SPE TopCon 2019

Cost Saving Opportunities Via Electromagnetic Joining

Emabond™
Your Welding Solutions Team!

Presented by;
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decorating & assembly .....DIVISION.....

Abstract

The ever-expanding use of plastics has created increased opportunities to utilize electromagnetic energy for welding or bonding of similar and dis-similar materials. Recent advancements in equipment, welding materials and processes will be presented offering cost saving opportunities when compared to alternative methods of assembly.

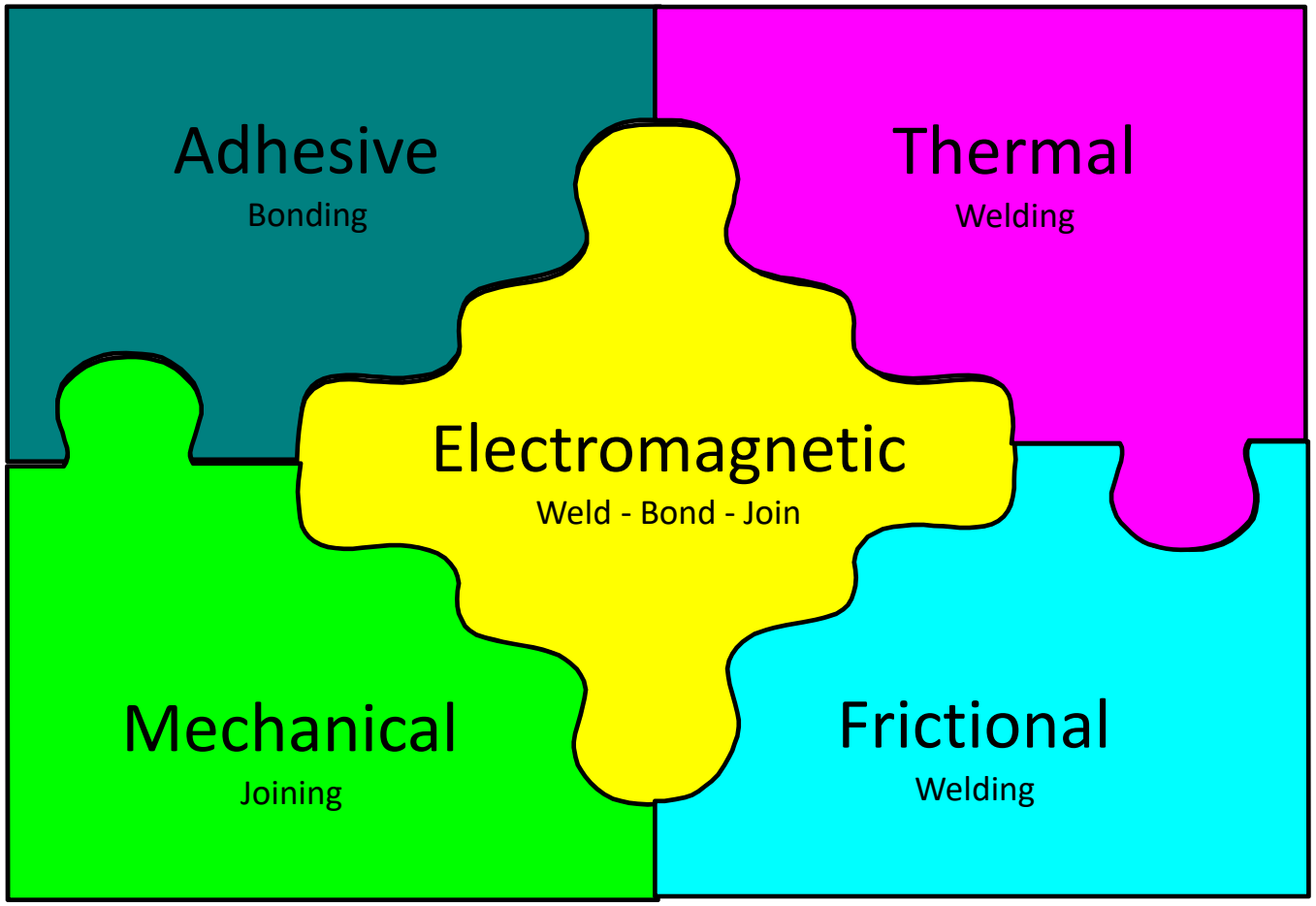
New, fast-setting polymeric adhesives can be specified to replace conventional adhesives thereby lowering labor, material and energy costs. The presentation also will discuss and illustrate examples of bonding dis-similar materials including attachment of ornamental and decorative emblems to plastic surfaces.

