisite, you have knowledge of the concepts covered in our *Principles of Metallurgy* online course. (I.D.# PD261322, page 133).

What You Will Receive
- 90 days (from date of purchase) of on-demand access to the one hour presentation
- Integrated knowledge checks to reinforce key concepts
- Course workbook (.pdf, downloadable)
- Proof of Participation (Transcript)

Author: Industrial Metallurgists, LLC
Fee $80

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**Metallurgy of Steel: Principles**

3 Hours  
I.D.# PD261326ON

This on-demand course teaches the phases and microstructures that form in steels, their effects on steel properties, the microstructure changes that occur when steel is heated and cooled, and the effects of carbon content and cooling rate on the microstructures that form. Also, how to read the iron-carbon phase diagram will be discussed. All this information is applicable to understanding the effects of steel heat treating processes and heat treating process parameters on the microstructure and properties of heat treated plain carbon, low-alloy, and tools steels. The course is divided into six modules followed by a quiz.

**Major topics include:**
- Steel types and designations
- Metallurgical phases that form in steel and their effects on properties
- Steel phase diagram
- Metallurgical changes in carbon steel during cooling
- Metallurgical changes in carbon steel during heating
- Course Review

**Is this Metallurgy On-demand Course for You?**

This on-demand course is targeted to design, manufacturing, and quality engineers, and sourcing specialists. It is suggested that, as a prerequisite, you have basic knowledge of solid solution, substitutions, interstitials, diffusion, effects of process temperature and time on diffusion and metallurgical changes, metallurgical phases, grains, grain boundaries, dislocations or the concepts covered in our Principles of Metallurgy online course. (I.D.# PD261322, page 133).

**What You Will Receive**
- 90 days (from date of purchase) of on-demand access to the two hour presentation
- Integrated knowledge checks to reinforce key concepts
- Course workbook (.pdf, downloadable)
- Proof of Participation (Transcript)

**Author:** Industrial Metallurgists, LLC  
**Fee:** $195

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**Tensile Testing**

Duration: 30 Minutes  
I.D.# PD261308ON

This on-demand course teaches about tensile testing of metals with a focus on how the testing is performed and tensile properties are measured. It includes one module followed by a quiz.

**Major Topics Include:**
- How a tensile test is performed
- Tensile specimen shape
- Calculation of stress and strain
- Stress and strain curve
- How to determine elastic modulus, yield strength, tensile strength, and elongation from a stress-strain curve

**Is this Metallurgy On-demand Course for You?**

This course is targeted towards design, manufacturing, supplier quality and quality control engineers, sales people and purchasing agents with technical backgrounds.

**What You Will Receive**
- 90 days (from date of purchase) of on-demand access to the 25-minute presentation
- Course handbook (downloadable, .pdf’s)
- Integrated knowledge checks to reinforce key concepts
- Proof of Participation (Transcript)

**Author:** Industrial Metallurgists, LLC  
**Fee:** $45

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**Wrought Aluminum Metallurgy**

1 Hour  
I.D.# PD261734ON

There are a wide variety of wrought aluminum alloys, each developed to provide specific properties. Getting the strength you need in an aluminum alloy requires knowledge of the effects of alloy composition, cold-working, and heat treating on aluminum metallurgy and properties. A good understanding of how aluminum alloys behave and what can be done to modify their properties is critical for being more productive and profitable. The course takes about one hour to complete and consists of one module and a final exam. Also, quizzes and problems give you opportunities to apply the concepts taught.

**Major topics include:**
- The different families of wrought aluminum alloys
ON DEMAND COURSES RESOURCE GUIDE

• Composition and strength differences between the alloy families.
• Relationship between metal strength and the microscopic structures that influence strength.
• Effects of cold-working, alloying, and heat treating on aluminum microstructure and strength.
• Aluminum temper designations for cold-worked and precipitation strengthened alloys.

Is this Metallurgy On-demand Course for You?
This course was designed for design, manufacturing, and quality engineers who need to better understand the metallurgy of aluminum alloys in order to make design decisions, evaluate suppliers, and fix quality problems.

What You Will Receive
• 90 days (from date of purchase) of on-demand access to the one hour presentation
• Integrated knowledge checks to reinforce key concepts
• Course handbook (.pdf, downloadable)
• Proof of Participation (Transcript)

Author: Industrial Metallurgists, LLC
Fee $85

Electroplating
3 Hours
I.D.# PD261735ON
Electroplating involves the deposition of thin layers of metal on metal components and metal stock. There are several uses for electrodeposited coatings including cosmetic, corrosion resistance, and wear resistance. Knowledge about electroplating and electroplated coatings is important for product design, preventing and solving quality problems, and evaluating supplier capabilities and quality.

Major topics include:
• Process steps for electroplating and supporting processes
• Different process formats
• Coating properties, features, and defects, and how they are evaluated
• Effects of electroplating process steps on coating properties, features, and defects
• Important coating properties, features, and defects for six different coating uses.
• Selecting and specifying electrodeposited coatings
• Evaluating electroplating companies

Is this Metallurgy On-demand Course for You?
If you’re ever involved with metal plating selection, supplier evaluation, and solving quality problems with electroplated metals, then this course is for you.

What You Will Receive
• 90 days (from date of purchase) of on-demand access to the one hour presentation
• Integrated knowledge checks to reinforce key concepts
• Course handbook (.pdf, downloadable)
• Proof of Participation (Transcript)

Author: Industrial Metallurgists, LLC
Fee $225

Acoustic Fundamentals for Solving Noise and Vibration Problems Web Seminar RePlay
6 Hours
I.D.# PD331309ON
Web Seminar RePlays are captures of the live web seminar. The course sessions are unedited and include interactions between the instructor and live participants. A learning assessment is available at the end of the course to reinforce learning and retention and gauge your understanding of the topic.

This course provides an introduction to the characteristics of sound waves, human perception of sound, sound and vibration measurements, measurement facilities, and various noise sources and noise control principles. It will include an overview of sound pressure, power, intensity, decibels, and frequencies. Practical examples will be used to familiarize participants with the acoustic fundamentals for solving noise and vibration problems and the associated solution principles.

Learning Objectives
By connecting with this course, participants will be able to:
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• Discuss the differences of various acoustic terminologies that are important to solve noise and vibration problems
• Define a relationship between sound pressure, sound power, and sound intensity
• Associate decibel to both sound and vibration
• Prepare effective acoustic specifications encompassing all variables that affect noise and vibration
• Select correct instrumentation for noise and vibration measurements recognizing the challenges of measurements
• Define the source-path-receiver relationship
• Determine the steps of noise and vibration source identification process for a given application
• Employ different noise control options to address specific noise and vibration issues

Is this Web Seminar RePlay for You?
This fundamental course is especially valuable for technical staff, engineers, and managers with limited experience in noise and vibration. It is designed to be suitable for all areas of the mobility industry. An Associate degree in the field of science or technology is recommended; BS degree is preferred.

Topical Outline
Session 1
• Introduction
  • Waves
  • Pressure, power, intensity
  • Frequency
  • Human perception of sound
• Decibels
  • What is decibel
  • Addition and subtraction of decibels
  • Background noise
  • Linear averaging/spatial averaging
• Frequency
  • Frequency Analysis
  • Linear and logarithmic frequency
  • Filters
Session 2
• Human Perception of Sound
  • Equal Loudness contours
  • Frequency weighting of sound
  • Loudness, loudness level, articulation index
• Instrumentation and Facilities
  • Transducers
  • Spectrum analyzers
  • Anechoic/hemi-anechoic room
  • Reverberation room
  • Sound power measurements
  • Source-path-receiver relationship

Session 3
• Various Noise Sources
  • Product noise
  • Community Noise
  • Industrial noise
  • Vehicle noise
  • Aircraft noise
• Noise Control Principles
  • Sound package materials
  • Absorber, barrier, damper, isolator
  • Mufflers, resonators
  • Active and passive noise control

Instructor: Pranab Saha
Fee $550 .6 CEUs

Vehicle Sound Package Materials Web Seminar RePlay
8 Hours
I.D.# PD331204ON

Web Seminar RePlays are captures of the live web seminar. The course sessions are unedited and include interactions between the instructor and live participants. A learning assessment is available at the end of the course to reinforce learning and retention and gauge your understanding of the topic.

This course offers a detailed understanding of the source – path-receiver relationship for developing appropriate sound package treatments in vehicles, including automobiles, commercial vehicles, and other transportation devices. The course provides a detailed overview of absorption, attenuation (barrier), and damping materials and how to evaluate their performances on material, component, and vehicle level applications. A significant part of course content is the case studies that demonstrate how properly designed sound package materials successfully address vehicle noise issues.

Learning Objectives
By connecting with this course, participants will be able to:
• Identify various descriptors that are used in acoustics while working with sound package materials
• Identify three fundamentally different sound package materials that are used in the industry
• Explain how these materials work and how to improve their performance
• Describe how various measurements are made and why they are necessary on a material level, component level, and vehicle level
Is this Course for You?
This course will be especially valuable for those new to the vehicle sound package area and those interested in how absorbers, barriers, and dampers work, how they are different from each other, how they interact with each other in an application, and what one needs to be aware of while making measurements so the results are meaningful. The course is also designed for OEM or supplier engineers and those in roles involved with design, evaluation, trouble-shooting, procuring, releasing, supplying, and/or manufacturing noise control materials and parts for passenger cars and light trucks, heavy trucks, off-highway vehicles, farm machinery, and other transportation systems including aircraft, watercraft and rail transit. An undergraduate degree and familiarity with basic acoustics and vibration, or acoustical materials would be beneficial.

Topical Outline

• Vehicle Noise Sources and Solutions
  • The noise system – sources
  • Ranking noise paths
  • Source-path-receiver relationship
  • The noise control system using sound package materials

• Sound Package Material – Absorber
  • Application
  • Primary function
  • Effect of various parameters
  • How it works
  • How to improve performance
  • Case studies
  • Measurements

• Sound Package Material – Barrier
  • Application
  • Primary function
  • How it works
  • How to improve performance
  • Case studies
  • Measurements

• Sound Package Material – Damper
  • Application
  • Primary function
  • How it works
  • How to improve performance
  • Case studies
  • Measurements

• Component and Vehicle Level Noise Measurements
  • Why
  • How
  • The need for standards and targets for NVH studies

Instructor: Pranab Saha
Fee $640 .8 CEUs
Liquid Atomization, Sprays, and Fuel Injection

3 Days
I.D.# 98019

Liquid fuel atomization and spray formation is the heart of the majority of stationary and mobile power generation machines that we rely on. This seminar focuses on the process of liquid atomization and spray formation and how it relates to fuel injection systems and emission of pollutants in modern engines. The seminar begins with background coverage of terminology, the purposes of liquid atomization and spray formation, and different designs of atomizers and nozzles employed in various industries. The focus is then directed to gasoline and diesel fuel injections, injector designs, and performance requirements for optimum engine operation with lowest possible emission of harmful pollutants. Based on the idea that knowledge of technical practices and advances in one area (i.e. diesel fuel injection) is beneficial to engineers in other areas (gasoline direct injection, rocket engines), this seminar takes an interdisciplinary approach. Attendees will understand the technology and logic behind different injector designs, and gain the knowledge to judge, adapt and transfer technology advances from one discipline to another.

Learning Objectives

By attending this seminar, participants will be able to:

- Explain important terminology commonly used in atomization and sprays
- Describe important processes in atomization and spray formation
- Articulate the effects of injection system design and operating conditions on engine performance, combustion, and emission of pollutants
- Describe different injector designs and the rationale for the use of each
- Define the role the injection system plays in combustion and emission and how it is used to provide guidance in design of low-emission combustion systems
- Implement appropriate design concepts and logic in the design of critical components such as intake valves and induction systems
- Evaluate future trends and technology developments in fuel injection

Who Should Attend

Automotive and aerospace engineers, technical and project managers, researchers and academicians will benefit by attending this seminar. Automotive engineers working on the design of combustion engine components, reduction of harmful pollutants emissions, software development and application for modeling of thermal-fluid, combustions and emissions and engineers and managers directly involved in fuel injection systems will also benefit. Aerospace engineers involved in the design of gas turbine or rocket engines’ combustion chambers will benefit as well.

Topical Outline

DAY ONE

- Description of the Atomization Process
- Disintegration of the Liquid Jets
  - Rayleigh criterion (no viscosity)
  - Weber’s criterion (effects of viscosity)
  - Ohnesorge criterion for atomization (Ohnesorge Number)
  - Rayleigh, first and second wind-induced breakup and atomization regimes
- Influence of some parameters -- jet velocity profile; nozzle length-to-diameter ratio; ambient pressure
- Disintegration of liquid sheets
• Drop breakup in air flow, turbulent flow, and viscous flow
• Types of Atomizers: Pressure, Air-Assist, Air-Blast, Effervescent, Electrostatic, Ultrasonic, Diesel Injector and Gasoline-Fueled Injectors
• Drop Size Distribution and Measurements
  • Graphical and mathematical representation of drop size distribution
  • Averaged diameter and representative diameters
  • Measurement techniques -- patternation; drop size measurements and spray characterization
  • Mechanical methods -- drop collection on slides; molten-wax and frozen-drop approach; cascade impactors; electrical; charged-wire and hot-wire methods; optical methods; imaging - photography and holography; single-particle light scattering (Phase Doppler Particle Analyzer, etc.); diffraction size analyzer
  • Drop evaporation

DAY TWO
• Diesel Fuel Spray, Injector and Injection System
  • Fuel injection system -- pumps: in-line injection, distributor-type injection, single-barrel injection, and unit injector & unit pumps; injector designs: nozzle holder, nozzles, others
  • Overall spray structure
  • Liquid fuel atomization
  • Spray angle
  • Intact core length
  • Spray evaporation
  • Ignition delay
  • Mixing-controlled combustion
  • HC emission mechanisms in diesel engines and its relation to fuel injection
  • Soot formation and fuel sprays
  • Advanced topics (details of split injection, common-rail injection, interacting-sprays injection, ultra-high pressure fuel injection, effects on performance and emissions, and others)

DAY THREE
• Gasoline Port Fuel Injectors and Injection System
  • Multipoint port injection system -- classes of gasoline port injectors: low pressure, medium pressure, high pressure, air-assisted, swirl, heated vaporizing, ultrasonic, and electrostatic; key requirements of gasoline port injectors; deposit considerations
  • Single-point throttle body injection system
  • Feedback system
  • Effects of injection parameters on engine performance and emission: injection timing, spray targeting, spray momentum, mean drop size, pulse-to-pulse variability, and others
  • Flow of Fuel and Air in Intake Manifolds
  • Details of Gasoline Direct Injection (GDI) and its Effects on Engine Performance and Emission of Pollutants

• Fuel-air mixing processes
• Spray Modeling and Demonstration of Computer Software for Spray Calculation in Engines

Instructor: Bruce Chehroudi
Fee $1745 2.0 CEUs

Seals and Sealing System Design of Actuation Systems in Military and Commercial Aircraft

1 Day
I.D.# C1212

This one day seminar presents an overview of seals and sealing system design for military and commercial aircraft. It is aimed to provide engineers having some previous actuator and control valve design background with an understanding of the general hardware groove standards, standard parts for static applications and how seal designs and sealing systems can be best used in dynamic reciprocating and rotary applications. Information will be provided regarding seal material and fluid compatibility, friction drag, expected wear rates depending on operating conditions and duty cycle, hardware surface finish and topography. Also included will be information on seal installation procedures and potential pitfalls to avoid.

Learning Objectives
By attending this seminar, participants will be able to:
• Identify the standards relevant to seals and seal systems
• Summarize key characteristics of dynamic reciprocating applications
• Summarize key characteristics of rotary applications
• Evaluate seal material characteristics and proper applications

Who Should Attend
This seminar is designed for engineers and other key personnel with some actuator and control valve design knowledge.

Topical Outline
• First O-Ring Patent
  • 1932-Niels A. Christensen
• Parker: Development of Range of Sizes
  • Tables
• ASS68
  • Range of sizes
  • Cross sections
  • Tolerances to Class 2- Tables
• History and Application of Aerospace Gland Dimensional Standards for Seals and Scrapers
  • MIL-P-5514 Revs A and B
  • MIL-P-5514 Revs C, D, and E
  • MIL-G-5514 Rev F
  • AS4716, AS5857, MS33675, AS4088, AS4052
• History of Backup Ring Standards
  • MIL-R-8791, MS28774, MS27595, MS28782, MS28783
  • AS8791, AS5781, AS5782, AS5860, AS5861
• EPDM History and Applications
  • NAS1613, NAS1611, NAS1612, AECMA specs
  • prEN 6111, prEN 6075, prEN6076
• Elastomer Materials and Applications
  • In red oils
  • In fuels
  • In turbine oils
  • Properties
• Storage of Elastomers
  • ARPS516
• Plastic Materials and Applications
  • AMS3678 and slash sheets
  • Effects of fillers on PTFE materials
• High Modulus Plastics
  • PEEK
  • PEKEKK
  • Carbon fiber composites
  • Properties and uses
• Reciprocating Seals for AS4716 grooves
• Piston Seals
  • Bi-directional – to fit std. and non-std grooves - examples
  • Uni-directional – to fit std. and non-std grooves - examples
• Rod Seals
  • Bi-directional – to fit std. and non-std grooves - examples
  • Uni-Directional – to fit std. and non-std grooves - examples
• Scrapers for MS33675, AS4088, and AS4052
• Reciprocating Sealing Systems
  • Tandem and tertiary sealing systems with scrapers
• Face Seals
  • Types for internal and external pressure
• Seal Design Notes: An Appreciation
  • Low temperature considerations
  • High temperature considerations
  • Friction calculations: C of F for PTFE compounds
  • Friction calculations: Elastomers
  • Consideration of elastomer shear strength
  • Consideration of elastomer tensile strength
  • Consideration of elastomer elongation percentage
  • Thermal cycling: Reciprocating PTFE seal components
• Rotary shaft seals
  • Metal can types: Elastomeric lip(s)
• Metal can types: PTFE lip(s)
• Flanged spring energized seals: Thermal cycling
• Hardware Surfaces, Coatings, and Roughness Finishes
  • Dynamic
  • Static
• Installation Tools and Procedures
• Hardware Design Tips: Avoiding Installation and Performance Catastrophes
• Pump/Motor Function Applications

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Instructor: Alan Schofield
Fee $810 .7 CEUs

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SAFETY AND QUALITY

Aircraft Cabin Safety and Interior Crashworthiness

2 Days
I.D.# C0926

The certification of transport category cabin interiors requires a thorough understanding of Part 25 Transport Category aircraft cabin interior safety and crashworthiness regulations and compliance requirements. Regardless of whether it is a simple modification, a specialized completion (VIP or VVIP) or airline passenger configuration, engineers, designers, and airworthiness personnel must understand and adhere to these requirements.

This two day seminar will begin with a discussion of Commercial off the Shelf (COTS) test requirements. The instructor will then guide participants through the various cabin interior emergency provisions and their requirements such as supplemental passenger oxygen, emergency equipment, seats, flammability, emergency exits, emergency lighting and escape path markings, and various other cabin interior systems. Additionally, DO-160 environmental, cooling and ventilation requirements will be discussed to provide participants a comprehensive introduction to cabin interior safety and crashworthiness requirements as specified in the CFR Part 25 Airworthiness Standards.

Learning Objectives
By attending this seminar, participants will be able to:
• Identify key strategies to managing certification programs effectively
• Recognize cabin safety and design problems in a timely manner so they may be addressed in advance
• Communicate intelligently on the requirements and effectively negotiate with others involved in FAA certification programs
• Interpret and identify the reasoning behind cabin safety rules and regulations
• Demonstrate an understanding of cabin safety and crashworthiness regulations
• Examine and evaluate current cabin safety issues and their solutions through open discussions between instructor and attendees

Who Should Attend
This course is designed for engineering and certification managers, design engineers, airworthiness and certification engineers, program managers, consultants, Federal Aviation Administration designated engineering representatives (DER) interested in gaining interior arrangement authorization added to their delegated functions and authorized areas, and other technical and administrative personnel involved in FAA certification activities.

