

-- REGISTRATION FORM --

Return the form below by March 7, 2022 with a payment of \$1,695* by check or \$1,765 by credit card (\$1,795* by check or \$1,865 by credit card for registrations received March 8, 2022 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 \$150 reduced registration fee per attendee.

Yes, I plan to attend the 3-day course entitled **“Automotive Plastic Part Design”** to be held **March 29, 30 & 31, 2021**

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.: _____

Fax No. () _____

E-Mail: _____

Total payment enclosed: _____

Please circle your choice below:

Check enclosed (payable to ETS, Inc.)

Completed original Purchase Order enclosed



American Express
Mastercard, Visa

Credit Card No.: _____

Cardholder Name: _____

Expiration Date: _____

You will receive confirmation upon receipt of your payment. 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 March 7, 2022, are subject to a \$150 service charge. Registrants who fail to attend or who cancel after March 15, 2022 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.
For directions to the seminar venue please call: (248) 879-2456.

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) 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**, 9th edition, published by Carl Hanser Verlag of Munich, Germany (2021) and computer software for automotive plastic part design.

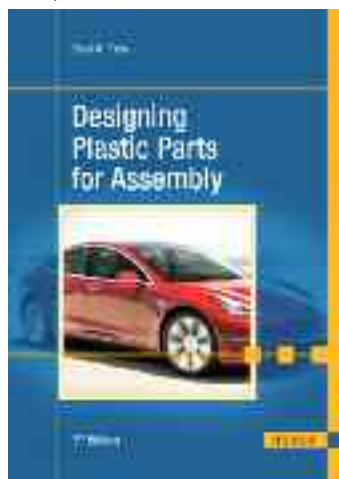
Speaker, educator, and lecturer at numerous national and international plastics seminars and conferences, with over 18,600 attendees worldwide, for: American Plastics Council, ASME, SAE, SME, SPE, Grand Valley State University, Michigan State University, Polymers Center of Excellence, Purdue University, 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.

Handout Materials

Two inch-wide binder containing color copies of more than 1,300 slides used during presentation + the 9th edition of **Designing Plastic Parts for Assembly** textbook (over 450 pages - \$159 value).



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

or register on line: www.ets-corp.com

Lodging

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

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

Free parking is available. Lunch is included.

FLOOR PLAN



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



811 West Square Lake Road
Troy MI 48098

NOW IN OUR 33rd YEAR!

Wednesday, Thursday & Friday
March 29, 30 & 31, 2022
8:30 a.m. - 4:30 p.m.

To register on line visit:

www.ets-corp.com/automotive.htm

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: One-Way Continuous Beam with Rectangular Cross Section](#)
Finite Element Analysis Example
[Case History: Hewlett-Packard Omnibook](#)
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](#)
Deformable Rib Design, Springiness Rate, Automotive Recyclability
Symbols for Plastics - - Class Exercise - Cantilever SNAP-FIT
Assembly-Disassembly Assists, Preventing over-deflection
[Automotive Case History: 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, PulseFit Log
Part Design & Material Selection, Materials Incompatibility For IMA
Indexing (Rotating Platen) Tool, Mold with Core Retraction
[Automotive Case History: TRW Louver 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, Warpage, 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 March 29-31, 2022

8:00 a.m. - 8:30 a.m. Registration (Day 1 only)

8:30 a.m. - 4:30 p.m. Course Hours

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 Ignition Key](#)

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: 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: 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
Runner Layout: Herring Bone, H-Type, Star

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
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: 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, Wollastonite, Glass spheres
Additives, Effect of Additives, Physical Properties, Elasticity, Toughness, Plasticity, Notch Sensitivities, Moisture Sensitivity, Shrinkage, Creep, Stress Relaxation, Automotive Thermal & Chemical Characteristics

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), iSight - Design of Experiments
DFMPro Injection Molding Pro/E 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](#)

“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.