Presentation Outline

- Plastic Assembly Overview
- Electromagnetic Process for Welding & Bonding
- When to Consider – the Process & Benefits
- Material & Design Options
- Application Examples
- Summary
- Q & A

New flexible power-delivery systems offer a highly efficient, compact, easy-to-integrate source of EM power for a wider variety of welding and bonding applications

Plastic Part Assembly Methods



via the Emabond® Process

The Emabond® Process

The Emabond® Process is for Innovative Plastic Part ***"Design & Assembly"***

Electro
Magnetic
Assembly
Bonding

an enabling technology !

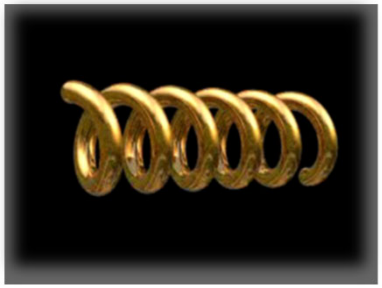
It is a *Product Design* and *Assembly Method* for Thermoplastics

Controlled Bond-line Heating Capability

Emabond® process

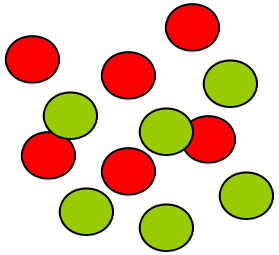
"Predictable Heating"

Induction Heating uses the interaction of High Frequency Electromagnetic Field Strength & Susceptors to generate Heat on Command



Electromagnetic
High Frequency
13.56 Mhz

+



Susceptor Particles
FE or SS

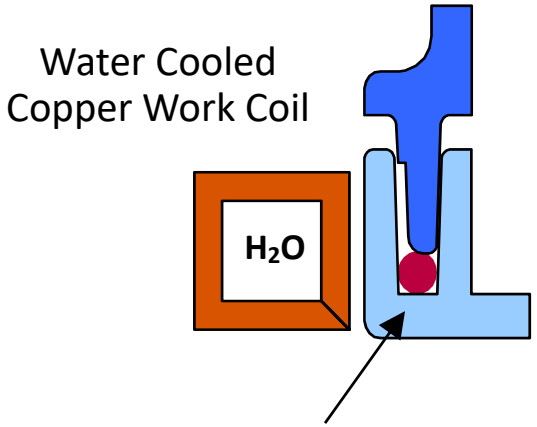
Polymer
PP - PE - PA - PC ….
Elastomeric materials &
Customized Formulations

Precise Heat
Delivery
Where it is
Needed

Electromagnetic Welding "how it works"

Before Joining

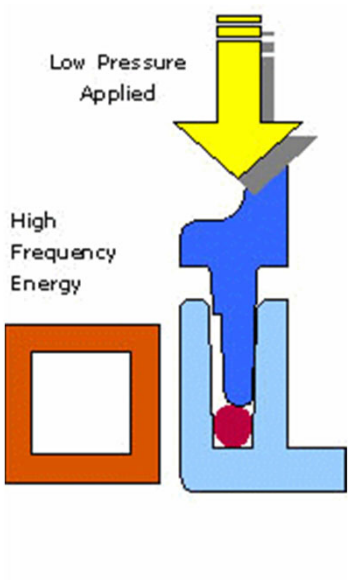
Emabond resin is deposited in the joint. The mating parts are brought together and placed within a fixture containing a work coil.