Topical Outline
DAY ONE
• Introduction to Part 25 Airworthiness Standards Requirements
• Commercial Off The Shelf equipment (COTS) and Super COTS
• Galleys
  • Electrical disconnects
  • Water shut-offs
  • Latches
• Passenger Oxygen and Oxygen Masks
  • Reach (5th percentile female)
  • Quantity and duration requirements
• Emergency Equipment
  • Ditching requirements -- Life rafts; Life vests; Survival kits
  • First aid kits
  • Defibrillators
  • Fire extinguishers
  • Smoke detectors
SAFETY AND QUALITY

- Access
- Placards
- Seats
  - Dynamic (C127a)
  - Static (C39b)
  - Divans
  - Seat belts and shoulder harness
  - Head strike
  - Oxygen mask requirements
  - Recline and rotations at exit rows
  - Exit access
  - Foot/leg rests
- Beds
- Latches and Secondary Latches
- Placards
  - Visibility
  - Contrast
  - Size
  - Locations
- Flammability
  - Bunsen Burner flammability tests and materials
  - Fire blocking on seat and back cushions and markings
  - Fire containment -- COTS; Lavatory and galley waste containers
  - Smoking and ash trays
- Smoke Detection and Penetration for Cabin Accessible Baggage Compartments

DAY TWO

- Emergency Exit Types and Requirements
  - Floor level
  - Window
  - Flight deck
- Exit Signs and Requirements
  - Size -- Equivalent safety
  - Visibility
  - Types and requirements -- Bulkhead; Locator; Marker
- Aisle Clearance Requirements
  - Cabin main aisles -- Cross aisles
- Exit Passageways
- Emergency Lighting Systems
  - Luminosity tests -- Cabin color contrast
  - Fuselage transverse separation
  - Emergency Escape Path Markings (EEPM) -- Luminous; Incandescent; Visibility; Seat baggage bars
- Crew Areas
  - Crew assist space
  - Crew assist handle
  - Crew visibility
  - Crew rest area
  - Oxygen
  - Communication
- Flight Deck Door
- Cabin Doors and Curtain Dividers
- Ordinance Signs
  - Visibility
  - Legibility
- Cross Aisle Visibility
- Passenger Address (PA) System
- Cabin Hand Sets and Egress Issues
  - Constant retention cord reels
  - Ratcheting
- EMI/RFI Tests
- DO-160 Environmental, Cooling and Ventilation Requirements
- Lithium Ion batteries
- Water systems

Instructor: Ken Farsi
Fee $1370 1.3 CEUs

Aviation Safety Engineer Job Functions

4 Days
I.D.# C1708

The skills and knowledge gained in this workshop will enable students to carry out regulatory responsibilities related to the administration of the Aircraft Certification and Continued Operational Safety. This course content provides the Civil Aviation Safety Engineers (Systems – Electrical) with the knowledge and skills to conduct oversight of aviation safety, aircraft certification and Continued Operational Safety. These areas of responsibility include, but are not limited to, Type Certification, Amended Type Certification, Supplemental Type Certification, Parts Manufacturing Approval (PMA), Technical Standard Order (TSO) Continued Operational Safety, Flight manuals, and Operational Approvals.

The workshop’s emphasis will be on Aircraft Certification activities as well as Continued Operational Safety tasks. With the goal to enable the students to provide regulatory oversight for the engineering certification activities that they are responsible for. In addition, the students will receive specific training on job functions for mechanical and electrical systems.

Learning Objectives

By attending this seminar, participants will be able to:
- Comprehend the FAA processes for certification of products
- Efficiently manage certification programs
- Describe the principles of Type Certification and Supplemental Type Certification requirements and process
- Communicate effectively with the FAA on certification programs
SAFETY AND QUALITY

• Describe the FAA system, FAA orders, Advisory Circulars, FAA rule making process
• Identify Equivalent Level of Safety, Special Conditions and Exemptions
• Identify the difference between airworthiness standard and operational rules
• Explain the FAA Enforcement procedures and applicant action

Who Should Attend
This seminar is designed for aerospace engineering roles such as: certification engineers, certification technicians, engineering leadership, program managers, and business development personnel. This course applies to any discipline associated with certification in areas such as: certifying products, testing, leading/managing certification projects and regulatory impact on new business opportunities. The information presented in this seminar builds on the content of SAE seminars, FAA Certification, Operations & Maintenance Orientation (ID# C1707, page 157) and FAA Part 21 Certification Procedures for Products and Parts (ID# C1701, page 156) but goes beyond certification into operations and maintenance activities in greater detail.

Topical Outline
DAY ONE
• Introduction
  • Who We Are & What We Do
  • Why We’re Here
  • Airworthiness Certification Training
• FAA Structure, Roles, Responsibilities, Who Are the Players?
  • Acronyms
  • Section Outline
  • Overall Structure
  • Aircraft Certification Service
  • Directorate
• FAA Guidance
  • Acronyms
  • Section Outline
  • FAA Regulatory Hierarchy
  • FAR Parts Defined – Aeronautics & Space
  • FAR Parts Governing Certification & Continued Airworthiness of Rotorcraft
  • FAR Parts 23, 25, 27 & 29
  • Advisory Circulars Pertaining Certification & Continued Airworthiness
  • Directives Pertaining Certification & Continued Airworthiness
  • Other Resources
DAY TWO
• FAA Designees/Delegations
  • Acronyms Section Outline
  • History
  • Representatives of the Administrator
• Designated Engineer Representatives (DER)
• Designated Airworthiness Representative (DAR) & Designated Manufacturing Inspection Representative (DMIR)
• Organization Designation Authorization (ODA)

DAY THREE
• Type Certification Process
  • Acronyms
  • Section Outline
  • TCP Overview
  • TCP Phase I: Conceptual Design
  • TCP Phase II: Requirements Definition
  • TCP Phase III: Compliance Planning
• Type Certification Process (Continued)
  • TCP Phase IV: Implementation
• Changes in Type Design
• Issuances of Airworthiness Certificates
• FAA Validation Under Bi-laterals
• Technical Standard Orders

DAY FOUR
• ASE Job Function
  • Subpart Breakdown
  • Applicable Paragraphs
  • Engineering Disciplines
  • Certification Tools
  • Systems & Equipment ACs/Dos/Orders/Job Aids
  • Operations Approvals
  • Simulator Qualifications
  • Lithium Battery Special Conditions
  • E-Enabled Operations Approval

Instructor: David Downey or Frederick Stellar
Fee $2175 2.6 CEUs

Understanding and Supporting Aircraft Accident Investigation and Reconstruction
2 Days
I.D.# C1143

Aircraft accident and incident investigations should be supported by all engineering disciplines and departments involved with design, manufacturing, certification, and field operations. For individuals called upon to serve as advisors or technical representatives to official aircraft accident investigation (AAI) teams, an understanding of aircraft accident investigation and reconstruction methodology and processes is critical to success in this supportive role.

This two-day seminar will begin with the basic requirements for conducting proper accident investigations, including investiga-
SAFETY AND QUALITY

tive philosophies and procedures. The instructor will then guide participants through various data gathering methods and cover several specific types of accident investigations including those related to human factors, crashworthiness, inflight breakups, and mid-air collisions. Presentations are based on actual accidents and real-life investigation experiences and accident investigation case studies are integrated throughout the course to provide participants the knowledge required to effectively support aircraft accident investigation and reconstruction.

Learning Objectives
By attending this seminar, participants will be able to:
• Identify the key requirements and steps in the AAI process
• Identify and evaluate analytical procedures used in an AAI
• Identify and analyze potential complications that arise during an AAI
• Construct and contribute analysis in support of an AAI

Who Should Attend
This course will benefit individuals seeking a fundamental understanding of the aircraft accident investigation and reconstruction process, particularly engineers within the aerospace industries that may be called upon to serve in a supportive role as a technical advisor to an official aircraft accident investigation team.

Topical Outline
DAY ONE
• Introduction
• Investigative Attitudes and Behaviors
• Approach to an Investigation
  • Simple vs complex
  • Collecting evidence
  • Reconstructing evidence
• Basic Analytical Procedures
  • Intuitive methods
  • Formal methods
• Results of Incomplete Investigation Processes
• Human Factors Analysis
  • G-load tolerance
  • Recognition and reaction time
  • Spatial and situational disorientation
  • Visual illusions
  • Cockpit warnings and control issues
  • Identifying hazards
  • Technologically advanced aircraft
• Aging Aircraft
DAY TWO
• Witness Interviews
• Photo Documentation
• In-Flight Breakups
  • Sequence
  • Radar data
  • Trajectory analysis
  • Flutter
  • Crashworthiness and Survivability
  • Design aspects
  • Implementation
  • Impact analysis
• Mid-Air Collisions
  • Operational/environmental aspects
  • Wreckage evaluation
• Nine-Box Matrix Exercise
• Wreckage Reconstruction Exercise

Note: Accident investigation case studies are integrated throughout the course.

Instructor: Donald F. Knutson
Fee $1370 1.3 CEUs

AS9100:2016 Rev D: Transitioning to the New Requirements
2 Days
I.D.# C1633

Individuals responsible for quality management system, implementation, and transition to the AS9100:2016 series of standards for Aviation, Space, and Defense will require an understanding of the requirements for the preparation and execution of the audit process as defined in these revised standards. Management and implementers of AS9100:2016 Rev. D within these organizations must also be aware of what these changes may mean for their company. A thorough understanding of the process approach to auditing as required by the standard and the Certification Body requirements will have a direct impact on the outcome of the QMS audit as companies look to transition their certificate to AS9100 Rev. D.

This two-day seminar will begin with an in-depth review of changes in AS9100 Rev. D: Quality Management Systems - Requirements for Aviation, Space and Defense Organizations and the intent of the revised requirements. Included is a detailed discussion of the AS9100 standard, with special emphasis on the process approach, Annex SL high level structure, risk-based thinking versus risk management, product safety, counterfeit parts, and human factors. Additionally, AS9101 Rev D: Quality Management Systems Audit Requirements for Aviation, Space, and Defense Organizations and AS9104-1: Requirements for Aviation, Space, and Defense Quality Management System Certification Programs will be examined so that individuals responsible for AS9100 Rev. D implementation understand the system and audit requirements and the immediate influence these changes will have on their certificate transition.
Learning Objectives

By attending this seminar, participants will be able to:

• Summarize the International Aviation, Space & Defense standards change process and why changes to the standards were required
• Identify key changes between AS9100 Rev. C and Rev. D and how these changes will impact an organization's certificate transition
• Identify the requirements of AS9100:2016 Rev. D with emphasis on the process approach, Annex SL high level structure, risk-based thinking versus risk management, product safety, counterfeit parts, and human factors
• Identify and understand AS9101:2016 Rev. F Audit Requirements for conducting and reporting audits and the impact these requirements will have on organizations and implementers involved in transitioning to AS9100:2016 Rev. D
• Identify key components of AS9104-1 Certification Process Overview and the influence this standard will have in the transition and certification process

Who Should Attend

This seminar is intended for Aviation, Space and Defense industry professionals who desire a detailed understanding of the requirements of AS9100 Rev. D in order to manage, implement, and perform internal audits to the standards. Additionally, trainers, consultants, and other individuals that maintain a significant interest in AS9100 standards will benefit from the information presented in this seminar.

Prerequisites

Participants should have an understanding of AS9100 Rev C and ISO 9001 QMS standards and concepts.

Topical Outline

DAY ONE

• Overview of AS&D Standards
  • Rationale for changes and the revision process
• AS9100:2016 Rev D Changes Overview
• AS9100:2016 Rev D Detailed Discussion
  • Context of the Organization
  • Leadership
  • Planning
  • Support
  • Operation
  • Performance Evaluation
  • Improvement

DAY TWO

• AS9100:2016 Rev D Detailed Discussion (continued)
• AS9101:2016 Rev F
  • Aviation, Space & Defense 3rd Party Auditing Focus
  • Enhanced audit processes

• Process based management systems
• Phases of the audit process
• Customer focus and feedback
• Conformity AND effectiveness
• Forms and their impact: Non Conformity Report (NCR); Objective Evidence Record (OER); Process Effectiveness Assessment Report (PEAR)
• AS&D AS9104/1 Certification Process Overview
• Summary of Certification Body requirements and expectations: NCR requirements; audit day table; audit report generation

Instructor: L. L. “Buddy” Cressionnie
Fee $1530 1.3 CEUs


4 Hours
Web Seminar: I.D.# WB1617
Web Seminar Replay: I.D.# PD331617ON

In a global economy, aviation, space and defense organizations are presented the challenge of producing and delivering safe and reliable products across a wide range of customer requirements and expectations. In an effort to address diverse quality requirements and expectations while also reducing costs throughout the supply chain, the SAE AS9100 family of standards was developed by international aerospace industry representatives to standardize international aerospace quality management system requirements.

This live online course will provide insights into the SAE AS9100D:2016 and ISO 9001:2015 significant changes as they adopt the common management system structure. It will include material on the standard’s development process including timelines, new Common Management System Structure, AS9100D:2016 and ISO 9001:2015 Requirement Review and reference material for gap analysis and successful implementation.

Learning Objectives

By participating in this web seminar, participants will be able to:

• Recognize the impact to new Quality Management Principles on the revision to the standards
• De-mystify the new 10-clause Common Management System structure and understand the impact on your organization
• Grasp the new language like organization and its context, interested parties, documented information, and risk-based thinking
SAFETY AND QUALITY

• Realize the Aviation, Space & Defense proposed additions to understand benefits
• Gain an understanding of the SAE AS9100D:2016 and ISO 9001:2015 requirements and intent
• Define the timeline for AS9100D:2016 transition period

Who Should Attend
The course is designed for quality managers, management representatives, auditors, engineers, supply chain managers and other professionals. AQMS Implementers will comprehend SAE AS9100D:2016 requirements for application at your organization. AQMS Internal Consultants will understand the intent to apply value-added implementation of the requirement. AQMS Auditors will comprehend requirements to confidently audit requirements at your organization. AQMS Executives and Management Representatives will better understand how to use AS9100D:2016 requirements to drive cost savings improvement. Individuals wanting an improved AQMS process understanding to integrate AS9100D:2016 requirements into company processes will also benefit.

Prerequisites
Those with AS9100 and ISO 9001 implementation or audit knowledge or expertise will get the most from this course.

Topical Outline
• Standards Development Process
• New Common Management System Structure and Language
• ISO 9001:2015 and AS9100D:2016 New Requirements
  • Introduction of additions to the standard
  • Impact of new AS9100D and ISO 9001:2015 requirements to your business
  • Context of the Organization
  • Leadership
  • Planning
  • Support
  • Operation
  • Performance Evaluation
  • Improvement
• Summary
  • Techniques to ensure the QMS is effective in meeting customer expectations
  • Reference resources for gap analysis and successful implementation

Instructor: L.L. ‘Buddy’ Cressionnie
Fee $425 .4 CEUs

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AS9100D Internal Audit Program Implementation

3 Days
I.D.# C1713

One of the most important requirements for AS91XX series and other quality standards, is to create, implement and maintain an effective Internal Audit Program. An improperly designed and implemented Internal Audit Program could result in non-conformances leading companies to improperly identifying and describing non-conformances, applying incomplete or inadequate root cause analyses, establishing ineffective corrective actions, implementing incomplete Internal Auditor Qualification Programs, etc. A well-developed auditing program enables the monitoring of and improvements to the effectiveness of the Quality Management System (QMS) which will reduce risk and cost of non-conformances.

This unique three-day seminar will cover how to create, implement and maintain an effective Internal Audit Program, including the preparation, the follow-up and closure of the internal audit and an internal auditor qualification program. The information presented in this seminar is related to the AS9100D Internal Auditor Training course but extends to the entire Internal Auditor Process including creation, implementation, and sustainment.

Learning Objectives
By attending this training program, participants will be able to:
• Describe the requirements of AS91XX series standards for internal audits
• Discuss the inputs, activities and outputs of an Internal Audit Program
• Recognize the different inputs and steps needed to implement and monitor an Internal Audit Program
• Demonstrate the knowledge, tools and steps to perform an Internal Audit Program from the opening meeting to the closing meeting
• Recognize the activities needed for non-conformance follow-up and closure
• Describe the process for creating an Internal Auditor Qualification Program
• Employ strategies to get everyone involved and succeed when conducting an internal audit

Who Should Attend
This seminar is designed for aerospace industry roles such as Quality Managers, Quality Engineers, Internal Auditors, Plant Managers, Compliance Officers, etc. This course applies to any discipline associated with Quality Management Systems, Internal Audit Program Management, Quality Control and Compliance. Internal auditees may also find the course helpful in understanding how an Internal Audit Program works to allow for more adequate
preparation. All Manufacturing, Maintenance, Design and/or Distribution Aerospace Companies already certified or seeking certification under AS91XX Standards would be interested in the content of this course.

**Topical Outline**

**DAY ONE**
- Agenda & Introductions
- Diagnostic Test
- Principles of Auditing
- AS9100D Requirements for Internal Audits
- Creating an Internal Audit Program
  - Types of audits
  - Audit program responsibilities
  - Inputs, activities and outputs
  - Audit forms

**DAY TWO**
- Implementing an Internal Audit Program
  - Objectives, scope and criteria
  - Audit tools and techniques
  - Selecting audit team members
  - The team leader
  - Considerations to get everyone involved
  - Outcome of the internal audit program
- Monitoring the Internal Audit Program
- Preforming an Internal Audit
  - Preparation
  - Conducting an internal audit
  - Considerations to success
  - Internal audit findings and reports (AS9101F forms)
- Internal Auditor Qualification Program
  - Lead and internal auditor profile
  - Selection of candidates
  - Evaluation
  - Re-qualificationss

**Instructor:** Dario Yamamoto

**Fee $1745** 2.0 CEUs

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**AS9100D Internal Auditor Training**

**3 Days**

**I.D.# C1634**

Internal audits (a requirement of the AS9100 Rev D Standard) are intended to verify the compliance and effectiveness of the organization’s quality management system. Internal auditors must be knowledgeable of these requirements and the expectations as identified in the standard. In addition, the audit requirements outlined in the AS9101 Standard have significantly changed the way auditors are expected to conduct audits in the aviation, space and defense industries.

This three-day internal auditor training program is designed to provide potential and existing internal auditors with the knowledge necessary to understand and successfully audit an organization against AS9100 Rev. D: Quality Management Systems - Requirements for Aviation, Space and Defense Organizations. Additionally, attendees will participate in a detailed examination of the requirements of AS9101 Rev E: Quality Management Systems Audit Requirements for Aviation, Space, and Defense Organizations. An overview of the Standards will also be provided to identify the effect this standard has on the way internal audits should be conducted. Case studies and classroom exercises will be presented in this class to provide participants the comprehensive knowledge and practical skills necessary to be an effective internal auditor.

Probitas Authentication, an IAQG recognized Auditor Authentication Body and Training Provider Approval Body, accepts this course as meeting the initial training requirements for its Aerospace, Space, and Defense Internal Auditor program. For more information about obtaining this formal Aerospace Internal Auditor recognition, please send your inquiry to probitas@sae-itc.org.

**Learning Objectives**

By attending this training program, participants will be able to:
- Summarize the impact ISO 9000:2015 has on the application of other Standards
- Identify and explain the requirements of AS9100 Rev D including process approach, project planning, risk management, configuration management, and work transfer
- Identify and explain the key requirements of AS9101 Rev E Auditing a QMS
- Identify the basic elements of a quality management system
- Identify the tools and techniques necessary for carrying out an effective audit
- Demonstrate the knowledge and skills required to independently perform a quality management system audit
- Document the outcomes of an audit
SAFETY AND QUALITY

Who Should Attend
This training program is designed for quality professionals in the aviation, space and defense industries who are involved in the internal audit program and/or management of quality systems seeking compliance to the AS9100D and the current version of the AS9101 standard Standards.

