

-- REGISTRATION FORM --

Return the form below by April 1, 2025 with a payment of \$1,895\* by check or \$1,965 by credit card (\$2,095\* by check or \$2,165 by credit card for registrations received April 2, 2025 or later) to:

**ETS Inc. - Attn.: Accounting**  
**P.O. Box 7747**  
**Bloomfield Hills MI 48302-7747**

\*Three or more participants from the same company attending and paying for same seminar are entitled to \$200 reduced registration fee per attendee.

◆ Yes, I plan to attend the 3-day course entitled "Automotive Plastic Part Design" to be held April 22, 23 & 24, 2025

Lunch is included for each day of the 3-day seminar.  
**Please Type or Print**

Name: \_\_\_\_\_  
Title: \_\_\_\_\_  
Company: \_\_\_\_\_  
Company Mailing Address: \_\_\_\_\_  
City: \_\_\_\_\_ St: \_\_\_\_\_ Zip: \_\_\_\_\_  
Phone: ( ) \_\_\_\_\_ Ext.: \_\_\_\_\_  
E-Mail: \_\_\_\_\_  
Total payment enclosed: \_\_\_\_\_

Please circle your choice below:

**Check enclosed (payable to ETS, Inc.)**

**Completed original Purchase Order enclosed**

**Mastercard, Visa**



Credit Card No.: \_\_\_\_\_

Cardholder Name: \_\_\_\_\_

Expiration Date: \_\_\_\_\_

Payment in full to be received prior to the seminar start date.

If you must cancel, call ETS at (248) 539-0473. You may cancel your registration for a full refund up to 21 days prior to the seminar. Cancellations received after October 15, 2024, are subject to a \$200 service charge. Registrants who fail to attend or who cancel after October 22, 2024 are liable for the entire fee. You may enroll a substitute at any time before the course starts.

For late registrations, cancellations or other questions please call our seminar hot-line: (248) 539-0473.

Walk-in registrants, with payment, will be admitted on an availability basis.

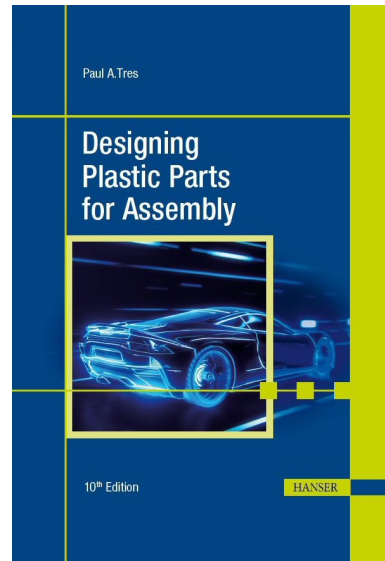
**INSTRUCTOR**

Paul A. Tres is a Senior Technical Consultant with ETS, Inc. of Bloomfield Hills, Michigan ([www.ets-corp.com](http://www.ets-corp.com)) serving the plastics and automotive industries. Author of a variety of seminar manuals, technical and marketing papers, including the best selling textbook **Designing Plastic Parts for Assembly**, 10<sup>th</sup> edition, published by Carl Hanser Verlag of Munich, Germany (2024) and computer software for automotive plastic part design.

Speaker, educator, and lecturer at numerous national and international plastics seminars and conferences, with over 20,000 attendees worldwide, for: American Plastics Council, ASME, SAE, SME, SPE, Grand Valley State University, Michigan State University, Polymers Center of Excellence, Purdue University, University of North Carolina, University of Wisconsin - Milwaukee and Madison, etc.

Paul Tres is a Fellow of International Society of Plastics Engineers. He is also an active contributor and member in Plastics Academy, International Society of Automotive Engineers and American Society of Mechanical Engineers.

Mr. Tres is also a highly sought-after expert witness having assisted such law firms as: Griffin & Szipl P.C.; Kreis, Enderle, Callander & Hudgins, P.C.; Lynn, Jackson, Shultz & Lebrun, P.C.; Morgan, Lewis & Bockius, LLP; Sellars, Marion & Bachi and many others.