Emabond Resin is 100% Contained

During Joining

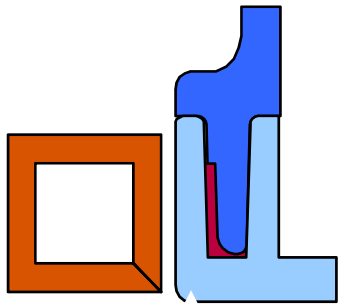
The activated coil heats the Emabond resin, causing the adjoining surfaces to melt.



Precise Heat Delivery from Power Source to Bond Line

After Joining

The Emabond resin has filled the gap. The process has fused the mating parts, resulting in polymer to polymer permanent bond.



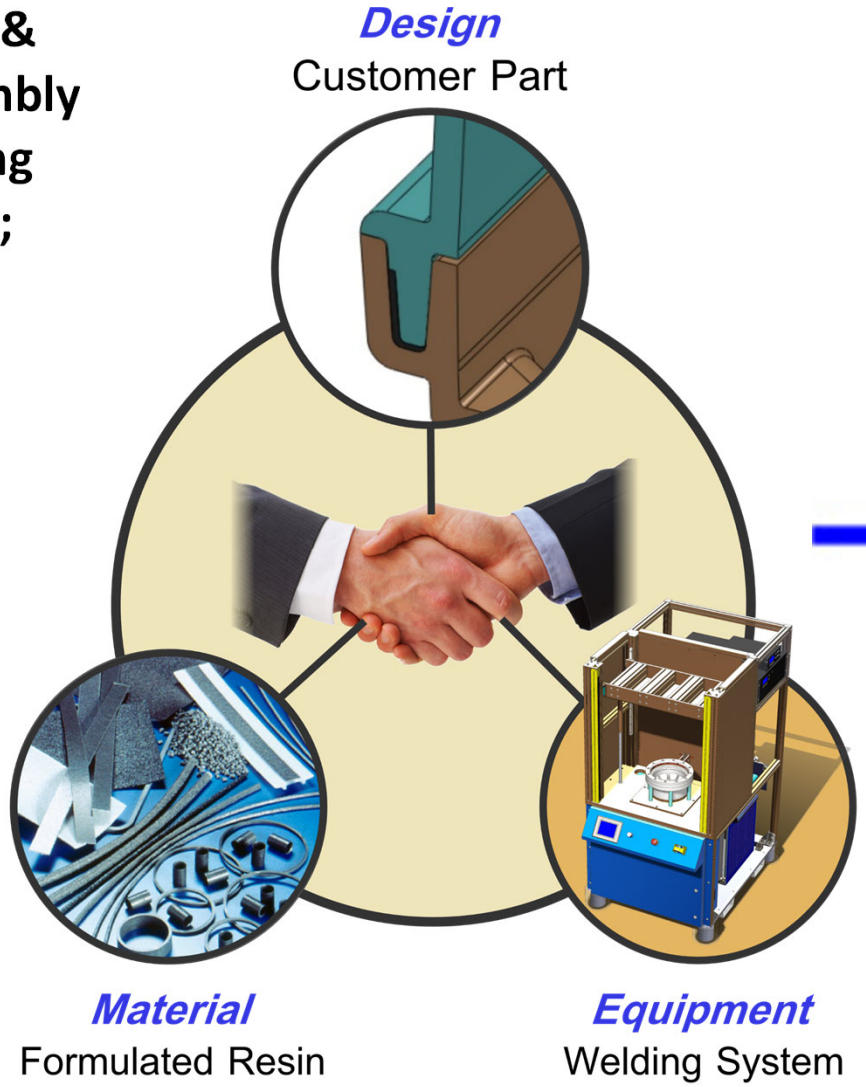
Produces a Structural Joint Capable of High Shear Strength

The Process is Similar to Injection Molding the Joint!