Topical Outline

DAY ONE

- Agenda and Introductions
- Introduction to the Basics of Quality Management Systems
- ISO-9000 Terms and Vocabulary Overview
  - Terms and Definitions
- AS9100 Rev D Overview
  - Quality Management System with emphasis on the process approach
  - Management responsibility with emphasis on customer focus
  - Resource management
  - Product realization, with emphasis on project, risk, and configuration management, and work transfer
  - Measurement, analysis and improvement

DAY TWO

- AS9101 Rev D Overview
  - Quality Management System with emphasis on the process approach
  - Management responsibility with emphasis on customer focus
  - Understanding the new aviation, space & defense 3rd party auditing focus
  - Use of AS9101E audit forms
- Auditing
  - Overview of the audit life cycle
  - Audit tools & techniques
  - Preparing to conduct an audit
  - Conducting QMS audits
  - Writing effective audit documentation

DAY THREE

- Case Studies and Classroom Exercises
  - Overview of the audit life cycle
  - Preparing to conduct an audit
  - Conducting an audit (simulated)
  - Reporting on the outcome of an audit

Instructor: Paul J. Kunder or George Ringger

Fee $1815 2.3 CEUs


2 Days
I.D.# C1706

The requirements of the AS9120, Rev. B, EN9120B and JIAQ9120B Standards have significantly changed and are based on the NEW ISO9001:2015 Standard. This two-day training program is designed to provide individuals with the knowledge necessary to understand and comprehend the NEW requirements described in AS9120 Rev. B, Quality Management Systems – Requirements for Aviation, Space, and Defense Distributors. The course includes classroom instruction combined with class exercises to further reinforce concepts and definitions now required by the standard. The course is taught from the aviation distributor’s perspective and is a must for all individuals or organizations involved in the procurement of parts, materials, and assemblies with the intent to resell these products to customers in the aviation, space, and defense industries.

Attendees will receive a copy of AS9120, Rev. B, Quality Management Systems – Requirements for Aviation, Space, and Defense Distributors.

Learning Objectives

By attending this training program, participants will be able to:
- Recognize the rationale for AS9120B:2016
- Identify the purpose of the new 10-clause high-level management system structure, as it relates to AS9120B:2016
- Recognize the process approach in AS9120B:2016
- Integrate AS9120B:2916 requirements into the organization’s core business processes
- Define the context of an organization
- Identify when risk, counterfeit parts, and product safety should be considered
- Identify the essential components of resources needed for compliance
- Evaluate when Clause 8.3 Design and Development of Products and Services might be applicable to and aviation, space and defense distributors
- Explain the concept of risk-based thinking in AS9120B:2016
- Assess when product safety, human factors, suspect counterfeit parts, and suspected unapproved parts should be considered when making decisions

Who Should Attend
This seminar is designed for aerospace quality management professionals such as: quality control managers, quality assurance managers, product managers, business development managers and supply chain managers. This course outlines changes in the
SAFETY AND QUALITY

standard which impact supplier quality in areas such as: distribution, purchasing, sales, product development, service development, and repair station operations. The information presented in this seminar would also compliment other SAE seminars such as, AS9100:2016 Rev D: Transitioning to the New Requirements (ID# C1633, page 146), or AS9100D Internal Auditor Training (ID# C1634, page 149).

**Topical Outline**

**DAY ONE**
- Introduction
- Recognizing the rationale for AS9120B:2016
- High level structure, Annex SL– purpose
- Major changes – ISO9001:2015
- Major changes – AS9120B:2016
- Terms and definitions – AS9120B:2016
- Process approach
- Context of the organization (Clause 4)
- Leadership (Clause 5)
- Planning (Clause 6)
- Support (Clause 7)
- Operational planning and control (Clause 8.1)
- Requirements for Products and Services (Clause 8.2)
- Design and development of products and services (Clause 8.3)

**DAY Two**
- Control of externally provided processes, products, and services (Clause 8.4)
- Production and service provision (Clause 8.5)
- Release of products and services (Clause 8.6)
- Control of nonconforming outputs (Clause 8.7)
- Performance evaluation (Clause 9)
- Improvement (Clause 10)
- Human Factors
- Managing Risk
- Transition timeline & support informations
  - Overview of the audit life cycle
  - Preparing to conduct an audit
  - Conducting an audit (simulated)
  - Reporting on the outcome of an audit

**Instructor:** George Ringger

**Fee:** $1505 1.3 CEUs

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**Common Training for DPRV Personnel**

(Formerly: Aerospace Supplier Quality: Common Training for Self-Release Delegates)

**3 Days**

I.D.# C1501

In the aerospace industry, delegated product release is a process whereby a supplier has been provided the authority to act on behalf of a delegating organization to verify and release products without additional oversight from that delegating organization. Currently, each of these delegating organizations manages and conducts a unique training program for individuals responsible for their product release overcheck process. For suppliers producing products for multiple delegating organizations, each must then manage the multiple training requirements. The delegating organizations, recognizing there is commonality among the various training programs, have come together to consolidate their training into a single, common training standard.

This three-day course will provide product release delegates with a comprehensive and standardized set of requirements for the self-release process. This course is designed to cover the key elements of the process along with a detailed explanation of product-release overcheck activities. Beginning with the role and responsibility of the product release delegate and its importance to flight safety, the instructors will guide participants through the various product release activities including a review of documentation, visual inspection, dimensional overcheck, part marking and serialization, and release documentation requirements. In addition to attending and participating in the full three days, attendees must take and pass a comprehensive learning assessment to successfully complete this course.

When the AS13001: Common Training for DPRV Personnel standard is imposed from a delegating organization as a requirement, this foundations course is recognized as satisfying the respective customer training requirement for initial self-release delegate qualification. This course also aligns with the requirements of the AS9117: Delegated Product Release Verification standard.

In addition to attending and participating in the full three day training, attendees must take and pass a comprehensive learning assessment to successfully complete this course and earn their initial DPRV qualification. This credential is conferred and tracked by Probitas Authentication, a third-party body that authenticates Aerospace Quality Management System (AQMS) auditors and training programs against specific aerospace requirements. Upon successful completion of this course and while the qualification remains valid, a product release delegate’s personal qualification...
SAFETY AND QUALITY

is recognized by all participating delegating organizations and is transferable between supplier organizations. The initial qualification is valid for a duration of three years, at which time the individual must then complete the necessary recertification training and learning assessment in order to maintain the qualification.

Learning Objectives

By attending this seminar, participants will be able to identify and explain:

- The role of the product release delegate
- Legal, ethics, and code of conduct
- Applicable airworthiness regulations and standards
- History of quality in the aerospace industry
- Human Factors and the importance of effective communication
- Customer requirements, flowdown, and compliance with material definition
- Key characteristics
- First article inspection reporting
- Dimensional over-inspection
- Visual inspection
- Part marking and serialization
- Nonconformance control and concession
- Subtier control
- Counterfeit, suspect, and unapproved parts awareness
- Packaging, labeling, preservation, handling, and storage
- Required documentation

Who Should Attend

This credentialing course is intended, as stated in AS13001, to meet the initial training requirements for designated personnel within aerospace supplier organizations that have been identified and approved as operating a product release process as a delegated activity. This course also meets the training requirement of the AS9117: Delegated Product Release Verification standard.

Topical Outline

DAY ONE

- Role of the Product-Release Delegate
  - Duties
  - Responsibilities
- Airworthiness Regulations and Standards
  - Industry oversight
  - Product release oversight
  - Quality standards
  - Government source inspection
- Legal, Ethics, and Code of Conduct
  - Industry expectations
  - Legal obligations
  - Ethical behavior
  - Code of Conduct
- Human Factors and the Importance of Effective Communication
  - Human factors concepts
  - Internal and external factors
  - Communication
  - Delegate’s role
- Quality History
  - Importance of supplier quality
- Aerospace Products
  - Our Industry: We make more than just engines
  - Aircraft engine technology
- Flight Safety
  - Defining flight safety
  - Delegate’s role
  - Potential impact
- Key Characteristics
  - Definition
  - Identifying key characteristics and how they originate
  - Key characteristics and your responsibilities
  - Relationship between key characteristics and critical items
- Customer Requirements, Flowdown, and Compliance with Material Definition
  - Definition of customer requirements and where they originate
  - Types of customer requirements
  - Tracking and implementation of requirements
  - Definition of flowdown, where they originate, and expectations
  - Flowdown activities and potential risk
  - Definition of compliance with material definition
  - Importance of materials compliance management

DAY TWO

- Subtier Control
  - Activities related to flowdown of sub-tier control at every level
  - Approved sources
  - “Certs” and common requirements
  - Receiving inspection
- Review Router/Traveler, OPS Complete
  - Purpose and requirements of Review Router/Traveler
  - Relationship to traceability,
  - Scope of OPS Complete and requirements
  - Certificates of Conformance
- First Article Inspection Reporting
  - Definition and when it is required
  - Applicability
  - Core components of FAIR activity
  - Delegate’s responsibilities
- Dimensional Over-Inspection
  - Definition of dimensional over-inspection
  - Independence of inspection
  - Customer specific requirements
  - Key activities of measurement systems analysis
SAFETY AND QUALITY

- Additional safety related requirements
- Critical features
- Hidden characteristics
- Sampling requirements
- Visual Inspection
  - Visual inspection best practices
  - Inspection techniques
  - Influence of environmental factors
  - Foreign object debris/damage (FOD)
  - Visual compliance verification
  - Workmanship examples
- Suspect, Unapproved, and Counterfeit Parts Awareness
  - Terms and definitions in counterfeit parts risk mitigation
  - Proliferation of counterfeit/fraudulent parts
  - Supply chain

DAY THREE
- Part Marking and Serialization
  - Importance of part marking
  - Key attributes of part marking
  - Requirements for verifying traceability marking
  - Delegate’s responsibilities
- Nonconformance Control and Concession
  - Definition of nonconformance
  - Responding to unplanned nonconformances
  - Waivers and deviations
  - Required documentation
  - Escaped product disposition
- Packaging, Labeling, Preservation, Handling, and Storage
  - Applicable regulations and standards
  - Packaging and labeling best practices
  - Product preservation
  - Product handling, storage, and accepted practices
  - Documentation requirements
- Learning Assessment

*The order in which the topics are presented is subject to change.

<table>
<thead>
<tr>
<th>Instructor:</th>
<th>Contact SAE Corporate Learning Solutions for Information on Instructors for this course.</th>
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<tbody>
<tr>
<td>Fee $1095</td>
<td>2.0 CEUs</td>
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Introduction to Advanced Product Quality Planning (APQP)

1 Hour
I.D.# PD530908ON
To become a preferred supplier in the automotive industry, organizations must demonstrate high-level engineering and organizational capabilities that will meet customers’ needs today and tomorrow. Because the outcome of a product development project may determine whether or not an organization procures a purchase order or contract from a global automotive customer, Introduction to Advanced Product Quality Planning provides an overview of the best practices / methodologies for planning and managing the successful launch of a new product.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

Quantitiy discounts and Site License options are available. Call the SAE Corporate Learning Solutions hotline at +1.724.772.8529 for a quote.

Principles of ISO 9001, ISO/TS 16949 and AS9100

35 Minutes
I.D.# PD530824ON
The Principles of ISO 9001, ISO/TS 16949, and AS9100 on demand course provides those in the automotive and aerospace industries with a high-level overview of these quality management system standards. It is designed to explore the history that lead to the development of the standards. The course also highlights the need for organizations to determine the necessary competence for personnel performing work affecting product quality, provide training or take other actions to satisfy these needs, evaluate the effectiveness of the actions taken, to ensure that personnel are aware of the relevance and importance of their activities and how they contribute to the achievement of the quality objectives, and maintain appropriate records of education, training, skills and experience.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

Quantitiy discounts and Site License options are available. Call the SAE Corporate Learning Solutions hotline at +1.724.772.8529 for a quote.
Understanding the FAA Parts Manufacturer Approval Process

2 Days
I.D.# C1324

The requirements for producing an FAA approved replacement part can be daunting. Understanding the steps required in the FAA Parts Manufacturer Approval (PMA) process can greatly streamline the approval life-cycle and reduce unnecessary costs and delays, thereby shortening the time and cost to market. This course is designed for those organizations and individuals interested in designing and manufacturing replacement parts for civil aviation aircraft.

This two-day course covers the crucial subjects and steps of the FAA-PMA approval process. The instructor will begin with an overview of the Federal Aviation Administration (FAA) organizational structure. The instructor will then guide participants through the roles and responsibilities of the PMA applicant, Aircraft Certification Office (ACO), Manufacturing Inspection District Office (MIDO), Flight Standards District Office (FSDO), and the Aircraft Evaluation Group (AEG) as outlined in FAA policies, guidelines, and requirements leading to FAA-PMA approvals. In addition, the instructor will present the necessary topics to be covered in all PMA engineering analyses including Approval by Identicality, Licensing Agreement, and Test and Computation. Throughout this course the instructor will combine classroom lecture with real-world examples to provide participants both a formal as well as practical learning experience.

Learning Objectives

By attending this seminar, participants will be able to:
• Understand the PMA process throughout the product life-cycle
• Recognize the roles and responsibilities of the PMA applicant
• Identify the roles and responsibilities of the FAA and FAA Designees
• Manage the PMA approval process with respect to schedules and time-lines
• Identify the required content for an acceptable Engineering Design Analysis

Who Should Attend

This course is designed for engineering and manufacturing managers, design engineers, airworthiness and certification engineers, quality assurance inspectors and engineers, program managers, consultants, Federal Aviation Administration designated engineering and airworthiness representatives (DER and DAR) and other technical administrative personnel involved in FAA-PMA certification activities. The course will help both newcomers to civil aircraft parts certification as well as experienced attendees better understand the PMA certification process.

Topical Outline

DAY ONE
• Introductions
• The purpose of this Course
• The FAA / Design & Production Approvals
• The Purpose for FAA-PMA
  • Who Needs a PMA?
  • What are the Exceptions to PMA?
  • Fabrication Inspection System
  • PMA and Older Products
  • The Roles of the FAA and Applicant
  • Project Specific Certification Plans (PSCP)
• What to Expect From Applicants
  • Who Gets Application Letter?
  • Content of Application Letter
  • Basis for Design Approval
  • Draft PMA Supplements
  • Applicant's Data Package
  • Special Requirements for Test and Computation Applications
  • Identicality by Other Than Licensing Agreement
  • Part Marking Requirements
  • Use of Designees
  • Establishment of the Fabrication Inspection System (FIS)
  • Responsibilities of PMA Holders After Approval
  • Deviations

DAY TWO
• Aircraft Certification Office (ACO) Responsibilities
  • General Responsibilities
  • Applicant Approaches
  • Review of Applicant’s Abilities
  • Coordination with Certificate Management ACO (CMACO)
  • Verification of Installation Eligibility
  • Service History Considerations
  • Life-Limited Parts
  • Special Considerations—Identicality Without a License Agreement
  • Special Considerations—Test and Computation
  • Evaluating the Drawing Package
  • Conformity Inspections
  • Design Approval
  • Revising the PMA Supplement
  • Non-Compliance
• Manufacturing Inspection District Office (MIDO) Responsibilities
  • PMA Activities
• Designated Engineering Representatives (DER) and Organization
  • Designation Authorization (ODA)
  • DER Roles in the PMA Process
  • Test and Computation

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• Fill out the online quote request at sae.org/corplearning • Email us at Corplearn@sae.org
Understanding the FAA Aircraft Certification Process

2 Days  
I.D.# C0821

The task of certifying an aircraft or part can be overwhelming given the lengthy process and the many steps that are required. Understanding the process can greatly enhance the outcome and reduce unnecessary delays or frustrations.

This course will provide an overview of the Federal Aviation Administration (FAA) organizational structure, its policies, guidelines and requirements leading to Type and Supplemental Type airworthiness approvals. It will also cover the rule-making process and rules applicable to aircraft parts and products. The course will define the roles and responsibilities of the Aircraft Certification Office (ACO), Manufacturing Inspection District Office (MIDO), Flight Standards District Office (FSDO), and the Aircraft Evaluation Group (AEG). Type and Supplemental Type Certification (TC and STC) processes, and Change Product Rule for alterations and modifications to previously type certified aircraft will be discussed. FAA rule-making process will be examined including review of FAA Orders, Notices, Advisory Circulars and other guidance material.

Learning Objectives
By attending this seminar, participants will be able to:
• Manage certification programs more efficiently, schedule the required milestones accordingly, and identify problems and address them promptly
• Describe the principles of Type Certification and Supplemental Type Certification requirements and process
• Converse intelligently and enter negotiations with others involved in FAA certification programs
• Describe the FAA system, FAA orders, Advisory Circulars, FAA rule making process
• Define what exemptions and special conditions are and how to obtain them
• Identify the difference between airworthiness standard and operational rules

Who Should Attend
This course is designed for engineering and certification managers, design engineers, airworthiness and certification engineers, quality assurance inspectors and engineers, program managers, consultants, Federal Aviation Administration designated engineering and airworthiness representatives (DER and DAR) and other technical administrative personnel involved in FAA certification activities. The course will help newcomers to aircraft certification as well as experienced attendees better understand the certification process and be able to present and negotiate certification matters with the Federal Aviation Administration Aircraft Certification Office.

Topical Outline
DAY ONE
• FAA History, Organization and Hierarchy
  • FAA certification “lingo”
  • FAA system organizational chart and hierarchy
  • How regulations are developed
• FAA Roles and Responsibilities
  • Aircraft Certification Office
  • Manufacturing Inspection District Office
  • Flight Standard District Office
  • Aircraft Evaluation Group
• Issue Papers - What They Are and How They Are Used
  • Exemptions
  • Special conditions
  • Equivalent level of safety
• Certification Basis
• Change Product Rule
DAY TWO
• Type Certificate Data Sheet - The “Birth Certificate” of an Airplane
• Documents and How to Develop Them
  • Airplane Flight Manual Supplements
  • Instructions for Continued Airworthiness
  • Type Inspection Authorization
  • Request For Conformity
  • Certification Plan
  • Conformity Plans
• FAA Advisory Materials
• Support Documents
  • Parts Manufacturing Authorization
  • Technical Standard Order
  • Field approvals
  • FAA Form 337 approvals
  • 8110-3 approvals
• Type and Supplemental Type Certification Process
  • Certification Plans and FAA coordination
  • Data generation and approvals
  • Conformity inspections
SAFETY AND QUALITY

- Testing
- Approvals

Instructor: Farsi, Ken
Fee $1370 1.3 CEUs

FAA Part 21 Certification Procedures for Products and Parts

2 Days
I.D.# C1701

Part 21 is the FAA regulation that provides the regulatory framework to conduct certification of products and parts. This includes the engineering, airworthiness, production and quality systems. The aerospace industry is hinged around compliance with Part 21; however, comprehension of Part 21 and its role in civil certification is challenging. This course is designed to provide participants with an understanding of the processes that encompass aircraft certification, including compliance with FARs, certification procedures and post certification responsibilities. It is also intended to introduce participants to the many regulatory issues upon which companies make business decisions that can be derailied by failing to see the part 21 implications. Such issues may include licensing, supplier control and relocation of manufacturing either domestically or internationally. Aerospace professionals will be able to implement time and resource saving actions resulting in cost savings. Participants will explore concepts of supplementing a Type Certificate, production certification procedures, quality system compliance, airworthiness certificates, and export procedures. Technical Standards procedures, parts manufacturing approval procedures, and implementation of the Change Product Rule and how to determine its applicability will also be covered.

Learning Objectives

By attending this seminar, participants will be able to:
- Define Part 21 and its role in the overall regulatory rule structure
- Describe and determine your role as a design approval holder (TC/STC/TSO/PMA)
- Describe and determine your role as a production approval holder (PC/TSOA/PMA)
- Outline what constitutes an FAA approved quality system
- Define the Various FAA airworthiness certificates and the impacts and implications for owner/operators
- Explain what constitutes changes to a design approval

Who Should Attend

This seminar is designed for aerospace engineering professionals such as: certification engineers and technicians, engineering leaders, program managers, business development personnel and compliance specialists. This course applies to any discipline associated with certification in areas such as: the certification of products, testing, leading certification projects, regulatory impact on new business opportunities and compliance with ITAR/EAR. The information presented in this seminar will be of interest to individuals interested in enrolling in other SAE seminars such as: Aircraft Cabin Safety and Interior Crashworthiness (ID# C0926, page 143), FAA Certification, Operations & Maintenance Orientation (ID# C1707, page 157), Aviation Safety Engineer Job Functions (ID# C1708, page 144).