**Course Location**

**Michigan State University**  
**Management Education Center (MSU-MEC)**  
811 West Square Lake Road, Room 105  
Troy MI 48098  
<http://mec.broad.msu.edu/location>  
<http://www.ets-corp.com>

Mail registration and payment to:  
ETS, Inc.  
P. O. Box 7747  
Bloomfield Hills MI 48302-7747  
Phone: (248) 539-0473  
Email: [info@ets-corp.com](mailto:info@ets-corp.com)

or register on line: [www.ets-corp.com](http://www.ets-corp.com)

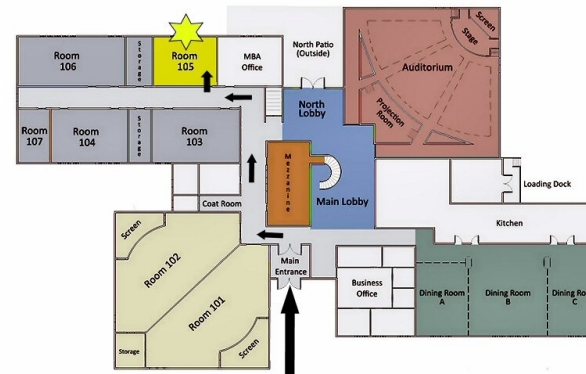
**Lodging**

Nearby Hotels: ETS does not arrange room accommodations. Hotels located near MSU-MEC in Troy, MI are:

- + Embassy Suites 1.5 miles P: 248-879-7500  
Troy, MI 48098
- + Hilton Garden Inn 2.8 miles P: 248-247-7280  
Troy, MI 48084
- + Drury Inn 3.5 miles P: 248-528-3330  
Troy, MI 48084

Free parking is available. Lunch is included.

**FLOOR PLAN**



Terzo Millennio

**Automotive Plastic Part Design**

*Embrace the Future of the Industry*

Detailed discussion and examples of:

**SAFETY SYSTEMS, Powertrain Interior Components, In-Mold Assembly Squeaks & Rattles, Integral Seals**

Offered by



Presented by **Paul A. Tres**

Held at

**NOW IN OUR 40<sup>th</sup> YEAR!**



MICHIGAN STATE UNIVERSITY

**911 West Square Lake Road**  
**Troy MI 48098**

Tuesday, Wednesday & Thursday  
**April 22, 23 & 24, 2025**  
8:30 a.m. - 4:30 p.m.

To register on line visit:

[www.ets-corp.com/automotive.htm](http://www.ets-corp.com/automotive.htm)

“This is likely the most informative class I've ever taken”

*Jeffrey Lubbers, Development Engineer - Mercedes-Benz*

“What a value to be with such an expert!”

*Michael Blicher, CGM Director - Magna International*

“Mr. Tres is very experienced, knowledgeable and an excellent speaker - a rare combination.”

*Scott Jarman, Sr. Manufacturing Engineer - Tyco Electronics*

## Course Description

This three-day in-depth automotive seminar provides information on material selection, design procedure, processing techniques, and assembly methods required for designing with plastics in the automotive industry.

Attendees will focus on what to expect from a polymeric material and discuss methods and methodologies used to simplify the design process and fully comply with FMVSS.

In addition, this course will enable the automotive OEM and the supplier to communicate more effectively. The OEMs will learn how to apply these concepts to their work, thus allowing for cost-efficiencies and fewer second thoughts when they understand the scientific basis, and the fine tuning that comes with experience.

A large number of automotive case histories will explain the step-by-step procedures to successful and robust designs.

## Who Should Attend

This course is targeted at designers, product managers, project managers, research engineers, materials engineers, sales and product development engineers and managers, undergraduate and graduate students or anyone involved in the development and manufacture of plastic products.

Its content is intended for a variety of industries such as medical, aerospace, furniture, packaging, computers, electronics, construction, automotive, recycling, consumer products, agricultural machinery, toy industry, fast food industry, and other industries which use plastic components in their products.

A number of case histories, including 26 short movies, will show you step-by-step procedures to successful and robust designs. Plan to come prepared with questions to ask or experiences to share.

## Benefits of Attending

- \* Understand advanced concepts for automotive design
- \* Learn how to define and use safety factors
- \* Determine the optimum methodology
- \* Utilize commercially available software
- \* Learn how to select materials
- \* Predict the behavior of plastic materials

## Individual Consulting Services

Seminars attendees can sign up for individual consulting sessions with the instructor. The sessions are free and allow the attendee to ask questions and discuss details that cannot be handled in a larger group. Consulting sessions are 20 minutes long and are handled on a first-come-first-served basis. You can sign up for a consulting session after you register for the seminar or during the seminar by contacting us at (248) 539-0473.