Emabond Offer's Turnkey Assembly Solutions

We Develop, Produce & Deliver Turnkey Assembly Systems for Demanding Applications including;

- Hi-Pressure Vessels
- Fluid Containers
- Elastomerics
- Dissimilar Materials
- Internal Components
- Difficult Geometries
- Multiple Component Weld lines
- Large Parts



Reliable Weld Results for;

- Injection Molded
- Blow Molded
- Extruded
- Thermoformed
- Continuous Web
- Thin Film
- Composites
- Fabrics

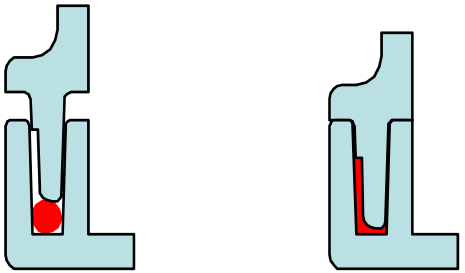
Typical Joint Designs

Flat to Flat

- ✓ Structural & low pressure leak-proof

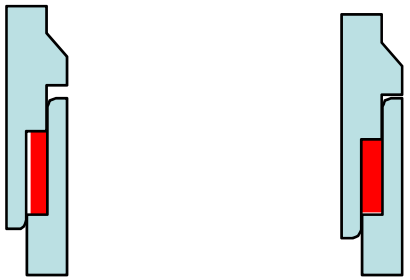
Flat to Groove

- ✓ Structural & low pressure leak-proof



Tongue and Groove: (most versatile)

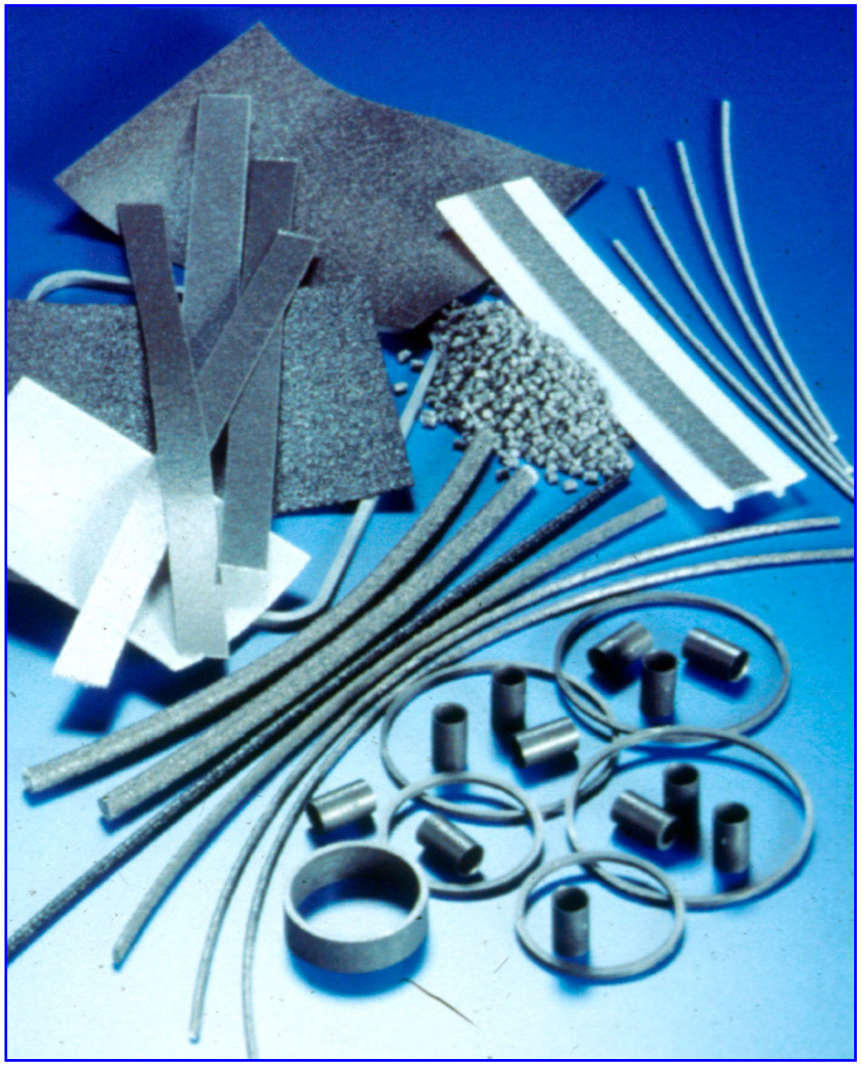
- ✓ Higher pressure and leak proof



Step

- ✓ For applications with limited space, usually small cylindrical shapes

EM Material preform options



Special Susceptor Particles and Compatible Thermoplastics

Available Forms Include;