Topical Outline

DAY ONE

- Subpart A – General
  - Applicability and definitions
  - Falsification of applications, reports, or records
  - Reporting of failures, malfunctions, and defects
- Subpart B – Type Certificates
  - Privileges
  - Transferability
  - Instructions for continued airworthiness and manufacturer’s maintenance manuals having airworthiness limitations sections
- Subpart C – Provisional Type Certificates
- Subpart D – Changes to Type Certificates
  - Major changes in type design
  - Minor changes in type design
- Subpart E – Supplemental Type Certificates
  - Requirement for supplemental type certificate
  - Issue of supplemental type certificate
- Subpart F – Production Under Type Certificate
  - Location of/or changes to manufacturing facilities
  - Production under type certificate
  - Statement of conformity

DAY TWO

- Subpart G – Production Certificates
  - Application
  - Organization
  - Quality system
  - Quality manual
  - Location of/or changes to manufacturing facilities
  - Inspections and tests
  - Production limitation record
  - Transferability
  - Responsibility of holder
  - Changes in quality system
- Subpart H – Airworthiness Certificates
  - Applicability
  - Issue of standard airworthiness certificates for normal, utility, acrobatic, commuter and transport category aircraft; manned free balloons; and special classes of aircraft

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SAFETY AND QUALITY

• Issue of airworthiness certificates for restricted category aircraft
• Experimental certificates: aircraft to be used for market surveys, sales demonstrations, and customer crew training
• Special flight permits
• Subpart I – Provisional Airworthiness Certificates
• Subpart K – Parts Manufacturing Approvals
  • Applicability
  • Application
  • Organization
  • Quality system
  • Quality manual
  • Location of/or changes to manufacturing facilities
• Subpart L – Airworthiness Approvals
  • Issuance of export certificates of airworthiness
  • Issuance of export airworthiness approvals for aircraft engines, propellers, and articles
  • Responsibilities of exporters
• Subpart N
  • Acceptance of aircraft engines and propellers
  • Acceptance of articles
• Subpart O
  • Applicability and definitions
  • Application
  • Organization
  • Quality system
  • Quality manual
  • Location of/or changes to manufacturing facilities
  • Responsibility of holder
  • Approval for deviation
  • Design changes
  • Changes in quality system
  • Issuance of Letters of TSO Design Approval: Import Article

Instructor: David Downey or Frederick Stellar
Fee $1370 1.3 CEUs

Learning Objectives

By attending this seminar, participants will be able to:
• Define the FAA processes for certification of products
• Efficiently manage certification programs
• Describe the principles of Type Certification and Supplemental Type Certification requirements and processes
• Communicate effectively with the FAA on certification programs
• Describe the FAA system, FAA orders, Advisory Circulars, FAA rule making processes
• Identify equivalent level of safety, special conditions and exemptions
• Identify the difference between airworthiness standard and operational rules
• Explain the FAA enforcement procedures and applicant action

Who Should Attend

This seminar is designed for aerospace engineering professionals including: certification engineers and technicians, engineering leadership, program managers, business development personnel, federal aviation administration inspectors/engineers, quality assurance inspectors/engineers and compliance specialists. This course applies to any discipline associated with certification in areas such as: certifying products, leading/managing certification projects, leading part 121/135 engineering modifications, regulatory impact on new business opportunities and compliance with ITAR/EAR. The information presented in this seminar will be helpful to individuals interested in enrolling in other SAE seminars such as: Aircraft Cabin Safety and Interior Crashworthiness (ID# C0926, page 143), FAA Part 21 Certification Procedures for Products and Parts (ID# C1701, page 157), or Aviation Safety Engineer Job Functions (ID# C1708, page 144).

Topical Outline

DAY ONE
• Introduction
• International Civil Aeronautics Organization (ICAO)
• FAA Structure, Roles, Responsibilities
• FAA Guidance
  • FAA regulatory hierarchy
  • FAR parts defined—aeronautics and space

FAA Certification, Operations and Maintenance Orientation

3 Days
I.D.# C1707

Certifying an aircraft, part or appliance can be challenging while navigating the maze of Federal Aviation Administration (FAA) procedures, rules, policies and guidelines. This course will help you to understand the FAA organizational structure, its policies, guidelines and requirements leading to Type and Supplemental Type airworthiness approvals, and provide you with a competitive edge and potential reduction in time in obtaining an FAA approval. The rule-making process and rules applicable to aircraft parts and products, as well as the roles and responsibilities of the Aircraft Certification Office (ACO), Manufacturing Inspection District Office (MIDO), Flight Standards District Office (FSDO), and the Aircraft Evaluation Group (AEG) will be covered. Type and Supplemental Type Certification (TC and STC) processes and Change Product Rule for alterations and modifications to previous type certified aircraft will also be discussed. Additional topics to be covered include: FAA Enforcement, Electronic Records, the Federal Register role and the National Transportation Safety Board and how it can impact your business.

I.D.# C1707
SAFETY AND QUALITY

- FAA Designees/Delegations
  - Representatives of the administrator
  - Designated Engineering Representatives (DER)
  - Designated Airworthiness Representative (DAR) & Designated Manufacturing Inspection Representative (DMIR)
  - Organization Designation Authorization (ODA)

DAY TWO
- Type Certification Process (TCP)
  - TCP overview and types of certificates issued by FAA
  - TCP phase I: conceptual design and certification plan
  - TCP phase II: requirement definition; establishment of TC project; certification basis
  - TCP phase III: compliance planning; oversight & delegation; conformity for engineering purposes; certification plan
  - TCP Phase IV: implementation; compliance data generation activities (Applicant); testing; compliance substantiation activates (Applicant); compliance finding activities (FAA)
  - TCP Phase V: post certification activities; continued airworthiness; data retention
- Changes in Type Design
  - Major/minor design changes
  - Certification basis for changed aviation products
  - Field approvals
  - STC
- Issuance of Airworthiness Certificates
  - Standard airworthiness certificates
  - Special airworthiness certificates - experiential
- FAA Validation Under Bi-laterals
- Technical Standard Orders

DAY THREE
- Flight Standards and Operations/Maintenance
  - Organization and functions
  - Regional flight standards division; certificate management office; flight standards district office; international field office; aircraft evaluation group
  - Flight operations evaluation board; master minimum equipment list
  - Flight standardization board; type rating; differences training
  - Aviation maintenance alerts
  - Significant difficulty report
  - Safety alert information bulletin
  - Operations approvals
- Enforcement
  - Self-Disclosure
  - FAA actions
  - Certificate holder actions
- Electronica Data and Retention
- Federal Register
- Regulations.gov
- National Transportation Safety Board (NTSB) and Recommendations

Instructor: David Downey or Frederick Stellar
Fee $1745 2.0 CEUs

Quality Function Deployment - A Tool for Generating Customer Excitement

2 Day
I.D.# C1509

Quality Function Deployment (QFD) is a cross functional, team based methodology recognized as a key technique in improving new product/service design and development. It is especially useful to translate both spoken and unspoken customer needs into a prioritized set of customer product or service characteristics in a language understandable to an organization’s engineering design group. And, by using a cascading approach, it ensures that the design intent is maintained throughout the production planning process and that the design intent is traceable both up and down the product/process planning effort. QFD establishes a correlation between the different phases of the design effort from concept to full scale production by identifying and prioritizing critical product characteristics and then deploying them into process characteristics, and lastly creating a corresponding set of process controls to ensure the design intent is preserved in the production process. With the ability to provide a clear and traceable path from Voice of the Customer to Manufacturing Process, the QFD helps to reduce Product Development Cycle Time by reducing unnecessary engineering changes. Throughout the class, participants will be involved in exercises/actual projects that demonstrate and incorporate direct application of learned principles.

Learning Objectives
By attending this seminar, participants will be able to:
- Recognize and describe the benefits of QFD to the product/process design and development phase
- Establish the various Voice of the Customer needs and priorities
- Describe the four phases of QFD
- Use QFD to identify product and process special characteristics
- Plan and organize a QFD project
- Prioritize technical risk to optimize product design
- Evaluate opportunities for improving processes, tooling and equipment

Who Should Attend
This seminar is designed for individuals who have key roles in product development and understanding and deploying the Voice of the Customer. This includes project managers, design engineering, quality assurance, manufacturing, testing, marketing, customer field service reps, and other product support personnel.
SAFETY AND QUALITY

Topical Outline

DAY ONE
• Introduction
  • What is QFD and Why is it Used
  • QFD and Advanced Product Quality Planning (APQP)
  • Basic QFD - The Four Phases
• Establishing the QFD Environment and Team Selection
  • Planning and Organizing a QFD Project
  • Team Selection and Management Support
  • Creating the Required QFD Databases
  • Issues with the QFD process
• Understanding the QFD Deployment Process
  • The Flow-Down of Product Development Activities
  • Deploying to a Special Characteristics Matrix- Critical, Significant, and Appearance
  • Theme Selection and Product Benchmarking
  • Exercise 1: Designing the Ultimate Coffee Travel Mug
• Voice of the Customer (VOC)
  • Establishing Customer Needs and Priorities
  • Methods for Capturing and Organizing VOC
  • Exercise 2: Develop & Select Product Concepts
  • Reliability Prediction Using Fault Tree/Success Tree Analysis

DAY TWO
• Product Planning
  • Developing the Product Planning Matrix Based on Voice of the Customer
  • Competitive Assessment & Product Strategy
  • Developing Technical Characteristics for New Product & Establishing a Correlation Matrix
  • Assessing Technical Difficulty and Project Risks
  • Exercise 3: Determine PRODUCT Level Special Characteristics
  • Understanding Risks Ratings
  • Analyzing the Product Planning Matrix and Developing Target Values
  • Exercise 4: Establish Ratings & Target Values for PRODUCT
• Process and Production Planning
  • Deployment of Product Characteristics to Process Characteristics
  • Evaluating the Process Approach and Material Selection Criteria
  • Determine Critical Process Parameters and Process Control Plan
  • Exercise 5: Develop & Select Process Concept, Determine Process Special Characteristics
  • Exercise 6: Establish Ratings & Target Values
  • Evaluating Opportunities for Improving Processes, Tooling and Equipment
  • Establish Target Values for Process Control, Test, and Maintenance Parameters

Instructors Wanted...

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• Standards
• Regulations
• Technologies

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Kevin Perry: Kevin.Perry@sae.org, +1.724.772.7502

Good Laboratory Practices (GLP) Training – CALISO On-Demand Course

8 Hours
I.D.# GLP

GLP refers to a Quality Systems of management controls for laboratories and research organizations to ensure the consistency and reliability and reproducibility of results. The original regulatory enforcement was first published by FDA and then a few years later by EPA. It is also outlined in the Organization for Economic Co-operation and Development (OECD) Principles of GLP in 1992 and has since been added to many national regulations. Your company, and all who partake in the daily activities of running a laboratory or a research and testing center, will benefit from this course. This 8-hour GLP (.8 CEU) overview is particularly adapted for training all levels of an organization on the requirements of this standard.

Instructor: Angelo E. Mago
Fee $1370 1.3 CEUs

Catalog Key: Classroom, Live, Online, On Demand, Certificate
SAFETY AND QUALITY

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

Quantitiy discounts and Site License options are available. Call the SAE Corporate Learning Solutions hotline at +1.724.772.8529 for a quote.

ISO 9001 Overview – CALISO On-Demand Course

4 Hours
I.D.# ISO9001OVERVIEW

ISO 9001 is a quality management standard developed by the International Organization for Standardization (ISO). The ISO 9001 standard is generic and can be used for any organization, whether it provides physical products or services. The requirements must be carefully interpreted to make sense within a particular organization. Developing automotive products is not like producing food products or offering consulting services; yet the ISO 9001 standard, because it is business and management oriented, can be applied to any activity. It is the most widely used quality management standard in the world. This four-hour ISO 9001 overview is particularly adapted for training top management on the high level requirements.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

Quantitiy discounts and Site License options are available. Call the SAE Corporate Learning Solutions hotline at +1.724.772.8529 for a quote.

ISO 9001:2008 Training – CALISO Online Course

8 Hours
I.D.# ISO9001TRAINING

ISO 9001 is a quality management standard developed by the International Organization for Standardization (ISO). Your company and all who partake in the daily activities of running the business will benefit from taking ISO 9001 training. This eight-hour (.8 CEU) ISO 9001 course provides training on the standard itself and on how to lead or conduct internal audits and supplier audits using ISO 19011, the guideline standard on how to audit management systems.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

Quantitiy discounts and Site License options are available. Call the SAE Corporate Learning Solutions hotline at +1.724.772.8529 for a quote.

ISO 9001:2008 Auditor Training – CALISO On-Demand Course

8 Hours
I.D.# ISO9001AUDITOR

ISO 9001 is a quality management standard developed by the International Organization for Standardization (ISO). Your company and all who partake in the daily activities of running the business will benefit from taking ISO 9001 training. The eight-hour (.8 CEU) ISO 9001 Auditor course provides training on the standard itself and on how to lead or conduct internal audits and supplier audits using ISO 19011, the guideline standard on how to audit management systems.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

Quantitiy discounts and Site License options are available. Call the SAE Corporate Learning Solutions hotline at +1.724.772.8529 for a quote.

ISO 9001:2008 Lead Auditor – CALISO On-Demand Course

22 Hours
I.D.# ISO9001LEADAUDITOR

As described in the previous ISO 9001 Overview description, ISO 9001 is a quality management standard developed by the International Organization for Standardization (ISO). Your company and all who partake in planning, leading and conducting the audit activities of running the business will benefit from taking ISO 14001 Auditor training. The 22-hour (2.2 CEU) ISO 9001 Auditor course provides training on the standard itself and on how to lead or conduct internal audits and supplier audits using ISO 19011, the guideline standard on how to audit management systems.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

Quantitiy discounts and Site License options are available. Call the SAE Corporate Learning Solutions hotline at +1.724.772.8529 for a quote.
SAFETY AND QUALITY

ISO 9001:2015 Overview – CALISO On-Demand Course

4 Hours
I.D.# ISO-9001-2015-OVERVIEW

ISO 9001:2015 is a quality management standard developed by the International Organization for Standardization (ISO). The ISO 9001:2015 standard is generic and can be used for any organization, whether it provides physical products or services. The requirements must be carefully interpreted to make sense within a particular organization. Developing automotive products is not like producing food products or offering consulting services; yet the ISO 9001:2015 standard, because it is business and management oriented can be applied to any activity. It is the most widely used quality management standard in the world. Your company and all who partake in the daily business activities will benefit from taking ISO 9001:2015 training. This 4-hour ISO 9001:2015 overview is particularly adapted for training top management on the high level requirements of this standard.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

ISO 9001:2015 Auditor Training – CALISO On-Demand Course

1.8 Hours
I.D.# ISO-9001-2015-AUDITOR

Your company and all who partake in the daily activities of running the business will benefit from taking ISO 9001:2015 auditor training. The 18-hour Auditor online course is the most effective training on the subject. It provides training on how to conduct internal audits and supplier audits using ISO 19011, the guideline on how to audit management systems, and covers auditing all the requirements of the standard through various case studies.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

ISO 9001:2015 Training – CALISO On-Demand Course

10 Hours
I.D.# ISO9001TRAINING

ISO 9001:2015 is a quality management standard developed by the International Organization for Standardization (ISO). The ISO 9001:2015 standard is generic and can be used for any organization, whether it provides physical products or services. The requirements must be carefully interpreted to make sense within a particular organization. Developing automotive products is not like producing food products or offering consulting services; yet the ISO 9001:2015 standard, because it is business and management oriented can be applied to any activity. It is the most widely used quality management standard in the world. Your company and all who partake in the daily business activities will benefit from taking ISO 9001:2015 training. This 10-hour ISO 9001:2015 course is particularly adapted for training all levels of an organization on the requirements of this standard.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

ISO 9001:2015 Lead Auditor – CALISO On-Demand Course

32 Hours
I.D.# ISO 9001-2015-LEAD-AUDITOR

Your company and all who partake in planning, leading and conducting the audit activities of running the business will benefit from taking ISO 9001 Lead Auditor training. The 32-hour ISO 9001:2015 Auditor course is the most comprehensive training on the subject. It provides training on the standard itself but also on how to lead or conduct internal audits and supplier audits using ISO 19011, the guideline standard on how to audit management systems.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

Quantitiy discounts and Site License options are available. Call the SAE Corporate Learning Solutions hotline at +1.724.772.8529 for a quote.
SAFETY AND QUALITY

ISO 14001:2004 Training – CALISO On-Demand Course
8 Hours
I.D.#ISO14001
Your company and all who partake in the daily activities of running the business will benefit from taking ISO 14001 training. This eight-hour ISO 14001 (.8 CEU) overview is particularly adapted for all members of the organization.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

ISO 14001:2004 Auditor Training – CALISO On-Demand Course
8 Hours
I.D.#ISO14001AUDITOR
ISO 14001 is an environmental management standard (EMS) developed by the International Organization for Standardization (ISO). The ISO 14001 standard is generic and can be used for any organization, whether it provides physical products or services. The requirements must be carefully interpreted to make sense within a particular organization. Developing automotive products and the environmental impact of this activity is not like producing food products or offering consulting services; yet the ISO 14001 standard, because it is business and management oriented can be applied to any activity. It is the most widely used EMS standard in the world. Your company and all who partake in the daily activities of running the business will benefit from taking ISO 14001 training. This eight-hour (.8 CEU) ISO 14001 Auditor course provides training on the standards and how to conduct internal audits and supplier audits using ISO 19011, the guideline standard on how to audit management systems.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

ISO 14001:2004 Lead Auditor – CALISO On-Demand Course
22 Hours
I.D.#ISO14001LEADAUDITOR
As described in the previous ISO 14001 course description, ISO 14001 is an environmental management standard (EMS) developed by the International Organization for Standardization (ISO). Your company and all who partake in planning, leading and conducting the EMS audit activities of your business and managing its environmental program will benefit from taking ISO 14001 training. The 22-hour (2.2 CEU) ISO 14001 Lead Auditor course is the most comprehensive training on the subject. It provides training on the standard itself but also on how to lead or conduct internal audits and supplier audits using ISO 19011, the guideline standard on how to audit management systems.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

ISO 14001:2015 Overview – CALISO On-Demand Course
4 Hours
I.D.#ISO-14001-2015-OVERVIEW
Your company and all who partake in the daily business activities will benefit from taking ISO 14001:2015 training. This overview course is particularly adapted for training top management on the high level requirements of this standard.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

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SAFETY AND QUALITY

ISO 14001:2015 Training – CALISO On-Demand Course

10 Hours
I.D.#ISO14001TRAINING

ISO 14001:2015 is an environmental management standard (EMS) developed by the International Organization for Standardization (ISO). The ISO 14001 standard is generic and can be used for any organization, whether it provides physical products or services. The requirements must be carefully interpreted to make sense within a particular organization. Developing automotive products and the environmental impact of this activity is not like producing food products or offering consulting services; yet the ISO 14001 standard, because it is business and management oriented can be applied to any activity. It is the most widely used EMS standard in the world. Your company and all who partake in the daily activities of running the business will benefit from taking ISO 14001 training. This course is particularly adapted for all members of the organization.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

ISO 14001:2015 Auditor Training – CALISO On-Demand Course

12 Hours
I.D.#ISO-14001-2015-AUDITOR

Your company and all who partake in the audit activities of your business and managing its environmental program will benefit from taking ISO 14001 training. The ISO 14001 Auditor course is the most comprehensive training on the subject. It provides training on the standard itself but also on how to conduct internal audits and supplier audits using ISO 19011, the guideline standard on how to audit management systems.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

ISO 14001:2015 Lead Auditor – CALISO On-Demand Course

32 Hours
I.D.#ISO 14001-2015-LEAD-AUDITOR-TRAINING

Your company and all who partake in planning, leading and conducting the EMS audit activities of your business and managing its environmental program will benefit from taking ISO 14001 training. The ISO 14001 Lead Auditor course is the most comprehensive training on the subject. It provides training on the standard itself but also on how to lead or conduct internal audits and supplier audits using ISO 19011, the guideline standard on how to audit management systems.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

Quantity discounts and Site License options are available. Call the SAE Corporate Learning Solutions hotline at +1.724.772.8529 for a quote.