## Course Program - Day 1

### PLASTICS MATERIALS AND AUTOMOTIVE TECHNOLOGIES

North American Automotive Plastics Usage by Segment  
Interiors: Infotainment, Instrument Panel  
Exterior: Mega Front End Module & Tesla + Stellantis Wheel Covers  
Underhood: Upper Engine Module, Brake-by-Wire, Steer-by-Wire, Active Suspension  
Powertrain/Chassis: Hybrid, Fuel Cells, Electric Vehicles, Composite Brakes

### UNDERSTANDING AND SELECTING PLASTIC MATERIALS

Resins: Thermoplastics & Thermosets; Water Assist Injection Molding  
**Automotive Case History: Kautex/Chrysler Fuel Tank**  
Mucell, Structures: Crystalline, Amorphous & LCP  
Inherently Conductive Polymers (ICP), Plastic Magnet, BioSteel  
BioPolymers, Light Emitting Polymers, Nanotubes  
Reinforcements: Glass, Aramid, & Carbon + Carbon Nanotubes  
Fillers: Talc, Mica, Calcium Carbonate, Wallstonite, Glass spheres  
Additives, Effect of Additives, Physical Properties, Elasticity, Toughness, Plasticity, Notch Sensitivities, Moisture Sensitivity, Shrinkage, Creep, Stress Relaxation, Automotive Thermal & Chemical Characteristics, Starter Case History

### MATERIAL INITIAL SELECTION & SCREENING

Thermal Behavior, Automotive Chemicals  
**Automotive Case History: Honda Lumbar Support Mechanism**  
Impact, Specific Gravity & Cost, Engineering Properties  
Snap Fits & Hiving Hinges, Assembly Methods

### UNDERSTANDING SAFETY FACTORS

What is a Safety Factor?  
Using Safety Factors in Automotive Design  
Design Safety Factors: Static, Dynamic, Time Related  
Material Properties Safety Factors: ISO 9000, Continuous Improvement  
Processing Safety Factors, Operating Condition Safety Factors  
Reliable Automotive Brands, Legal Aspects of Automotive Business

### PROPER AUTOMOTIVE PLASTIC PART DESIGN

Boss Design for Different Type of Polymers  
**Case History: 1952 De Havilland Comet**  
Boss Design Layout, Ribbing: Dimensions, Junctions  
**Automotive Case History: BMW 550i & 750i Transmission Mount**  
Wall Thickness, Fillets, Part Stiffness, Undercuts  
Draft Angles: Core Vs. Cavity, Texturing

### STRENGTH OF MATERIALS FOR PLASTICS

Stresses: Tensile, Compressive, Shear, Torsion, Elongations (Strains)  
True Stress and Strain Vs. Engineering Stress and Strain  
Poisson's Ratio, Elastic Modulus  
Young's Modulus, Secant Modulus, Tangent Modulus  
Which Modulus to Use, and How to Use It

### NON-LINEAR CONSIDERATIONS

Material: Linear and Non-Linear Polymer Models  
Geometry: Linear and Non-Linear Models  
Finite Element Analysis (FEA) and How to Use It  
Non-Linear Considerations, Behavior Modeling (BMX),  
Sight - Design of Experiments, DFMPRO Assistance Module  
TRIZ: Theory of Solving Problems Inventively

### ULTRASONIC WELDING

Equipment, Vibration Types, Ultrasonic Cycle  
Design: Shear Joint & Energy Director Joint  
Heat Stake Joint Design: Flash, Hollow, Spherical  
Spot Welding, Swaging, Stud, Heat Staking  
Post Design: Round Solid, Round Hollow, Cross

### HOT PLATE WELDING

Equipment, Process  
Joint Area Strength Capability, Joint Design  
**Automotive Case History: Mercedes-Benz Windshield Washer Bottle**

## Course Program - Day 2

### VIBRATION WELDING

Equipment, Process  
Phases, Cross-thickness  
Joint Design, Welding Glass Reinforced Polymer, Fixture Design  
**Automotive Case History: PSA Peugeot Citroën - Diesel Engine AIM & VW Sharan**

### ELECTROMAGNETIC WELDING

Equipment  
Induction Coil Materials  
Bonding Agent  
Joint Design  
**Automotive Case History: Mitsubishi Motors - Power Steering Fluid Reservoir**

### LASER WELDING

Surface Heating & Through Transmission  
Joint Designs, Examples  
**Automotive Case History: Mercedes-Benz Ignition Key**

**HOT GAS WELDING:** Equipment, Joint Design

### BONDING

Failure Theories: Adhesive, Cohesive  
Substrate Wettability Tests, Drafting Symbols  
What is Surface Energy and How to Improve It  
Surface Treatments: Corona, Plasma, Flame  
Bonding Stresses: Tensile, Shear, Peel, Cleavage, Compression  
Joint Designs  
**Automotive Case History: Chrysler CCV Car Program**  
Stress Cracking, Adhesives, Solvents

### AUTOMOTIVE PAINTING

Adhesive Promoters, Primers, Base Coat, Top Coat  
Painting Considerations, Painting Work Flow  
Power Wash Parameters  
**Automotive Case History: Mercedes-Benz Wheel Hub Cover**