- **Extruded Profiles**
- **Sheet**
- **Die Stamped Gaskets**
- **Slit Tape**
- **Injection Molded Gaskets**
- **Formed Rings**
- **3D Printed shapes**
- **Co-injection & Co-extruded**
- **Resin – direct dispense**

Custom Formulated Susceptor Materials and Thermoplastic Resins

Emabond Welding / Joining Compatibility Guide

Design

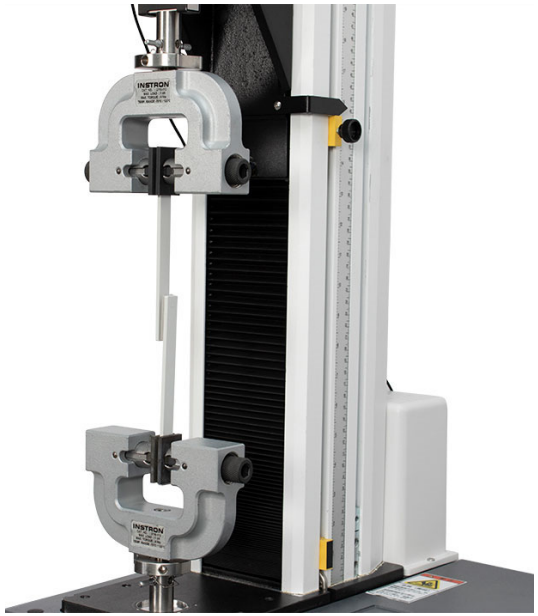
MATERIAL FAMILY	ABS	Elastomers	Hytrel	Noryl GTX	Nylon	EVA Foam	PBT	PBT/PC	PC	PC / ABS	PCL	HDPE / LDPE	Polyester	PMMA	PP	PVC
ABS	■	■	■	□	□	□	□	□	■	■	■	□	□	■	□	■
TPE / TPO / TPU / TPV	■	■	■	□	□	■	□	□	□	□	■	■	□	□	■	□
Hytrel Polyester Elastomer	■	■	■	□	□	□	■	■	■	■	□	□	■	□	■	■
Noryl GTX / PPO / PPX	□	□	□	■	■	□	□	□	□	□	□	□	■	□	□	□
Nylon (PA6/PA66)	□	□	□	■	■	□	□	□	□	□	□	□	□	□	■	□
EVA Foam	□	■	□	□	□	■	□	□	□	■	□	□	■	□	□	■
PBT	□	□	■	□	□	□	■	■	□	□	□	□	□	□	□	□
PBT/PC - Xenoy	□	□	■	□	□	□	■	■	■	■	■	□	■	□	□	□
PC - polycarbonate	■	□	■	□	□	□	■	■	■	■	■	□	■	■	■	■
PC / ABS	■	□	■	□	□	■	□	■	■	■	■	□	■	■	□	■
PCL - polycaprolactone	■	■	□	□	□	□	□	■	■	■	■	■	■	■	□	■
HDPE / LDPE	□	■	□	□	□	□	□	□	□	□	■	■	□	□	□	□
Polyester	□	□	■	■	□	□	□	■	■	■	■	□	■	□	□	■
PMMA - Acrylic	■	□	□	□	□	□	□	□	■	■	■	□	□	■	□	□
PP - Polypropylene	□	■	■	□	■	□	□	□	■	□	□	■	□	□	■	□
PVC - flexible / rigid	■	□	■	□	□	■	□	□	■	■	■	□	■	□	□	■

Legend

■ ***Weld Compatible***
Substrate Failure Mode

■ **Partial Compatibility,** Can be joined
Application specific requirements need defining

□ ***Generally can be bonded -***
Consult Emabond regarding your requirements



Emabond offers a *no charge* service for evaluation of new materials including combinations not shown above

www.emabond.com

OEM Welding System – Low Cost Entry - Versatile

1 - HF Generator

2 - Pneumatic Press

3 - Control System

4 - Water Cooling

5 - Specific Tooling

Flexible Configuration

- ✓ Power; 600 to 5,000 watts
- ✓ Weld Tooling
  - ✓ 1 – Up welding
  - ✓ Multi – Up welding, 2, 4 ,6 …
  - ✓ Tank rotation
  - ✓ Custom Solutions