ISO/TS 16949:2009 Training – CALISO On-Demand Course

8 Hours
I.D.# ISO16949

Your company and all who partake in the daily activities of running the business will benefit from taking ISO/TS 16949 training. This eight-hour ISO/TS 16949 (.8 CEU) overview is particularly adapted for training all levels of an organization on the requirements of this standard.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

Quantity discounts and Site License options are available. Call the SAE Corporate Learning Solutions hotline at +1.724.772.8529 for a quote.
ISO/TS 16949:2009 Auditor Training – CALISO On-Demand Course
8 Hours
I.D.# ISO16949AUDITOR
Your company and all who partake in the QMS and supplier audit activities will benefit from taking ISO/TS 16949 training. The eight-hour (.8 CEU) ISO/TS 16949 Auditor course is the most comprehensive training on the subject. It provides training on the standard itself but also on how to lead or conduct internal audits and supplier audits using ISO 19011, the guideline standard on how to audit management systems.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

Quantitiy discounts and Site License options are available. Call the SAE Corporate Learning Solutions hotline at +1.724.772.8529 for a quote.

ISO 19011:2011 Auditor Training – CALISO On-Demand Course
4 Hours
I.D.# ISO19011
Your company and all who partake in the daily activities of running the business will benefit from taking ISO 19011 training for its auditing activities. The four-hour (.4 CEU) ISO 19011 course is the most comprehensive training on the subject. It provides training on the standard itself but also on how to lead or conduct internal audits and supplier audits using ISO 19011, the guideline standard on how to audit management systems.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

Quantitiy discounts and Site License options are available. Call the SAE Corporate Learning Solutions hotline at +1.724.772.8529 for a quote.

ISO/TS 16949:2009 Lead Auditor Training – CALISO On-Demand Course
22 Hours
I.D.# TS16949LEADAUDITOR
This lead auditor course provides management representatives, QA managers or supervisors and others not only the information needed to conduct an audit for ISO/TS 16949, but also to organize, implement and lead it. All audit teams need a leader, and the body of knowledge of this course covers all of the lead auditing aspects.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

Quantitiy discounts and Site License options are available. Call the SAE Corporate Learning Solutions hotline at +1.724.772.8529 for a quote.

Six Sigma Overview – CALISO On-Demand Course
8 Hours
I.D.# SIGMA
Six-Sigma is a systematic way to improve a product, process and/or service. This is the ideal course for employees or managers who want to get a basic training on Six-Sigma concepts, methodology and techniques. Six-Sigma methodology can be used for any size organization, whether it provides physical products (i.e. hardware or software) or services. Developing and maintaining profitable products and services require continuous improvement in numerous key areas such as quality, performance and efficiency. Six-Sigma techniques can help any company achieve these goals.

This is the ideal course for individuals who you want improve their résumé and career opportunities in Six-Sigma, by adding this industry-wide recognized course to the education or training section of your CV. The course covers Six-Sigma process improvement techniques; it is a stepping stone for Six Sigma Green and Black-belt certifications.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

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TESTS AND TESTING

Accelerated Test Methods for Ground and Aerospace Vehicle Development

2 Days  
I.D.# C0316

A similar course is available on demand – Accelerated Test Methods for Ground and Aerospace Vehicle Development – see course info below.

Engineers and managers involved with product development are constantly challenged to reduce time to market, minimize warranty costs, and increase product quality. With less and less time for testing, the need for effective accelerated test procedures has never been greater. This course covers the benefits, limitations, processes, and applications of several proven accelerated test methods including accelerated reliability, step stress, FSLT (Full System Life Test), FMVT® (Failure Mode Verification Testing), HALT (Highly Accelerated Life Testing), and HASS (Highly Accelerated Stress Screening). A combination of hands-on exercises, team activities, discussion, and lecture are used throughout the course. Participants will also receive a copy of the instructor’s book, Accelerated Testing and Validation Management, which includes numerous hands-on exercises and a CD with analytical spreadsheets. Attendees are requested to bring a calculator to the seminar.

Learning Objectives
By attending this seminar, participants will be able to:
• Choose the accelerated test method for a given application
• Analyze accelerated testing results
• Explain how to accelerate one’s current test methods
• Explain how to accelerate one’s validation program
• Adjust accelerated test programs for business situations
• Describe how product development cycles can be reduced from 18 to 6 months

Who Should Attend
This seminar is designed for anyone involved in product design, life testing, reliability testing and validation for passenger cars, light trucks, heavy duty, off-highway or aerospace vehicles, including reliability engineers, validation engineers, design engineers and their managers. Individuals who need to achieve shorter time to market or higher quality through custom test plans will find this course to be especially valuable. Purchasers or users of testing or engineering services will also find this course to be valuable. There are no pre-requisites for this course although a technical background is helpful.

Topical Outline
• Statistical model for reliability testing
  • Fundamentals of a statistical reliability test
  • Effects of automotive supply chain on sample size and duration
  • Common pitfalls
  • Examine and solve two or three real life statistical data set problems
• Key Accelerated Tests, Terms, and Methods
  • Definitions: Information Goal, Basic Method, Limitations
  • Full System Life Test (FSLT)
  • Step Stress
  • Accelerated Reliability Highly Accelerated Life Test (HALT)
  • Failure Mode Verification Test (FMVT) -- Development; Warranty; Life Prediction
• Test Acceleration vs. Program Acceleration
  • Advantages of accelerating a full validation program compared to an individual test
  • Examples of time/cost saved on individual test acceleration
  • Examples of time/cost saved on program acceleration
Hybrid Acceleration Methods
- Using information goals of individual test methods to combine and leverage tests
- Hands-on team exercise: combine test methods to solve a particular information need

Decision and selection process
- How to choose which method
- Considering position in supply chain
- Considering business model and product type
- Considering development phase
- Considering component, subsystem, and system level testing
- Hands on team exercise: selecting optimal testing solution for several scenarios

<table>
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<tr>
<th>Instructor:</th>
<th>Alexander (Alex) J. Porter</th>
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Accelerated Test Methods for Ground and Aerospace Vehicle Development

10 Hours
I.D.#PD130624ON

This course offers more than 10 hours of instruction divided into fourteen modules; a coordinated handbook; and a copy of the instructor’s book, *Accelerated Testing and Validation Management*, which includes numerous hands-on exercises and a CD with analytical spreadsheets. Convenient, portable, and with core content from the instructor-led seminar (view description for classroom seminar just above), the e-seminar program option offers new and alternative ways to receive the same instruction as the live classroom learning without the expense of travel and time away from the workplace.

Learn more about this course in the On Demand Courses Resource Guide on pages 97-139.

Quantitative discounts and Site License options are available. Call the SAE Corporate Learning Solutions hotline at +1.724.772.8529 for a quote.

Practical NVH Signal Processing Methods

2 Days
I.D.# C0431

Signal processing has become a critical tool in optimizing vehicle noise. This seminar will help you to understand the foundation common to all NVH data acquisition equipment including digitizing, windows, aliasing, averaging techniques, and common analysis functions such as the power spectrum, transfer function and coherence. Fundamental concepts such as filtering, modulation, convolution, and correlation, as well as specialized techniques used in rotating machinery such as adaptive re-sampling and order tracking, will be covered. The seminar will also cover multi-input multi-output (MIMO) signal processing, array based solutions for force identification, source and path characterization and data visualization. Brief introductions to emerging concepts will also be explored and computer demonstrations, physical experiments and case studies will be used to illustrate applied, real-world problems.

Learning Objectives

By attending this seminar, participants will be able to:
- Explain the fundamental controls typical in modern spectrum analysis tools
- Interpret NVH data and judge its relevance to physical phenomena
- Extract new types of useful information from NVH data
- Implement new signal processing techniques

Who Should Attend

NVH technicians, engineers and managers who want to understand how NVH data is produced and interpreted will find this seminar valuable. The material is presented at a level suitable for beginners, but offers the more experienced practitioners new insight into the concepts presented through the illustrations and demonstrations that are included.

Prerequisites

The majority of the course material is presented through qualitative descriptions, practical examples, illustrations and demonstrations, which require only basic mathematical skills. However, some familiarity with time and frequency domain measurements.

Topical Outline

- Properties of the FFT
  - Sampling and digitizing
  - Aliasing and filters
  - Leakage and windows
  - Averaging techniques
  - Autopower, crospower and coherence
  - Transmissibility and isolation
  - Measuring and interpreting the transfer function
TESTS AND TESTING

• Rotating Machinery Basics
  • What is an order?
  • Rotation synchronous data acquisition methods
  • AM and FM modulation effects
  • FIR, IIR and re-sampling filters
  • Up-sampling down-sampling and adaptive re-sampling
• Time Frequency Methods
  • Short time Fourier transform
  • Gabor expansion and Gabor transform
  • Orthogonality, invertability and the dual function relationship
  • Gabor order tracking
  • Introduction to wavelets
• Fundamentals of Multi-Input-Multi-Output (MIMO) System Analysis
  • Review of Single-Input-Single-Output (SISO) systems
  • Introduction to Single-Input-Multiple-Output (SIMO) systems
  • Partial correlation concepts
  • Coherent output power
  • Statistical errors in basic estimates
  • Conditioned spectral analysis
• Forces and Sources in MIMO Systems
  • Least squares solution techniques
  • Force estimation technique Conditioned Source Analysis (CSA)
  • Case history: transfer path analysis
  • Case history: model correlation and updating
• Introduction to Data Classification and Pattern Recognition
  • Techniques for building and analyzing feature vectors
  • Recognition engines: neural networks and hidden Markov models
  • Applications: machine noise recognition, vision based gear mesh quality

Instructor: Michael F. Albright
Fee $1370 1.3 CEUs

CATALOG KEY
You will see the following icons alongside the course descriptions. These icons indicate:
• delivery formats available for the course
• the course is part of an SAE certificate
Many courses are available in multiple formats. See page X to get more information on the learning formats offered by SAE. In addition to finding courses that fit your technology need, look for courses with icons that fit the way you want to learn.

Classroom – indicates the course is an instructor-led seminar or workshop offered in a classroom setting

Live, Online – indicates the course is an instructor-led web seminar offered live and online via telephone and internet connection

On Demand – indicates the course is available online anytime the participant would like to access the course through the internet

Certificate – indicates the course is part of an SAE International curriculum-based, multi-course certificate. See a list of the multi-course certificates on page XII

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• Fill out the online quote request at sae.org/corplearning • Email us at Corplearn@sae.org
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INSTRUCTOR BIOGRAPHIES

**Albright, Michael F.**

Michael F. Albright is co-founder and General Manager of Signal.X Technologies LLC, a firm specializing in NVH engineering and custom test & measurement application development. His past positions include Business Development Manager for the NVH consulting group of LMS North America, Management and Project Engineering positions at the Roush Anatrol Division of Roush Industries, Inc, and Civilian engineering for the U.S. Navy. With experience predominantly in the automotive industry, Mr. Albright has addressed a very diverse range of noise and vibration control issues including powertrain NVH, vehicle NVH, brake noise, engine accessory noise, driveline NVH, test procedure and facility development, test/CAE hybrid simulation methods, as well as a host of manufacturing quality issues. Mr. Albright holds a B.S. in mechanical engineering from University of Cincinnati and an M.S. in mechanical engineering from Purdue University.

**Bardasz, Ewa**

Dr. Ewa A. Bardasz is a Fellow at The Lubrizol Corporation where she is currently responsible for overseeing technical activities related to lubricating novel combustion hardware, aftertreatment systems and emissions. She is experienced in the areas of crankcase lubrication, corrosion inhibition, engine testing and exhaust emissions control. Dr. Bardasz holds over 25 patents, has published multiple technical and scientific papers, authored chapters for technical books and is a frequent invited speaker at conferences throughout the U.S. and Europe. She is the recipient of the SAE International 2002 Award for Research on Automotive Lubricants, and 2009 SAE International Environmental Excellence in Transportation Award. Dr. Bardasz is a Fellow of SAE International and a Fellow of the Society of Tribologists and Lubrication Engineers (STLE) where she is also on the Board of Directors. Dr. Bardasz obtained a M.Sc. in Chemical Engineering from Warsaw Technical University and a PhD in Chemical Engineering from Case Institute of Technology.

**Bate, Dhruv**

Dhruv Bhate is an Associate Professor at the Arizona State University (ASU), The Polytechnic School, where he conducts research in the design and mechanics of Additive Manufacturing (AM) structures and materials, and teaches courses in AM processes, design and materials at the undergraduate and graduate level. Prior to joining ASU, Dhruv spent two years at PADT, Inc, a small business in Tempe, AZ, where he led the company’s R&D efforts in Additive Manufacturing. Prior to joining PADT, he spent seven years at Intel Corporation developing several laser-based manufacturing processes, taking them from early-stage research to High-Volume-Manufacturing. He also spent a year in the automotive industry, working for India’s largest car manufacturer, Tata Motors.

Dhruv has a Ph.D. in Mechanical Engineering from Purdue University where he developed constitutive and failure models for the prediction of fatigue fracture in ductile metal alloys. Prior to this, he obtained his M.S. from the University of Colorado at Boulder where he studied the phenomenon of adhesion in MEMS (Micro Electro Mechanical Systems) structures. Dhruv’s passion lies in combining theory, experimental methods and simulation to answer challenging research questions in new and effective ways, seeking inspiration from multiple disciplines.

**Belanger, John-Paul**

John-Paul Belanger is president of Geometric Learning Systems, a consulting firm specializing in geometric dimensioning and tolerancing (G D & T). For over ten years, he has trained people throughout North America and Europe in the proper interpretation and application of G D & T per the Y14.5 standard by using practical examples. Mr. Belanger is certified by the American Society of Mechanical Engineers as a Senior G D & T Professional, and has worked with a wide range of companies in the automotive, aerospace, electronic, and other industries to apply tolerances and perform stack calculations. He holds a B.S. in aerospace engineering from the University of Michigan specializing in aircraft design and safety.

**Bissell, Larry E.**

Larry Bissell is a renowned and well respected international trainer, consultant, and auditor specializing in automotive supply chain management, supplier development, business management systems, business excellence, and continual improvement for all size automotive companies. Mr. Bissell is recognized as an authority on global supply chain requirements and global supplier development, particularly regarding the stringent requirements of automotive OEM’s within the United States. His expertise, abilities, and techniques are designed and structured for automotive supplier organizations that wish to participate in the automotive global supply chain market. Mr. Bissell has over 30 years of industrial experience and has been directly involved in over 1000 highly successful management system audits and client consultations within the ISO 9001, QS-9000, and ISO/TS 16949:2002 arenas.
INSTRUCTOR BIOGRAPHIES

Breneman, Jim
Jim Breneman is currently a Statistical and Reliability consultant and instructor in the Mathematics Department at the Tri-County Technical College (South Carolina). Prior to that, Mr. Breneman held various technical and managerial positions with Pratt & Whitney (PW&I) Division of United Technologies including: Supervisor of Applied Mathematics and Statistics Group; Manager of Reliability and Design Review Group; Safety, Reliability, Maintainability & Quality Assurance (SRM&QA) Manager for Rocket Programs; Manager of Reliability, Maintainability & Safety Engineering; Manager of Engineering Integrity for all PW products; founder and leader of PW’s Engineering Technical University; Manager of PW’s University R&D programs; and ACE Mentor (equivalent to Master Black Belt). Mr. Breneman has an extensive background in reliability, as both a PW Fellow in Reliability Statistics and Risk Analysis, and an SAE International Fellow. He has presented papers on reliability topics at various conferences. Mr. Breneman holds a B.S. in Mathematics from the University of North Carolina (Chapel Hill) and an M.S. in Applied Mathematics/Statistics from N.C. State University.

Bullen, George (Nick)
Mr. Nick Bullen is the President and CEO of Smart Blades, Inc. Located in Oxnard, California, Smart Blades designs and develops highly efficient wind turbine blades and modular facilities for in-situ wind turbine blade manufacturing. Previously, Mr. Bullen was Principal Engineer, Technical Fellow, and Technical Expert for Advanced Manufacturing Technology and Advanced Programs for Northrop Grumman Corporation. His expertise includes inhabited and uninhabited aerial vehicles, space vehicle design and manufacture, laser weapon system design and manufacture, and Lean processes and applications. Mr. Bullen has been awarded 16 US and International patents for technology innovations related to manufacturing, mechanization, robotics, robotics control software and nuclear testing/quality devices that are the basis for all current automated systems used for the assembly of airframes in the US and Europe. Mr. Bullen is a Fellow in the Society of Manufacturing Engineers and is certified in Production and Inventory Control Management. He actively serves and maintains membership on academic boards of several major universities, is a member of the steering committees of professional societies including SAE and SME, and is founder of the International Aerospace Automation Consortium. He also is a board member of the RFID supply chain governing body, EPC Global. A widely published author in magazines, proceedings, journals and peer review journals, he received the AIAA Design Engineering Award in 2000 for Significant Advances in Aerospace Engineering. Mr. Bullen received his BSM degree from Pepperdine University, an MBA from Loyola Marymount University, and is currently finishing his PhD in Decision Sciences, Engineering Research.

Chehroudi, Bruce
Dr. Chehroudi is Chief Scientist and Group Leader at Advanced Technology Consultants. His previous positions include: Principal Scientist at Air Force Research Laboratory (AFRL/ERC), Chief Scientist at Raytheon STX (formerly Hughes Aircraft STX), Professor of Mechanical Engineering, and Research Staff Member at Princeton University. He specializes in fluid mechanics and heat transfer, laser optical diagnostics, internal combustion engine, gas turbine and rocket engines, structure of sprays, gas turbine engines, combustion, fuel injection issues and emission of pollutants. Dr. Chehroudi is an AIAA Associate Fellow, a member of Ta Beta Pi and the recipient of several SAE awards including the Arch T. Colwell Merit Award, the Ralph R. Teetor Award, the SAE Recognition Award and the SAE Forest R. McFarland Award in recognition of his efforts and leadership in contributions to the Continuing Professional Development Seminars. He has taught courses in the areas of internal combustion engines, thermodynamics, thermophysics of gas flows, combustion, and measurement system, and has more than 150 publications and over 200 presentations in conferences, national and international journals. Dr. Chehroudi has a Ph.D from Princeton University.

Columbaro, Norina
Norina L. Columbaro has more than 15 years of experience as a Talent Development Leader with a variety of public and private organizations. She is an award-winning designer and powerful deliverer of curriculum for learning and development programs that build organizational competencies, optimize human performance, and increase competitive edge. Norina has successfully taught this and similar scientific and technical communication workshops since the early 2000s to engineers and technical personnel in a variety of manufacturing, energy, scientific research, automotive, commercial vehicle, and academic organizations. Norina was employed by Key Bank prior to launching her own consulting practice in 1999. She has held consulting and leadership positions at Cuyahoga Community College, Lorain County Community College, and ASM International. Under her leadership, ASM International was awarded IACET accreditation for continuing education programs in 2014. She has recently been published in Adult Learning, The International Journal of Teaching and Learning in Higher Education, and on Military.com. She completed her Ph.D. in Urban Education, Leadership and Life-Long Learning at Cleveland State University.

Cressionnie, L. L. “Buddy”
Buddy Cressionnie is the Americas Aerospace Quality System Committee (AAQSC) chair and Americas leader of Requirements, Projects, and AS9100. He is active in standards development including being a liaison member to ISO/TC 176 WG24 in writing ISO 9001:2015 and US Technical Advisory Group (TAG) where he serves on the US TAG Interpretations Committee. Buddy has over 30 years in Aviation, Space and Defense and is a certified AS9110, AS9110, and AS9120 aerospace experienced auditor. Mr. Cressionnie received his MBA degree from Texas Christian University and Bachelor of Science in Engineering from the University of Florida.