### PRESS-FITS

Material Properties, Geometric Definitions, Safety Factors, Creep, Loads  
Press-Fit Theory  
Design Algorithm Methodology  
**Case History: Cassette Deck**  
**Automotive Case History: Chrysler Upper Intake Manifold**  
Fusible Core Injection Molding  
Upper Intake Manifold Design Requirements  
CAMPUS (Computer Aided Material Preselection by Uniform Standards)  
Design Algorithm  
**Case History: Successful Press-Fit Designs**

### LIVING HINGES

Design for Polyolefins  
Common Living Hinge Design  
Design for Engineering Plastics  
Design Analysis  
Elastic, Elastic/Plastic, Plastic Hinge Designs  
**Automotive Case History: Delphi World-Class Connector**  
Step-by-Step Design Analysis  
**Automotive Case History: GM V-6 Ignition Cable Bracket**  
Molding Hinges, Processing Issues  
Coined Hinges  
*Class Exercise #1: Design, Material Selection & Tooling*  
Oil-Can Terminology & Concepts, Oil-Can Designs  
*Software Demo for Designing Living Hinges*

### TOOLING CONSIDERATIONS

Gate Design: Direct, Edge, Film, Fan, Tunnel, Pin  
Sprue, Spoke, Disk, Diaphragm, Valve, Hot Runner  
Reverse, Z, & Ring Sprue Puller, Design Formula  
Runner Design: Runner Cross-Section

## Course Program - Day 3

### SNAP FITS

Material & Design Considerations  
Assembly Positioning, Assembly Motions, Yield Criteria  
Safety Factors & Cantilever Snap-Fits  
Snap-Fits: Angle of Deflection, Self-Locking Angle  
**Automotive Case History: Tesla Door Panel**  
One-Way Continuous Beam with Rectangular Cross Section  
Finite Element Analysis Example  
**Case History: Hewlett-Packard Omnibook Laptop**  
*Class Exercise #2: Cantilever Beam Calculation*  
Annular Snap-Fits: Shallow Groove, Deep Groove  
**Case History: Pen & Cap**  
Torsional Snap-Fits

**Automotive Case History: GM World Class Connector**  
**Case History: Snap-fits Which Kill — FirstSave Defibrillator**  
Deformable Rib Design, Springiness Rate, Automotive Recyclability  
Symbols for Plastics -- Class Exercise - Cantilever SNAP-FIT  
Assembly-Disassembly Assists, Preventing over-deflection  
**Automotive Case History: Honda Accord Lumbar Support Actuator**  
Tooling for Snap-Fits, Issues with Snap Fitting  
**Case History: Injection Blow Molded Bottle Assembly**  
Serviceability, Conclusions, Software Demos

### AUTOMOTIVE INTEGRAL SEAL DESIGN

Design Issues: Integral Seal - Design A & Design B  
Structural Analysis: Step 1 through 7, Material Model  
Engineering Stress-Strain Curve  
True Stress-Strain Curve - Plastic Region  
Analysis Results: Total Displacement, Von Mises Stresses  
Simulating Leak Through Seal 1 & Through Seal 2  
Processing Issues, Drying, Melt Temperature  
Injection Rate, Screw Forward Time, Mold Temperature  
Tool Design: Mold Closed - Part Filling

### OVER-MOLDING AND IN-MOLD ASSEMBLY

Reasons for Multi-Material, Materials Compatibility, Pulsafe FitLogic  
Part Design & Material Selection, Materials Incompatibility For IMA  
Indexing (Rotating Platen) Tool, Mold with Core Retraction  
**Automotive Case History: TRW/ZF Lower Assembly**

### TROUBLESHOOTING

Air Traps, Black Specks, Burn Marks, Dark Stripes  
Flashing, Flow Marks, Hesitation, Jetting  
Peeling, Sink Marks, Shrinkage, Splay, Sprue Sticking, Unfilled Parts  
(Short Shots), Unmelt, Warp, Waves, Weld lines  
*Class Exercise #3: Rim*

### FASTENERS

Self-Threading, Tread Forming, Recessed Driving Heads  
Clamp Load Vs. Time  
Torque Vs. Penetration Depth  
Type AB, Type B, Type C, Hi-Lo, PT,  
Free Body Diagram, Pullout Load Vs. Engagement Area  
Assembly Stress, Plastic Boss Design for PT Fasteners  
RS Plast, Delta PT, Polyfast, and Plastite Thread Designs  
**Automotive Case History: Threaded Assembly Calculation**  
Weld and Meld Lines  
Thread Cutting: BF, T, Hi-Lo, RS Duroplast, & Duro PT  
Pilot Hole Design Detail

### PLASTIC PART DESIGN ON THE WORLD WIDE WEB PROJECTS REVIEW SESSION -- FREE

**Seminar Schedule**  
**April 22, 23 & 24, 2025**

8:00 a.m. - 8:30 a.m. Registration (Day 1 only)  
8:30 a.m. - 4:30 p.m. Course Hours