Integrated to Meet Specific Requirements

CE

When to Consider the Electromagnetic Process

- ✓ When you require a hermetic seal
- ✓ Joining Dissimilar materials
- ✓ Joining Highly filled materials
- ✓ Bonding flexible to rigid materials (TP Elastomer to PP….)
- ✓ When you currently use adhesives to bond your parts together
- ✓ If you require surface treatment prior to welding or bonding
- ✓ If you are screwing your parts together currently and / or use gaskets
- ✓ Surfaces require non-contact (when tool access side of part is an A-surface)
- ✓ Welding or Bonding multiple bond lines
- ✓ Require superior strength than traditional welding or joining methods provide
- ✓ When you are experiencing high and costly failure from your present process

Advantages of Emabond

- ✓ Eliminates costly Adhesives / Fasteners / O-Rings
- ✓ No need for surface treatment
- ✓ Part is done in seconds, no clamping fixtures or green strength time
- ✓ Less Work in Process
- ✓ Process allows for warped or mismatched parts
- ✓ Provides you the ability to Un-Weld assemblies to harvest components
- ✓ Less Scrap, no need to clean or de-flash parts after welding
- ✓ No Environmental issues
- ✓ Quick change tooling allows capital to be utilized across multiple applications

Lower your direct and indirect overall costs

All of these increase profit margins

Application Examples

License Plate Lamp Bezel's

Application Needs

- High pull force requirement (500N +)
- Clean aesthetic weld lines
- Hermetic seal required

Why Emabond?

- Prior method of sonic welding could not meet pull force required or hermetic seal without thickening of walls
- Design limitations did not allow access for other welding processes
- LH & RH Welded at same time
- Material – TPO to PP

Both Welded @ same time

Die stamped gasket

Overhead Soundbar – Lamp Assembly

Application Needs

- Clean, aesthetic weld lines.
- 11 individual bond lines including 13 feet of perimeter weld.
- Create leak proof chambers for improved sound quality.

Why Emabond?

- Complicated geometry eliminated vibration and cycle time/maintenance of Hot Plate could not meet specifications.
- Adhesive joining is least preferred given multiple joining interfaces and need for high structural loading.
- Emabond offered fast and reliable welding @ lower overall cost
- Material – filled PP
- Provided “Zero” failures

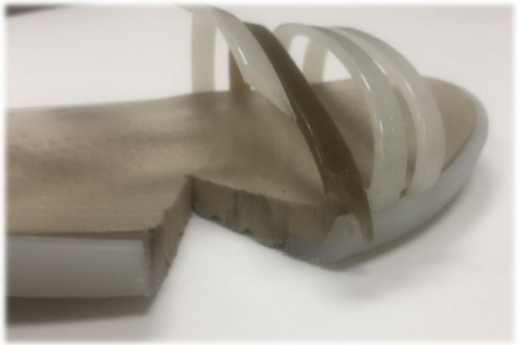
Footwear – Construction & Ornament Attachment

Value Delivery

- ✓ Elimination of Adhesives
- ✓ Environmentally Green Process
- ✓ No surface pretreatment required
- ✓ Clean distortion free attachment
- ✓ Fast, clean, operator friendly process
- ✓ One step attachment process
- ✓ Elimination of WIP, scrap & reduced floorspace requirements
- ✓ Bonding of dissimilar materials