Dobrusin, Eric M.
Eric M. Dobrusin is a shareholder in the Dobrusin Law Firm, PC in metropolitan area of Detroit, Michigan, where he concentrates his practice in intellectual property law. He is a member of the Michigan Bar and is registered to practice before the United States Patent and Trademark Office, Mr. Dobrusin previously served as the Executive Director of the National Patent Board, and he has served as an ADR Neutral and a Special Master in IP litigation disputes. Mr. Dobrusin has presented talks and authored articles on a variety of intellectual property topics. He also has co-authored books entitled, “Intellectual Property Culture: Strategies to Foster Successful Patent and Trade Secret Practices in Everyday Business” (LexisNexis) and Intellectual Property Litigation: Prewitt Practice, Third Edition (Wolters Kluwer Law & Business). Mr. Dobrusin has earned recognition as a SuperLawyer®, Best Lawyers® in America (2014 Patent Law Lawyer of the Year for Detroit), dBusiness Magazine Top Lawyers in Metro Detroit, Leading Lawyers™, and Managing Intellectual Property Magazine IP Stars. In 2013, he was recognized by the Michigan Lawyers Weekly publication as among its “Leaders in the Law”. Mr. Dobrusin received a B.S. degree in materials and metallurgical engineering from the University of Michigan and a J.D. degree from Wayne State University Law School.

Dodson, Bryan
Dr. Dodson is currently the Executive Engineer for SKF. Prior to joining SKF, Dr. Dodson held the positions of Senior Director Corporate Quality & Continuous Improvement for Collins & Aikman and Associate Director of Quality & Reliability Engineering with global responsibility for Visteon. Dr. Dodson has authored several books including: The Reliability Engineering Handbook, Practical Accelerated Testing, and Weibull Analysis; with Software. Dr. Dodson has also developed several software packages including; the Training Pro Interactive Study Guides, the Reliability & Maintenance Analyst, and Measurement Assurance. Dr. Dodson served as Chair of the committee that created the International Quality Federation’s Six Sigma Exam and also developed the software that
Delivers this state of the art exam. Dr. Dodson has published numerous articles in technical journals and teaches several courses for technical societies and as an adjunct faculty member at universities. A Fellow of SAE and ASQ, Dr. Dodson holds a B.S. in Petroleum Engineering, an M.S. in Industrial Engineering, an M.B.A., and a Doctor of Business Administration. In addition, he is a Certified Quality Engineer (CQE), a Certified Reliability Engineer (CRE), a Six Sigma Master Black Belt, and a licensed Professional Engineer in Michigan.

**Downey, David**

David Downey is a consultant and trainer in the aviation and defense sectors for Downey Aviation Services. Mr. Downey previously served as President, North America, at Aerospace Risk Management. Prior to that role he was a Vice President at Bell Helicopter where he was responsible for Systems Engineering, Engineering Operations, Flight Test Operations, Flight Safety, the Bell Organization Delegation Authorization and the Product Safety Board. Prior to joining Bell, Mr. Downey was a member of the FAA Senior Executive Service where he served as the Manager, FAA Rotorcraft Directorate in Fort Worth, Texas. He provided strategic direction on all aspects of rotorcraft and tilt-rotor policy/certification. In this position he was also responsible for all FAA experimental flight test policy, training and administration. He was a Team Leader on the FAA Safer Skies Commercial Aviation safety program. As Co-Chair of the International Helicopter Safety Team, Mr. Downey achieved a 33% reduction in the number of U.S. fatal helicopter accidents. He has FAA engineering and manufacturing experience with engines, propellers, APUs, UAVs and airplanes. He is an FAA DER. He has also worked closely with the NTSB and international Aviation Authorities such as TCCA, EASA, CAAC and ICAO. Mr. Downey began his career as a U. S. Army Pilot. His aviation experience includes over 4,000 hours of fixed and rotary wing accident-free flying on 125 different models. He holds an FAA Airline Transport Pilot rating as well as single/multi engine land/seaplane and helicopter commercial pilot, and CFI ground. Mr. Downey is the 2010 Society of Experimental Test Pilots Tony LaVier Flight Safety Award for life time achievement in Flight Safety. A published author and international public speaker on aviation and leadership, Mr. Downey graduated from the University of Tennessee Space Institute with an MS and earned his BS from Embry Riddle Aeronautical University. He is also a graduate of the US Navy Test Pilot School.

**Doyle, Joseph**

Joseph Doyle is the principal of Strategic Insights, Inc., a Michigan-based consulting firm, specializing in executive leadership. Mr. Doyle completed a 30-year career with General Motors Corporation, where he held a variety of positions including Internal Business Consultant with General Motors University, Senior Research Manager with the Corporate Organization Research and Development Activity, Manager of the Corporate Executive Development Activity and Lead Consultant with the Corporate Strategy and Decision Support Staff. Prior to joining General Motors, he held positions with the U.S. Public Health Service, Ford Motor Company and the Management and Organization Development Department of General Motors Institute (now Kettering University). While at GM, Mr. Doyle established GM’s Executive Development Curriculum; facilitated Executive Global Task Teams in India, Indonesia, Thailand, England and Australia; and served as the Corporate Liaison on Leadership and Strategy to the US Army War College and the National Defense University. As an adjunct professor, he has taught Engineering Administration at the University of Detroit’s Graduate School of Engineering, Organization Behavior at The University of Michigan Dearborn’s School of Business and Business Strategy at Oakland University’s School of Business Administration. Dr. Doyle holds a B.S. in Mathematics and Physical Science from Eastern Michigan University, a Master’s Degree in Applied Statistics and Research Methodology from Wayne State University, and a Ph.D. in Organizational Behavior from the University of Michigan.

**Farsi, Ken**

Mr. Farsi is currently a Managing Partner, and President of Aerospace Design and Compliance, LLC; an aircraft engineering and STC certification company based in Wilmington, Delaware. He has over 30 years of experience in aircraft engineering, certification and operations and has worked for various aircraft manufacturers, airlines, completion center, and MRO’s managing engineering and certification programs on helicopters, as well as small and large transport category aircraft. He is an FAA Designated Engineering Representative (DER) with Interior Arrangement and Compliance Inspection, as well as Aircraft Loading Document approval authority for Part 25 and 25 aircraft. Mr. Farsi has taught aircraft certification and Federal Aviation Regulations as an Adjunct Instructor at Northrop-Rice Aviation Institute of Technology in Los Angeles, and Aircraft Systems at San Mateo Community College in San Mateo, California. He has participated in and managed FAA certification programs for major U.S., European, Chinese, and Australian airlines as a consultant. He is a life time member of Tau Alpha Pi, the honor society for Engineering Technologies. Along with a Bachelor of Science in Aircraft Maintenance Engineering Technology from Northrop University, Mr. Farsi has participated in graduate studies in Aerospace and Aviation Operations and Management at Embry-Riddle Aeronautical University. He holds FAA Airframe and Powerplant as well as Private Pilot Certificates.

**Fulton, Wes**

Mr. Wes Fulton is the Founder and CEO of Fulton Findings. Prior, he was a program engineer/manager for AirResearch Los Angeles Division, Allied-Signal Aerospace Corporation. As a program engineer for aircraft actuation projects he had engineering and management responsibility for the Indigenous Defensive Fighter (IDF) leading edge flap actuation system (LEFAS) development and production, the Rockwell/MBB X-31A LEFAS flight test program, and the F-16 Fighting Falcon LEFAS production and deployment support. He co-patented a multi-fuseable shaft (high performance drive train device). Additionally, Mr. Fulton has over 20 years of programming experience as a private programmer and developed SuperSMITH®; Visual, WeibullSMITH®, LogNormSMITH®, Normal+SMITH®, Visual*SMITH®, BiWeibullSMITH®, and MonteCarloSMITH® analysis software. He received his B.S.M.E. from Georgia Tech and his M.S.M.E. from California State University at Long Beach.

**Hall, Jody N.**

Dr. Jody Hall is currently the Vice President, Automotive Market for the Steel Market Development Institute. Prior to that she was the Technical Integration Engineer for the Body Manufacturing Engineering Center at General Motors in North America where she was responsible for new steel applications and specifications for all stamped steel body components. Jody's experiences in manufacturing at General Motors ranged from research and development of new materials and manufacturing processes to solving production problems. Her background includes engine and transmission components, body sheet metal, stamping die design and construction, plant floor data management, and manufacturing strategic planning. She was also GM's manufacturing representative to the Auto/Steel Partnership Joint Policy Council for fourteen years. Dr. Hall is the recipient of numerous professional awards including the University of Michigan College of Engineering Alumni Merit Award in 2007, the Auto/Steel Partnership Instrumental Change Award in 2007, the GM Die Engineering Services Award for Leadership in 2005, the USCAR Special Recognition Award for Outstanding Contributions in 2004, and the GM Chairman’s Honors Award in 2001. Dr. Hall has a B.S. in Materials & Metallurgical Engineering, and a M.S. and Ph.D. in Materials Science and Engineering from the University of Michigan.
INSTRUCTOR BIOGRAPHIES

Haughey, Bill
Bill Haughey is a respected consultant and instructor in the areas of Failure Modes Effects Analysis, Design for Manufacturability and Assembly, Design Review Based on Failure Modes, Design Review Based on Test Results, and other GD3 methodologies. He is a current member of the issuing committee of the SAE J1739 FMEA standard, SAE Automotive Quality and Process Improvement Committee; the SAE Automotive Electronic Systems Reliability Standards Committee; and the AIAG FMEA Fourth Edition Recommended Practice Committee. Mr. Haughey was recently approved to lead the development of a new SAE DRBFM Recommended Practice (J2886). Mr. Haughey formerly worked for GM, where he held various managerial, manufacturing, and engineering positions including Process Lead and Supervisor for FMEA and DFMA. While at GM, Mr. Haughey also supported Tatsukio Yoshimura in the global implementation of the GD3 (DRBFM) methodology. Yoshimura considers Mr. Haughey to be a subject matter expert in the GD3 methodologies, including DRBFM and DRBTR. Mr. Haughey received a B.S. degree from the University of Michigan and M.S from Central Michigan University, and has the following certifications: Black Belt in GD3 (DRBFM and DRBTR); Master Design for Manufacturability and Assembly Engineer; and Certified Internal Auditor.

Hilderman, Vance
Mr. Vance Hilderman has over 25 years of engineering experience in software and systems avionics, focusing on safety-critical avionics software, systems, hardware development, and related technical products. He is the Director of Global Services for Vector Software where he provides software development services and training. In addition, Mr. Hilderman is the primary subject matter expert in avionics software and systems at Afuzion, Inc. Previously, Mr. Hilderman founded TekSci and while serving as President and CTO, he led his company to become the largest independent avionics software services company in the world. Mr. Hilderman also co-founded HighRely Inc, an avionics certification consultancy company. Holding a BSEE and MBA from Gonzaga, along with a Masters in Computer Engineering from USC (Hughes Fellow), Mr. Hilderman is the principal author of dozens of technical whitepapers, plus the world’s best-selling book on avionics development/certification. Published by Avionics Communications and titled Avionics Certification – A Complete Guide To DO-178B & DO-254, Mr. Hilderman donates all royalties to the Boy Scouts of America.

Hough, Karen
Karen Hough is the author of the Amazon Bestseller, The Improvisation Edge: Secrets to Building Trust and Radical Collaboration at Work, published by Berrett-Koehler. Her company, ImprovEdge received the silver Stevie International Award for “Most Innovative Company of the Year 2012” for Women in Business. She is the recipient of the Athena PowerLink Award for outstanding women-owned business. Ms. Hough is a graduate of Yale University and La Sorbonne, Paris IV. She is deeply committed to volunteer activities and philanthropy.

Jennings, Jason
Jason Jennings is a researcher and one of the most successful and prolific business and leadership authors in the world. A back-to-back bestselling author, he has written eight highly-acclaimed business books on the topics of growth, productivity, leadership, and innovation. He and his teams have screened and studied more than 200,000 companies and interviewed more than 12,000 CEOs and business owners in their research. Critics call his books, “extraordinarily well researched, insightful, crisply written, accessible, intriguing and a vital resource for everyone in business,” and USA TODAY calls him “one of the three most in-demand business speakers on the planet.” Jennings says his greatest thrill is helping lead organizations to their full economic potential.

Kim, Michael
Michael Kim is Principal Engineer for Tribological Materials at GGB Bearing Technology. He holds a Ph.D. in Materials Science from Drexel University and has spent 20+ years in the development, testing and application of tribological materials. That has included the development of numerous multi-layer and functionally gradient self-lubricating composite materials designed for use in aggressive bearing applications.

Knutson, Donald F.
Over the past 20+ years, Mr. Knutson has conducted a multitude of field investigations on domestic and foreign accidents involving various models of civilian and military aircraft. He is President of Knutson Aviation Services (KAS), a consulting firm specializing in aircraft accident and incident investigations, wreckage reconstruction, airframe and powerplant system failure analysis, crashworthiness analysis, and air safety education and research. Mr. Knutson has taught graduate and continuing education courses on aircraft accident investigation for the Wichita State University (Wichita, KS) Aerospace Engineering program and Lewis University Aviation programs (Romeoville, IL). For Boeing’s military operations in Wichita, he instructed engineers in basic and advanced topics on supporting U.S. Air Force crash investigations. Prior to starting KAS, Mr. Knutson was with The Boeing Company as a Flight Test Engineer where he evaluated fuel system designs and remote aerial refueling operations for the 767 Tanker program. Mr. Knutson also served as Director of Aviation for a forensics engineering firm where he provided aircraft accident investigation consulting and business development. Mr. Knutson’s experience also includes Senior Engineer and Air Safety Investigator for the Raytheon (Beech) Aircraft Company where he was the engineering liaison between Raytheon and the NTSB, the FAA, and foreign government investigators. He served as a Designated NTSB Representative for several international accidents and helped train new air safety investigators during field investigations. He also performed airframe and powerplant (turbine and piston) system inspections, wreckage reconstruction, metallurgical examinations, and crashworthiness analysis involving survivability issues. Mr. Knutson is a member of the Experimental Aircraft Association and the International Society of Air Safety Investigators. He is an FAA-certified pilot and Airframe and Powerplant mechanic. He received his B.S. in Mechanical Engineering from the University of Southwestern Louisiana (Lafayette, LA).

Kunder, Paul J.
Mr. Kunder is the President of Amera-Veritas, Inc., a provider of quality, safety, and risk management. Mr. Kunder is a lead instructor for the Aerospace Auditor Transition Training and is currently an International/ Americas Quality Group and RABQSA AS9100 Aerospace Auditor and Quality System Lead Auditor (ref. #1834). He is active in standards development as a voting member of the US Technical Advisory Group (TAG) to ISO Technical Committee 176 which is responsible for development of the ISO 9001 Standard. He serves as the Vice Chair of the National ANSI/ASQ Z1A Committee on Auditing (ISO 19011) and on the US TAG Interpretations Committee. He has performed more than five hundred audits and has assisted more than eighty organizations with the development and certification of their quality management systems including the Federal Aviation Administration Office of Aviation Safety. Prior to his current position, Mr. Kunder was involved in the accreditation of several 3rd party registrars, acted as an administrator for the first RAB accredited registrar in the United States and works as a subcontract auditor for a number of registrars. Mr. Kunder is an ASQ senior member and holds a B.S. in Mechanical Engineering.
Kuwrowski, Paul
Dr. Paul Kurowski is a professor in the Department of Mechanical and Materials Engineering at the University of Western Ontario in London, Ontario. His teaching experience includes finite element analysis, machine design, mechanics of materials, kinematics and dynamics of machines, mechanical vibration and product development. He is also the President of Design Generator Inc., a consulting firm specializing in product development, design analysis and training in Computer Aided Engineering methods. Dr. Kurowski has published multiple technical papers and taught professional development seminars for SAE International, the American Society of Mechanical Engineers, the Association of Professional Engineers of Ontario, the Parametric Technology Corp. (PTC), Rand Worldwide, SolidWorks Corp. and other companies and professional organizations. He is the author of the SAE book, Finite Element Analysis for Design Engineers, Second Edition, and contributes regularly to several engineering publications focusing on the implementation of CAE methods into the product development process. He is a member of SAE International and the Association of Professional Engineers of Ontario. Dr. Kurowski obtained his M.Sc. and Ph.D. in Applied Mechanics from Warsaw Technical University and completed postdoctoral work at Kyoto University.

Mago, Angelo E.
Angelo Mago is senior consultant and owner of ATM Consulting, Inc., which provides customized training and consulting services to a varied design and manufacturing supplier community in the areas of Project Management, Design to Cost, Quality Assurance, Document Management, Supplier Development and Management, and Customer Management. He has over 25 years of experience in product design, quality assurance, and project management working in both the Governmental and Commercial mobility industry. DOD experience includes serving in the US Army TACOM Program Office in the M1 Abrams and Bradley Program Management offices and Plant Manager for the Depot Repair Facility in Mannheim Germany. Commercially Mr. Mago has worked as the Senior Supplier Quality Engineer for GM Truck Group responsible for NAO and off-shore supplier ISO qualification, Product Development, and PPAP qualification and approval. Through ATM Consulting, Mr. Mago has played a lead role in deploying a PM and APQP environment for both large and small companies. He is a recipient of the SAE Forest R. McFarland Award for distinction in professional development/education. He has a B.S. in Mechanical Engineering from Florida Institute of Technology.

Manzanares, David
David Manzanares has been employed at Moog Inc. for eighteen years, mostly in the aircraft flight control arena. He is presently Manager of Primary Flight Controls Engineering in Moog Aircraft Group’s Commercial Sector. During his career, Mr. Manzanares has led multiple engineering development activities for cockpit controls and electromechanical actuators including the design and development of the 787 spoiler EMA and horizontal stabilizer trim actuator. His present activities include technical oversight for engineering development programs, employee development, customer technical interface, and technology road mapping for Moog’s actuation product lines. He received his B.S. degree in Mechanical and Aerospace Engineering from Cornell University and his M.S. degree in Mechanical Engineering from the University of Utah.

Masiak, James
James Masiak has more than 32 years of experience in product and process development and implementation of business processes for General Motors. Activities include the implementation of an enhanced engineering product cost management process within GM North America, the alignment of cross-functional organizational initiatives, and development of an engineering resource allocation plan for GM Regions. Mr. Masiak was also responsible for the development and implementation of Global Engineering and Business Strategies across General Motors International Operations. His initial assignments at GM included vehicle and component testing & analyses, product development & management and strategic planning and benchmarking. He has recently applied the Innovation Corps Business Model Canvas methodology in assisting college and private sector startups. Mr. Masiak received his B.S. in Mechanical Engineering from Wayne State University; his M.S. in Mechanical Engineering from the Massachusetts Institute of Technology, and his M.B.A. from the Michigan State University Executive Management Program.

Nazri, Gholam-Abbas
Dr. Nazri is currently the technical director of new technologies at Frontier Applied Sciences and Technologies, LLC. and is also Professor of Physics at Wayne State University. Dr. Nazri began his career as a Research Scientist at General Motors Global Research and Development Center after two years of postdoctoral fellowships at the Lawrence Berkeley National Laboratory. He also served as a visiting Professor at the University of Pierre and Marie Curie, Paris France, Institute of Condense Matter Chemistry at Bordeaux France, and Institute of Materials at Nantes, France. He is an active organizer of Symposia on advanced batteries and is on the International Science Advisory Board of several Lithium Battery Meetings and Conferences. Dr. Nazri has published over 100 scientific papers, 12 proceedings volumes, two textbooks on science and technology of lithium batteries, and is the holder of 15 U.S. patents. His research interests are in the area of corrosion and corrosion protection, design of new materials for advance batteries for transportation, supercapacitors, solid-state hydrogen storage materials, electrochemical catalysis, synthesis of novel materials, and advanced analytical techniques for real-time study of electrochemical systems. Dr. Nazri received his Ph.D. in Physical Chemistry from the Center for Electrochemical Sciences, Case Western Reserve University where his theses focused on Corrosion and Passivation of Ferrous Alloys.