Material: PVC, Foamed PVC, ABS & Polyester

Bondlines: Flat to Flat & 3D Shapes



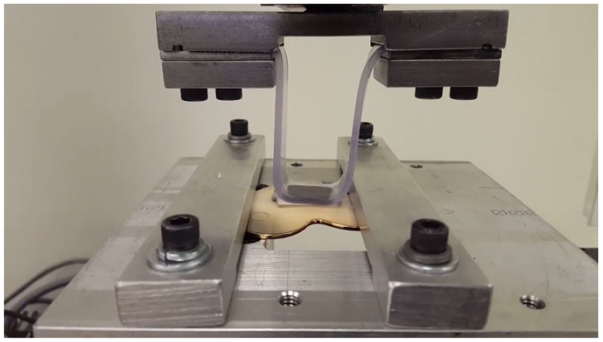
Sole Construction

Ornament Attachment

Footwear – Ornament Attachment

Value Delivery

- ✓ Elimination of Adhesives
- ✓ Environmentally Green Process
- ✓ No surface pretreatment required
- ✓ Fast, clean, operator friendly process
- ✓ One step attachment process
- ✓ Elimination of WIP, scrap & floorspace savings
- ✓ Bonding of dissimilar materials
- ✓ Real Cost Savings $$$
- ✓ Reduced Floorspace



Material: PVC to Foamed PVC or ABS

Bondline: Flat to Flat

Footwear – Sole Construction

3D Printed gasket

Material: PVC, Foamed PVC & ABS

Bond lines: 3D Shapes

Value Delivery

- ✓ Elimination of Adhesives
- ✓ Environmentally Green Process
- ✓ No surface pretreatment required
- ✓ Clean distortion free attachment
- ✓ Fast, clean, operator friendly process
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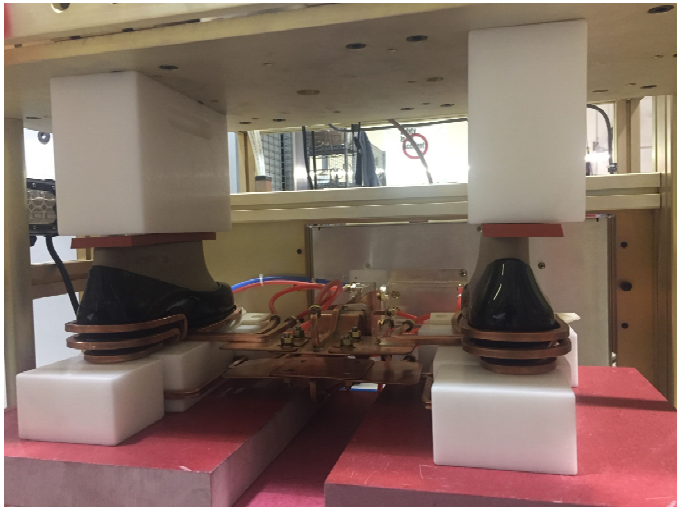


Consumer Electronics Sound Enclosure – *Case Study*

Material: PC/ABS to PC

Bond lines: Flat to Flat with taper

Existing Assembly Method

- ✓ Adhesive – Acrylic
- ✓ + Sealing gasket to ensure airtight
- ✓ + Screws to ensure structural and positioning of critical components

Issues >>> Opportunities to Solve

- ✓ High Direct Costs
- ✓ Environmental – required enclosed conveyors for venting the outgassing
- ✓ Long cure cycle before testing - WIP
- ✓ Excessive Labor
- ✓ Relatively large Floorspace for assembly, curing conveyors & WIP
- ✓ Desire to convert to a new material

Consumer Electronics Sound Enclosure – Emabond

New Assembly Method - Emabond

Benefits > Savings

- ✓ Cycle time reduced from 11 min 45 sec to 40 seconds
- ✓ Eliminated WIP – test immediately
- ✓ Direct Material cost reduced by 74%
- ✓ Joint strength increased by 130%
- ✓ Floor space reduced from approx. 150 sq. ft. to 25 sq. ft.
- ✓ Operator reduction from 2 to 1