Oliver, Michael, J.
Michael J. Oliver is Vice President of Electrical / EMC Engineering at MAJR Products Corporation, where he is responsible for customer EMC design and consulting and new product development. He is also the company’s ISO-9001:2000 management representative. An expert in EMI/RFI shielding technology, he has experience in electronics, military shelter electrical systems, and high power antenna/radome design. His experience also includes the design and testing of aerospace antennas, shielding of military shelter electrical systems, and discrete EMC shielding components. Mr. Oliver has expertise in open and anechoic chamber radiated testing to military standards and has utilized various antennas and radiated test systems. In addition, he has written numerous technical papers and publications on electromagnetic shielding components, product testing and design, and military antenna/radome test methodology standards. Mr. Oliver is the founder and currently serves as Chairman of the IEEE Pittsburgh EMC Chapter. He is Co-Chairman of the SAE AE4 Electromagnetic Compatibility Committee, and a member of the IEEE EMC Standards Advisory Coordination Committee (SACCom). Mr. Oliver has three patents (one pending) on EMC shielding-thermal management devices and he received a B.S. in Electrical Engineering Technology from Gannon University.
INSTRUCTOR BIOGRAPHIES

Pawloski, Curt

Curt Pawloski is President/Senior Consultant for Integral Operations, Inc. He has over 30 years of experience in project management, geometric dimensioning and tolerancing, process and quality improvement, problem solving, and quality system development and implementation. Mr. Pawloski has helped auto industry OEMs and numerous supplier organizations prepare or improve their Quality Systems, facilitated the writing of quality procedures and work instructions, and consulted on implementation of quality systems. In addition, he was the leader of a team to develop a comprehensive Project Management training and certification system for Volkswagen’s IT function. Mr. Pawloski is an Adjunct Faculty Member at Oakland Community College, Delta College, and Midlands Technical College. He is a board member and past member of the year for the Saginaw Valley Section of the American Society for Quality. He has a B.S.ChE from the University of Michigan, a Graduate Certificate in Hazardous Materials Management/Chemical Engineering from Wayne State University, and an M.B.A. from Wayne State University.

Peterson, Eric M.

Mr. Peterson is currently Vice-President of Systems and Safety for Electron International, Inc. He has over 35 years’ experience in aerospace management, system design and analysis, development of hardware and software, and safety assessments for commercial and military flight critical avionic and fly-by-wire system applications. He is also an inactive Systems and Equipment DER with a software endorsement. Mr. Peterson serves as vice-chairman of the SAE S-18 Aircraft & Systems Development and Safety Assessment committee and has provided key contributions to ARP4754A, ARP 4761, and ARP 5150. Mr. Peterson is also a member of the SAE AeroTech General Committee and has served as the Technical Program Chair for a number of SAE conferences. In addition, he is the recipient of the SAE Forest R McFarland Award for outstanding contributions to the SAE Engineering Meetings Board and is also the recipient of the SAE Outstanding Contribution Award for his work in the development of SAE Technical Standards. Mr. Peterson received his B.S. in Electrical Engineering from Montana State University.

Porter, Alexander (Alex) J.

Alexander J. Porter is the Chief Engineer for Programs, Performance, and Durability for Intertek, and has been with the company since 1992. Since 1996, he has been developing accelerated testing methods for mechanical components and systems. Mr. Porter has three patents relating to accelerated testing equipment and has authored over 40 articles and technical papers on accelerated testing. Alex is the author of the book Accelerated Testing and Validation, Elsevier 2004. His work in the past has included implementation of FEA in a laboratory setting and development of a thermal management system for an advanced data acquisition package developed by NASA’s Dryden Flight Research Facility. Alex is a member of SAE and IEEE. He holds a B.S. in aircraft engineering and an M.S. in mechanical engineering, both from Western Michigan University.

Ringer, George J.

Mr. Ringer is a member of the IAQG AS9120 Writing Team. He has over three decades of experience in the commercial aviation and US defense industries. His practice provides full-time services in QMS certifications, engineering design, structural analysis, material flammability performance, FAA production approvals, employee training, QMS and supply-chain auditing. As an Adjunct Assistant Professor of Aeronautics at Embry-Riddle Aeronautical University, Mr. Ringer teaches graduate and undergraduate courses in Mechanical/Structural Factors; Aerodynamics; Aviation Human Factors; Aviation System Safety Management; Aviation/Aero Industrial Safety Management; and Aviation Safety Program Management (SMS). Mr. Ringer has held executive positions in engineering and quality assurance for top defense and aviation manufacturers, FAA repair stations, and aftermarket distributors. His responsibilities included company-wide quality system training and acting as liaison in matters pertaining to compliance with all applicable ISO, AQMS, FAA, C.A.S.E., EASA, and InternationalCAA regulations, as well as air-carrier domestic and international regulatory issues. As a design engineer, he specialized in structural analysis, testing, and flammability performance of aircraft interior structures. Mr. Ringer holds a Masters of Aeronautical Science degree in Aerospace/Aviation Safety Systems, is a Board Licensed Professional Engineer in the field of Mechanical Engineering, and holds FAA-DER authorizations in both Aircraft Structures and Flammability. He holds certifications as both a FAA Manufacturing DAR (Airworthiness) and FAA Maintenance DAR (Export). In addition, he is Six-Sigma Black Belt (Phase I & II) Certified, and is a certified ISO 9001, AS9120, and AS9100 Internal Auditor. He holds various patents and applications, has authored numerous technical reports and presentations, and is a contract writer/speaker for various trade organizations.

Ross, Phillip J.

Phillip J. Ross is President of Quality Services International, Inc., a consulting firm specializing in quality and statistical training. He has accumulated over 4500 hours of classroom instruction teaching courses in quality, design tools, and manufacturing processes and problem solving in the United States, Great Britain, Holland, Japan, and Singapore. Prior to his consulting business, Mr. Ross worked for General Motors in automotive powertrain design and development and automobile manufacturing and assembly. He first worked with Allison Transmission Division in product design/development and then with Saturn Corporation in the manufacturing and assembly aspects. Mr. Ross was involved in the design phase of many transmission components and systems, developed statistical/quality methods and training, and performed process development. He also performed process development for lost foam casting, painting, molding, and others while at Saturn. Mr. Ross is the author of the book Taguchi Techniques for Quality Engineering which has sold over 35,000 copies worldwide, has had articles published in Quality Progress by ASQC and in Target by AME and is the holder of three patents on product design. Mr. Ross received a B.S. in mechanical engineering from General Motors Institute, and is an ASQ Fellow and Certified Quality Engineer.

Rutledge, Drexel L.

Mr. Rutledge is an Aerospace Consultant with Integrity Engineering, Inc. where he works with several aerospace companies in the area of Product Support and Sustainment. His principal areas of expertise are in project management, technical information development and delivery, and proposal development activities. Most recently, his expertise in performance based logistics and international support applications have been sought out by several DFW area providers. Prior to joining Integrity Engineering, Inc., Mr. Rutledge was employed by Lockheed Martin Aeronautics Company as the Systems Engineering Director responsible for developing and delivering the technical information needed to operate and maintain all aircraft manufactured or supported by Lockheed Martin Aeronautics by all US and foreign operators. Mr. Rutledge is a Certified Professional Manager, a Past Chairman of the Product Support Executive Board of Directors of the Aerospace Industries Association, a Past President and Chairman of the Board of Directors of the General Dynamics Management Association, a member of the Air Force Association, and an Honorary Lifetime Member of the International Office and Professional Employees Industrial Union. He has served as the Industry Representative and co-chair of multiple Department of Defense and Industry project teams including the 2003 Logistics Transformation Initiative. He is the recipient of the 2006 Leonard Ross Memorial Award for Outstanding Contributions in the field of Logistics. Mr. Rutledge has a Bachelor of Science in Business Management as well as a Master of Business Administration from LeTourneau University in Texas.
INSTRUCTOR BIOGRAPHIES

Saha, Pranab
Pranab Saha is the principal consultant and co-founder of Kolano and Saha Engineers, Inc., an independent professional engineering and consulting company in acoustics, noise and vibration control. With global responsibility for the engineering function of the organization’s five business groups, as well as the Central Engineering function, Mr. Saha was in charge of the management of all aspects of engineering design, product and material development covering applications engineering, R&D, validation, and in-service engineering support of all products. The Global Engineering function consisted of 118 engineers and support staff distributed over 10 sites in the USA, UK, France, Germany, Japan and Singapore. Mr. Saha was also Aerospac Engineering Manager prior to his appointment as Global Director. Prior to that he was with Coorstek as Director of Engineering Sales and Marketing, at Fluorocarbon Co. (now St. Gobain) as Seals Product Manager, at Shamban Intl. as Engineering Manager, and at W. S. Shamban & Co. (now Trelleborg) as Sales Engineer. The holder of three U.S. patents involved in seal design and application, Mr. Schofield presently serves on (now Trelleborg) as Sales Engineer. The holder of three U.S. patents involving seal design and application, Mr. Schofield presently serves on

Schmid, Steven R.
Dr. Schmid is a Professor at the University of Notre Dame, where he conducts research and teaches courses in manufacturing, metal forming, tribology and design. Prior to joining academia, Dr. Schmid was a project engineer at Triodyne, Inc., a consulting firm specializing in machine and manufacturing/product consulting with a special emphasis on safety. As such, he has visited hundreds of manufacturing facilities as diverse as sugar cane plants in Hawaii to battery factories in Vermont, and has been a consultant to industry and government. He is a past recipient of the Society of Manufacturing Engineers John T. Parsons Outstanding Young Manufacturing Engineer Award, has won numerous teaching awards, and was named a Kaneb Center Teaching Faculty Fellow at the University of Notre Dame in 2003. Dr. Schmid is a graduate of the Illinois Institute of Technology and Northwestern University. In 2012-2013, Dr. Schmid was the first Academic Fellow at the Advanced Manufacturing National Program Office, where he helped design the National Network for Manufacturing Innovation. He is the co-author (with S. Kalpakjian) of the world’s most popular manufacturing textbook, which has been translated into many languages including German, Japanese, Korean, Chinese (Mandarin), Italian, and Spanish. He is President of the North American Manufacturing Research Institute of the Society of Manufacturing Engineers (NAMRI/SME).

Schofield, Alan
Alan Schofield is an active consultant for Greene, Tweed & Co., where he recently retired as Global Director of Engineering. With global responsibility for the engineering function of the organization’s five business groups, as well as the Central Engineering function, Mr. Schofield was in charge of the management of all aspects of engineering design, product and material development covering applications engineering, R&D, validation, and in-service engineering support of all products. The Global Engineering function consisted of 118 engineers and support staff distributed over 10 sites in the USA, UK, France, Germany, Japan and Singapore. Mr. Schofield was also Aerospace Engineering Manager prior to his appointment as Global Director. Prior to that he was with Coorstek as Director of Engineering Sales and Marketing, at Fluorocarbon Co. (now St. Gobain) as Seals Product Manager, at Shamban Intl. as Engineering Manager, and at W. S. Shamban & Co. (now Trelleborg) as Sales Engineer. The holder of three U.S. patents involving seal design and application, Mr. Schofield presently serves on the Steering Council for the SAE-A6 Fluid Power, Actuation and Control Technology Committee. Additionally, he also represented Airbus on the SAE-A6C2 Seals Panel, serving as Panel Chair for eight years and Secretary for six years. He has also served as a member of the SAE-AMS Committee P (Polymers) for twenty-three years and the AMS Committee CE (Elastomers) for fourteen years. During his participation in SAE committees, Mr. Schofield has acted as sponsor for twenty-two document reviews and sponsor for the publication of six new documents. Mr. Schofield received his B.S. in Mechanical Engineering in the UK.

Seyboldt, Charles F.
Mr. Charles Seyboldt has degrees in Mechanical Engineering and Law. He has over 15 years of experience in the transportation industry, having engineering responsibilities covering a broad range of product and manufacturing technologies. He is a registered Professional Engineer and a registered patent agent.

Shapiro, Stephen
Stephen Shapiro is one of the foremost authorities on innovation culture, collaboration, and open innovation. During the past twenty years, his message to hundreds of thousands of people in forty countries around the world has remained the same: Innovation only occurs when organizations bring together divergent points of view in an efficient manner. Over the years, Stephen Shapiro has shared his innovative philosophy in books such as 24/7 Innovation and The Little Book of BIG Innovation Ideas. He has also trained more than 20,000 consultants in innovation during his 15 year tenure with Accenture.

Sittsamer, Murray
Murray Sittsamer of The Luminous Group has over 26 years’ experience in operations management, strategic planning, new process launches, financial analysis, quality systems and process improvement. During the past 12 years, Murray has focused his work on supporting automotive OEMs and suppliers with their quality and productivity improvement efforts, especially in the areas of Advanced Product Quality Planning (APQP), Failure Mode and Effects Analysis (FMEA), variation reduction and Problem Solving. Before entering the consulting field in 1994, Murray served as director of distribution support and quality systems for Gelman Sciences. While there, he led a successful 15-month effort to obtain ISO 9000 quality system registration and had the role of project manager for a highly publicized groundwater contamination dispute. Murray holds a Master of Science in Industrial Administration from Carnegie Mellon University. He earned his undergraduate degree in industrial engineering from the University of Pittsburgh.

Sorrentino, Joseph
For nearly three decades, Joseph Sorrentino has been instrumental in implementing successful quality management systems for commercial companies, military and aerospace contractors, and government agencies throughout the U.S. As president and CEO of Lean Quality Systems, Inc., Sorrentino specializes in implementing new standard methods for the corporate sector and has successfully worked with more than 25 corporations in the southern California area alone. A retired U.S. Navy quality assurance specialist, Sorrentino is certified as a level III examiner for visual, magnetic particle, dye penetrant, and ultrasonic inspections. He began his career as a quality management professional in the U.S. Navy, initially as chief petty officer, level III NAVSEA examiner/quality assurance division officer and spent eight years as a GS1910 quality specialist.
**INSTRUCTOR BIOGRAPHIES**

**Spence, William Cory**
As the founding partner of SpencePC, Mr. Spence assists individual and business clients in obtaining their best possible outcome in contentious legal matters. He has experience in litigation, arbitration, and mediation involving all areas of intellectual property law. He has litigated claims in both state and federal courts throughout the United States. Additionally, Mr. Spence has experience with patent monetization strategies and complex, international patent infringement litigation involving multiple parties and jurisdictions, including Asia. He is a registered patent attorney and published author and frequent speaker on patent monetization and other intellectual property issues. Prior to forming Spence PC, Mr. Spence spent twelve years practicing law with Kirkland & Ellis LLP in Chicago, IL and Tokyo, Japan. He is a graduate of the University of Notre Dame, where he obtained separate Bachelor of Science Degrees in Chemical Engineering and Biophysics (“Physics in Medicine”), and a graduate of the University of Houston Law Center.

**Stack, Laura**
Award-winning keynote speaker and bestselling author of seven books, Laura Stack is a noted expert in employee and team productivity. She is best known by her moniker, “The Productivity Pro.” Her engaging personality, combined with nearly 25 years of experience helping organizations achieve RESULTS, have made her one of the most sought-after experts and keynote speakers in her field.

**Stellar, Frederick**
Fred Stellar served as Director of Certification and FAA’s Organization Designation Authorization (ODA) lead administrator to issue Airbus Helicopters Inc. (AHI) Supplement Type Certificates (STCs). Prior to joining AHI, Fred was the lead administrator for Bell Helicopter’s ODA and manager of the civil certification group. He served to oversee development and certification of TC’s and STC’s. While a manager in the Federal Aviation Administration Stellar served in the aircraft certification office responsible for oversight and certification of Part 25 airplane modifications in Fort Worth, Texas. Fred also served 4 years managing the FAA International Policy Office in Brussels, Belgium where he worked closely with the European Aviation Safety Agency (EASA), Stellar served as a Research Assistant Professor of Aviation Systems with the University of Tennessee Space Institute (UTSI) where he taught a broad spectrum of graduate applied engineering courses focused on the aircraft certification processes as well as managing UTSI flight operations and maintenance activities for the University’s research aircraft. Before his civil aviation experience, Stellar was a 22-year veteran of the Army where his aviation assignments included experimental test pilot and assistant professor in the engineering department at West Point. Stellar earned a Bachelor of Science from the United States Military Academy, West Point, NY. He is a graduate of the US Navy Test Pilot School. He also earned a Master of Science Degree in Aerospace Engineering from the Georgia Institute of Technology. He is a graduate of the Program Manager course at the Defense Systems Management College. He holds a FAA commercial pilot license with helicopter, single/multi-engine airplane, and instrument ratings. He has more than 3200 accident-free flying hours in over 65 different aircraft.

**Timmis, Eric**
Eric Timmis is the owner of BusinessIsAContactSport.com, a training and consulting company dedicated to business process improvement, focusing on value and quality management implementation, program/project management training, and the integration of strategic partnership relationships between departments and organizations. Mr. Timmis has over thirty years of diversified experience across several industries, which includes the delivery of value engineering facilitation services to Ford Motor Co. and its supplier community and training for Eaton Corporation’s, Product Development Group. He is also a recognized speaker at various national conferences. Eric received a B.Sc. in Civil Engineering from the University of Birmingham in England and is a member of the Institution of Civil Engineers.

**Walker, R.W. (Bill)**
Bill Walker is the owner and principal engineer at Walker Technical Services where he provides consulting services in design, testing, and certification for manufacturers and operators of aerospace and mobile equipment throughout North America, Europe, and Asia. Mr. Walker has almost four decades of experience in test engineering, regulatory compliance engineering, and product safety engineering. Mr. Walker previously held the position of Manager of Safety and Compliance at John Deere Forestry, Inc., where he oversaw safety engineering, regulatory compliance, product liability management, intellectual property management, and standards development activities for the world-wide manufacturer of advanced forestry equipment. Additionally, Mr. Walker held the positions of Manager of Testing at Diamond Aircraft Industries, Director of Engineering, Manager of Flight Testing, and Test Engineer at Eurocopter Canada, Ltd. He is currently a member of SAE MTC4 (forestry machinery), ISO TC23/SC15 (Forestry Machinery), TC23/SC3 (Safety and comfort of the operator), and TC23/SC14 (Operator Controls, Operations Symbols and other displays, and Operator Manuals). He has also served on Canadian Standards Association Technical Committees on Mobile Forestry Machines and Rollover Protective Structures. Mr. Walker received a B.S. in Aerospace Engineering from Northrop University and M.A.Sc. in Aerospace Engineering from the University of Toronto Institute for Aerospace Studies.

**Wang, Wego**
Dr. Wang is currently an aerospace engineer in the Engine Certification Office of the Federal Aviation Administration, where he serves as the focal point for Parts Manufacturer Approval. He has been a technical instructor and a researcher in mechanical engineering and materials science for more than twenty years. Dr. Wang taught at Northeastern University and is currently an adjunct faculty at Boston University and the University of Massachusetts - Lowell. He received many awards, commendations and recognitions from the Army Research Laboratory, the FAA and other institutions. Dr. Wang authored or co-authored over 40 technical/professional articles, and presented lectures/reports at numerous seminars/conferences. Active with professional societies, he is on the executive committee of ASM International Boston Chapter and was the 2005-06 Chairman of the Chapter. He also served on the executive committee of TMS Boston Section, where he was president from 1993-95. Dr. Wang has a B.S. in Mechanical Engineering from National Cheng - Kung University, a M.S. in Mechanical Engineering from National Taiwan University, and a M.S. and Sc.D. in Materials Science and Engineering from Massachusetts Institute of Technology.

**Woodside, Kenneth B.**
Ken Woodside is a senior consultant with The Luminous Group. His consulting experience has focused on assisting organizations improve their ability to operate more effectively and efficiently while meeting customer needs and expectations. He is particularly experienced in designing and implementing interventions that focus on developing creative bottom line strategies, increase productivity and improve production effectiveness. These interventions have included senior management and line personnel in the process of developing and implementing change strategies including restructurings, lean manufacturing, quality improvement, and customer/supplier relations. Ken was part of a long term consulting experience to install process control at a major metal stamping and assembly plant that provided the foundation for Q5-9000 certification. As a part of this consultation 26 production teams were launched and trained using process control, lean manufacturing and quality improvement processes resulting in a 200% improvement in line transition, significant up-time improvement, product
quality and lowest inventory cost in the division. One of these teams reduced inventory by 60%, had only three quality issues in two million parts and no quality problems for 18 months. This effort had the full support of both Management and UAW leadership. Ken has a Bachelors Degree in Finance and a Masters Degree in Social Psychology, both from Boston University. He earned his Doctorate Degree in Organization Development and Psychology from United University in Dayton Ohio.

Yamamoto, Dario

Dario Yamamoto has over 10 years’ experience in the aerospace and aviation industries as a Plant, Engineering and Quality Manager in aerospace manufacturing and aviation companies. He also has over 11 years’ experience in education as an Engineering Program Coordinator, University Professor and Certified Bombardier Aerospace Structural Assemblies Instructor. Dario holds a B.S degree in Metallurgical Chemical Engineering from the National Autonomous University of Mexico (UNAM), is an AS9100:2016 Rev. C Aerospace Industry experienced auditor certified by Probitas Authentication, and an ISO9001:2015 QMS Lead Auditor certified by Exemplar Global. Mr. Yamamoto is a worldwide AS9100 lead aerospace industry experienced auditor and instructor, conducting 3rd party audits according to the Aerospace Manufacturing Standard AS9100 and teaching internal auditor and lead auditor courses. Following experiences with AS9110 Maintenance and AS9100 Manufacturing Aerospace Standards in companies such as Alpha Star Aviation Services (Saudi Arabia), Turborreactores ITR, Ketema Aerospace Mexico and the Aeronautical University in Queretaro (UNAQ). Dario started working as an auditor, consultant and instructor providing services of Gap Analysis; Internal & External Audits; development and implementation of Quality Management Systems according to AS9100, AS9110, OHSAS 18001, ISO9001; development and Implementation of NADCAP special and manufacturing processes; process mapping; root cause analysis; 8 Ds and 5 whys problem solution techniques; risk assessment and quality, manufacturing, auditing and operation staff training and certification.

Zielinski, Kevin

Kevin Zielinski currently owns and operates Red Cedar Media LLC, a training and corporate communications consulting, design, development and delivery company based in Michigan. Previously, Kevin was Senior Applications Specialist for EDS (including General Motors/EDS and Hewlett Packard/EDS) specializing in technical training delivery, training consulting, courseware design and development, and e-Learning. He has designed, developed and delivered over 40 lecture- and web-based courses attended by General Motors and EDS employees worldwide. Mr. Zielinski has also served as Adjunct Professor for the Wayne State University College of Engineering and WSU/Focus:Hope for many years. His areas of expertise include: e-Learning design and development, Quality Tools and Methods (Design of Six Sigma, Robust Engineering, Design of Experiments (DOE), Statistical Tolerancing and GD&T); Design for Manufacturing and Assembly (DFMA); Engineering Economics; and Plant Floor Throughput Improvement. He has been an instructor for SAE Professional Development since 1990, and is a recipient of SAE’s Forest R. McFarland Award (April 2005). He holds a bachelor’s and master’s degree in engineering from Wayne State University.
PROFESSIONAL DEVELOPMENT SCHEDULE

2018 SAE PROFESSIONAL DEVELOPMENT COURSE SCHEDULE – AEROSPACE
JANUARY - DECEMBER 2018

JANUARY 2018

Live Online
Jan 10-19 New! Design for Additive Manufacturing: Towards End-Part Production – I.D.# WB1705
Jan 10-19 Vehicle Sound Package Materials – I.D.# WB1204
Jan 22-26 New! FEA Beyond Basics: Nonlinear Analysis – I.D.# WB1725
Jan 22-Feb 2 Design of Experiments (DOE) for Engineers – I.D.# WB0932

El Segundo, CA, USA - MicroTek - Los Angeles (El Segundo, CA)
Jan 8-10 New! AS9100D Internal Audit Program Implementation – I.D.# C1713

Kirkland, WA, USA - MicroTek - Seattle
Jan 23-25 Design Review Workshop – I.D.# C1306

Common Training for DPRV Personnel – I.D.# C1501
Jan 16-18 Phoenix, AZ, USA - MicroTek – Phoenix
Jan 23-25 Bloomfield, CT, USA - MicroTek – Hartford
Jan 23-25 Kirkland, WA, USA - MicroTek – Seattle
Jan 30-Feb 1 Dallas, TX, USA - MicroTek – Dallas
Jan 30-Feb 1 Indianapolis, IN, USA - MicroTek - Indy
Jan 30-Feb 1 Plantation, FL, USA - MicroTek - Lauderdale

FEBRUARY 2018

Live Online
Feb 5-9 New! FEA Beyond Basics: Thermal Analysis – I.D.# WB1726
Feb 19-28 Root Cause Problem Solving: Methods and Tools – I.D.# WB0931
Feb 19-Mar 7 Fundamentals of Geometric Dimensioning & Tolerancing (GD&T) – I.D.# WB0933

Phoenix, AZ, USA - MicroTek - Phoenix
Feb 5-6 ARP4754A and the Guidelines for Development of Civil Aircraft and Systems – I.D.# C1118

Feb 8-9 ARP4761 and the Safety Assessment Process for Civil Airborne Systems – I.D.# C1245

Cleveland, OH, USA - Ohio Aerospace Institute
Feb 12-13 New! FAA Part 21 Certification Procedures for Products and Parts – I.D.# C1701
Feb 14-16 Fundamentals of GD&T 2009 3-day – I.D.# ET1151

Livonia, MI, USA - Effective Training Inc. (ETI)
Feb 12-13 The Role of the Expert Witness in Product Liability Litigation – I.D.# 92054
Feb 14-16 Fundamentals of GD&T 2009 3-day – I.D.# ET1151

Common Training for DPRV Personnel – I.D.# C1501
Feb 13-15 Cerritos, CA, USA - Cerritos College (SCCTT)
Feb 21-23 Phoenix, AZ, USA - MicroTek - Phoenix
Feb 20-22 West Chester, OH, USA - Indiana Wesleyan University
Feb 20-22 Las Vegas, NV, USA - MicroTek - Vegas
Feb 5-7 Birmingham, United Kingdom - MicroTek - Birmingham (UK)
Feb 27-Mar 1 Bloomfield, CT, USA - MicroTek - Hartford

MARCH 2018

Troy, MI, USA - SAE International Troy Office
Mar 12-13 Practical NVH Signal Processing Methods – I.D.# C0431

Warrendale, PA, USA - SAE International World Headquarters
Mar 12-13 Understanding the FAA Aircraft Certification Process – I.D.# C0821
Mar 14-15 Aircraft Cabin Safety and Interior Crashworthiness – I.D.# C0926

Live Online
Mar 5-16 Design of Experiments (DOE) for Engineers – I.D.# WB0932

For the most up-to-date live learning schedule visit training.sae.org/calendar
PROFESSIONAL DEVELOPMENT SCHEDULE

Livonia, MI, USA - Effective Training Inc. (ETI)
Mar 20-21  Advanced Concepts of GD&T 1994 2-day – I.D.# ET2411
Mar 26    Fundamentals of Shielding Design for EMC Compliance – I.D.# C0835

Toulouse, France - To Be Determined
Mar 5-6   Design for Manufacture and Assembly (DFM/DFA) – I.D.# C0418
Mar 5-6   Design of Experiments - Basic Simplified Taguchi – I.D.# C0231
Mar 7    ANOVA for Design of Experiments – I.D.# C0714
Mar 7-8  Design Review Workshop – I.D.# C1306
Mar 7-9   New! AS9100D Internal Auditor Training – I.D.# C1634
Mar 8-9   Design and Process Failure Modes and Effects Analysis (FMEA) – I.D.# C1510

Herndon, VA, USA - MicroTek - Herndon (Dulles)
Mar 5-6   Understanding and Supporting Aircraft Accident Investigation and Reconstruction – I.D.# C1143
Mar 6-9   New! Aviation Safety Engineer Job Functions – I.D.# C1708
Mar 19-21 Injuries, Anatomy, Biomechanics & Federal Regulation – I.D.# 85049

Durham, NC, USA - MicroTek - Raleigh/Durham

Common Training for DPRV Personnel – I.D.# C1501
Mar 6-8  Toronto, ON, Canada - MicroTek - Toronto
Mar 13-15 Munich, Germany - MTU Aero Engine AG
Mar 13-15 Singapore, Singapore - MicroTek - Singapore
Mar 13-15 Durham, NC, USA - MicroTek - Raleigh/Durham
Mar 19-21 Paris, France - MicroTek - Paris
Mar 20-22 Phoenix, AZ, USA - MicroTek - Phoenix
Mar 20-22 Norwalk, CA, USA - Cerritos College (SCCTT)
Mar 20-22 West Chester, OH, USA - Indiana Wesleyan University
Mar 27-29 Bloomfield, CT, USA - MicroTek - Hartford
Mar 27-29 Norwalk, CA, USA - Cerritos College (SCCTT)
Mar 27-29 Kirkland, WA, USA - MicroTek - Seattle

APRIL 2018
Troy, MI, USA - SAE International Troy Office—held in Conjunction with the WCX™: SAE World Congress Experience
Apr 3    Principled Negotiation – I.D.# C1602
Apr 4-6  Managing Engineering & Technical Professionals – I.D.# C0608
Apr 30-May 2 Strategic Leadership – I.D.# C0620

For the most up-to-date live learning schedule visit training.sae.org/calendar
## PROFESSIONAL DEVELOPMENT SCHEDULE

<table>
<thead>
<tr>
<th>Month</th>
<th>Location</th>
<th>Event Description</th>
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</thead>
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<tr>
<td>April 17-19</td>
<td>West Chester, OH, USA - Indiana Wesleyan University</td>
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<tr>
<td>April 23-25</td>
<td>Birmingham, United Kingdom - MicroTek - Birmingham (UK)</td>
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<tr>
<td>April 24-26</td>
<td>Dallas, TX, USA - MicroTek - Dallas</td>
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<td>Indianapolis, IN, USA - MicroTek - Indy</td>
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<tr>
<td>April 24-26</td>
<td>Plantation, FL, USA - MicroTek - Lauderdale</td>
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<tr>
<td>May 10-11</td>
<td>Troy, MI, USA - SAE International Troy Office</td>
<td>Material Selection and Testing for Plastics – I.D. # C0134</td>
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<tr>
<td>May 14-25</td>
<td>Live Online</td>
<td>Finite Element Analysis (FEA) for Design Engineers – I.D. # WB1241</td>
</tr>
<tr>
<td>May 29-Jun 1</td>
<td>New! FEA Beyond Basics: Nonlinear Analysis – I.D. # WB1725</td>
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<tr>
<td>Livonia, MI, USA - Effective Training Inc. (ETI)</td>
<td>May 1-2</td>
<td>New! ISO Geometric Tolerancing 2-day – I.D. # ET7103</td>
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<tr>
<td>May 15-17</td>
<td>Fundamentals of GD&amp;T 2009 3-day – I.D. # ET1151</td>
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<tr>
<td>May 22-23</td>
<td>Functional Gaging and Measurement 2-day – I.D. # ET8200</td>
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<tr>
<td>May 14-18</td>
<td>Troy, MI, USA - SAE International Troy Office</td>
<td>Engineering Management Academy – I.D. # ACAD09</td>
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<tr>
<td>May 8-10</td>
<td>Greenville, SC, USA - MicroTek - Greenville</td>
<td>New! AS9100D Internal Audit Program Implementation – I.D. # C1713</td>
</tr>
<tr>
<td>May 10-12</td>
<td>New! AS9100D Internal Auditor Training – I.D. # C1634</td>
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<tr>
<td>May 1-3</td>
<td>Common Training for DPRV Personnel – I.D. # C1501</td>
<td>St Louis Park, MN, USA - MicroTek - Minneapolis</td>
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<tr>
<td>May 8-10</td>
<td>Nashville, TN, USA - MicroTek - Nashville</td>
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<tr>
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<td>Cerritos, CA, USA - Cerritos College (SCCTT)</td>
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<tr>
<td>May 15-17</td>
<td>Mexico City, Mexico - CompuEducación, S.A. de</td>
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# Professional Development Schedule

**Shanghai, China - SAE International China Office**
- **Jun 4-5**: New! FAA Part 21 Certification Procedures for Products and Parts – I.D.# C1701
- **Jun 7-8**: Understanding the FAA Parts Manufacturer Approval Process – I.D.# C1324

**Common Training for DPRV Personnel – I.D.# C1501**
- **Jun 5-7**: Montreal, QC, Canada - MicroTek - Montreal
- **Jun 12-14**: Cerritos, CA, USA - Cerritos College (SCCTT)
- **Jun 18-22**: Hamburg, Germany – To Be Determined
- **Jun 18-20**: Paris, France - MicroTek - Paris
- **Jun 19-21**: West Chester, OH, USA - Indiana Wesleyan University
- **Jun 26-28**: Bloomfield, CT, USA - MicroTek - Hartford

**JULY 2018**

**Troy, MI, USA - SAE International Troy Office**
- **Jul 9-14**: New! Workforce Readiness Academy – I.D.# ACAD13
- **Jul 16-17**: Managing Programs and Associated Risks – I.D.# C0409
- **Jul 16-17**: Robust Design – I.D.# C1231

**Live Online**
- **Jul 11-20**: Tolerance Stack-up Fundamentals – I.D.# C0842

**Warrendale, PA, USA - SAE International World Headquarters**
- **Jul 9-10**: New! FAA Part 21 Certification Procedures for Products and Parts – I.D.# C1701
- **Jul 11-13**: New! FAA Certification, Operations and Maintenance Orientation – I.D.# C1707

**Livonia, MI, USA - Effective Training Inc. (ETI)**
- **Jul 24-25**: New! Critical Concepts of Tolerance Stacks – I.D.# ET1701

**Greenville, SC, USA - MicroTek - Greenville**
- **Jul 16-17**: ARP4754A and the Guidelines for Development of Civil Aircraft and Systems – I.D.# C1118
- **Jul 19-20**: ARP4761 and the Safety Assessment Process for Civil Airborne Systems – I.D.# C1245

**Common Training for DPRV Personnel – I.D.# C1501**
- **Jul 3-5**: Taipei City, Taiwan - MicroTek - Taipei City
- **Jul 10-12**: Cerritos, CA, USA - Cerritos College (SCCTT)
- **Jul 10-12**: Nashville, TN, USA - MicroTek - Nashville
- **Jul 17-19**: West Chester, OH, USA - Indiana Wesleyan University
- **Jul 17-19**: Munich, Germany - MTU Aero Engine AG
- **Jul 24-26**: Bloomfield, CT, USA - MicroTek - Hartford
- **Jul 24-26**: Kirkland, WA, USA - MicroTek - Seattle
- **Jul 31-Aug 2**: Dallas, TX, USA - MicroTek - Dallas

**Aug 1-3**: Principles of Cost and Finance for Engineers – I.D.# C0828
**Aug 15-17**: Weibull-Log Normal Analysis Workshop – I.D.# 86034
**Aug 22-23**: Design for Manufacture and Assembly (DFM/ DFA) – I.D.# C0418
**Aug 27-29**: Managing Engineering & Technical Professionals – I.D.# C0608
**Aug 30**: Principled Negotiation – I.D.# C1602

**Live Online**

**Livonia, MI, USA - Effective Training Inc. (ETI)**
- **Aug 7-9**: Fundamentals of GD&T 2009 3-day – I.D.# ET1151

**Cleveland, OH, USA - Ohio Aerospace Institute**
- **Aug 30-31**: Understanding the FAA Parts Manufacturer Approval Process – I.D.# C1324

**El Segundo, CA, USA - MicroTek - Los Angeles (El Segundo, CA)**
- **Aug 13-16**: New! Aviation Safety Engineer Job Functions – I.D.# C1708

**Common Training for DPRV Personnel – I.D.# C1501**
- **Aug 7-9**: St Louis Park, MN, USA - MicroTek - Minneapolis
- **Aug 14-16**: Cerritos, CA, USA - Cerritos College (SCCTT)
- **Aug 28-30**: Bloomfield, CT, USA - MicroTek - Hartford

**SEPTEMBER 2018**

**Troy, MI, USA - SAE International Troy Office**
- **Sep 20-21**: Accelerated Test Methods for Ground and Aerospace Vehicle Development – I.D.# C0316
- **Sep 27-28**: Engineering Project Management – I.D.# 99003
- **Sep 24-29**: New! Workforce Readiness Academy – I.D.# ACAD13

**Live Online**
- **Sep 10-26**: Fundamentals of Geometric Dimensioning & Tolerancing (GD&T) – I.D.# WB0933

**Warrendale, PA, USA - SAE International World Headquarters**
- **Sep 12-14**: New! AS9100D Internal Auditor Training – I.D.# C1634

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PROFESSIONAL DEVELOPMENT SCHEDULE

Livonia, MI, USA - Effective Training Inc. (ETI)

Sep 12  Fundamentals of Shielding Design for EMC Compliance – I.D.# C0835
Sep 25-26  Fundamentals of GD&T for Inspectors 2-day – I.D.# ET2053

Common Training for DPRV Personnel – I.D.# C1501

Sep 11-13  Cerritos, CA, USA - Cerritos College (SCCTT)
Sep 12-14  Birmingham, United Kingdom - MicroTek - Birmingham (UK)
Sep 18-20  West Chester, OH, USA - Indiana Wesleyan University
Sep 18-20  Phoenix, AZ, USA - MicroTek - Phoenix
Sep 24-26  Madrid, Spain - MicroTek - Madrid
Sep 25-27  Bloomfield, CT, USA - MicroTek - Hartford
Sep 25-27  Kirkland, WA, USA - MicroTek - Seattle

Oct 17-19  Injuries, Anatomy, Biomechanics & Federal Regulation – I.D.# 85049

Common Training for DPRV Personnel – I.D.# C1501

Oct 1-3  Milan, Italy - MicroTek - Milan
Oct 8-10  Ostrava, Czech Republic - Park Inn by Radisson Hotel Ostrava
Oct 9-11  Cerritos, CA, USA - Cerritos College (SCCTT)
Oct 9-11  Durham, NC, USA - MicroTek - Raleigh/Durham
Oct 16-18  Phoenix, AZ, USA - MicroTek - Phoenix
Oct 16-18  West Chester, OH, USA - Indiana Wesleyan University
Oct 16-18  Munich, Germany - MTU Aero Engine AG
Oct 22-24  Paris, France - MicroTek - Paris
Oct 23-25  Bloomfield, CT, USA - MicroTek - Hartford
Oct 23-25  Las Vegas, NV, USA - MicroTek - Vegas
Oct 30-Nov 1  Indianapolis, IN, USA - MicroTek - Indy
Oct 30-Nov 1  Dallas, TX, USA - MicroTek - Dallas
Oct 30-Nov 1  Plantation, FL, USA - MicroTek - Lauderdale

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PROFESSIONAL DEVELOPMENT SCHEDULE

Kirkland, WA, USA - MicroTek - Seattle

Nov 14-15 Aircraft Cabin Safety and Interior Crashworthiness – I.D.# C0926
Nov 15-16 Understanding the FAA Aircraft Certification Process – I.D.# C0821

Common Training for DPRV Personnel – I.D.# C1501

Nov 13-15 Mexico City, Mexico - CompuEducación, S.A. de C.V. (Mexico City)
Nov 13-15 West Chester, OH, USA - Indiana Wesleyan University
Nov 13-15 Col. Los Morales Polanco, Mexico - MicroTek - Mexico City
Nov 14-16 Cerritos, CA, USA - Cerritos College (SCCTT)
Nov 21-23 Birmingham, United Kingdom - MicroTek - Birmingham (UK)
Nov 27-29 Bloomfield, CT, USA - MicroTek - Hartford
Nov 27-29 Kirkland, WA, USA - MicroTek - Seattle

DECEMBER 2018

Troy, MI, USA - SAE International Troy Office

Dec 10-12 Managing Engineering & Technical Professionals – I.D.# C0608
Dec 10-12 Weibull-Log Normal Analysis Workshop – I.D.#86034
Dec 13 Principled Negotiation – I.D.# C1602

Live Online

Dec 11-20 Tolerance Stack-up Fundamentals – I.D.# C0842

Livonia, MI, USA - Effective Training Inc. (ETI)

Dec 4-6 Fundamentals of GD&T 2009 3-day – I.D.# ETI1151

Common Training for DPRV Personnel – I.D.# C1501

Dec 4-6 Durham, NC, USA - MicroTek - Raleigh/Durham
Dec 4-6 Montréal, QC, Canada - MicroTek - Montreal
Dec 5-7 Cerritos, CA, USA - Cerritos College (SCCTT)
Dec 11-13 West Chester, OH, USA - Indiana Wesleyan University
Dec 18-20 Bloomfield, CT, USA - MicroTek - Hartford
Dec 18-20 Phoenix, AZ, USA - MicroTek - Phoenix

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- And more...

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