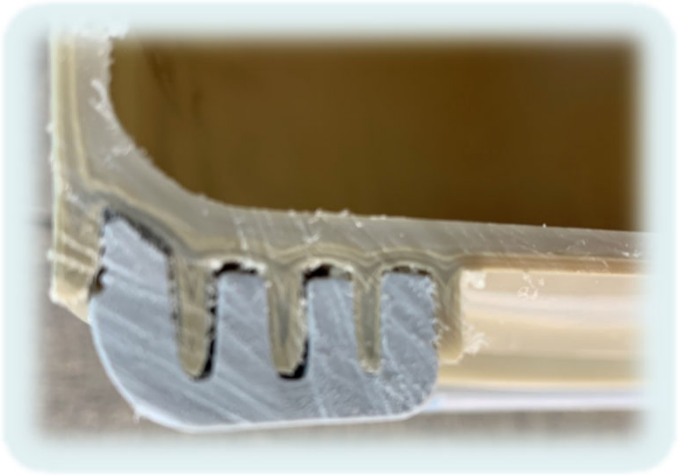
Economic Impact – Fast ROI

- ✓ Capital & Tooling $100,000
- ✓ ROI for above @ Volume = 2 months
- ✓ Significant Ongoing Savings

Material: PP – Cellulose filled to Glass filled PP

Joint: Flat to Flat with taper

YETI LoadOut Bucket Anti-slip Ring



Benefits > Savings

- ✓ Eliminated costly adhesives
- ✓ Eliminated Surface Treatment
- ✓ Cycle time reduced
- ✓ Joint strength exceeds base material
- ✓ Floor space reduced nearly 400%
- ✓ Operator reduction from 3 to 1

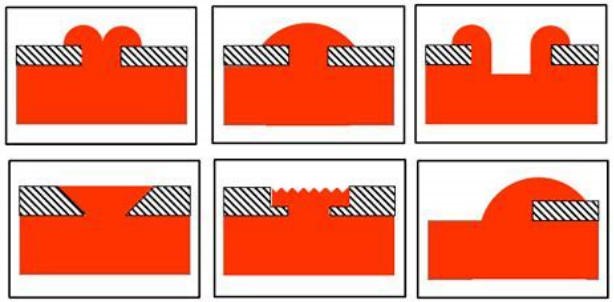
Economic Impact – Fast ROI

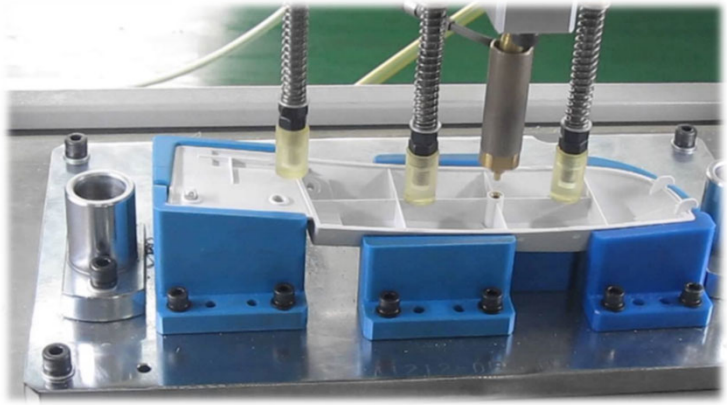
- ✓ ROI @ Volume = < 12 months
- ✓ Significant Ongoing Savings YoY

Material: HDPE to Kraton TPE

Joint: Tongue to Groove

Decorative Emblem Assembly - very new technology



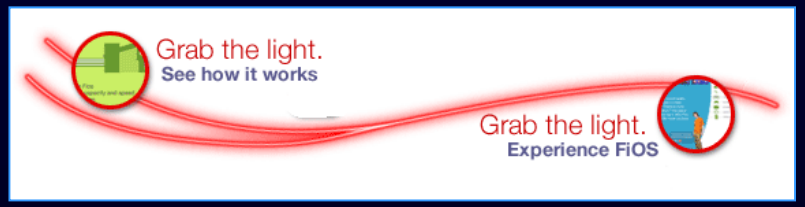


Emabond Polymeric Adhesives

- ✓ Replace Traditional Adhesives
- ✓ Replace Heat Staking
- ✓ No Masking of Chrome
- ✓ Handle Immediately

Many Cost Saving Opportunities

Solutions for Demanding Applications



Summary of Benefits

Material Flexibility

- ✓ Superior Welding of PP and PE plus Engineering Resins
- ✓ Filled Polymers - Glass, Talc, Cellulose or other …
- ✓ Joining of dis-similar materials

Aesthetic Appearance

- ✓ Flash Free Weld Line
- ✓ Smooth distortion free weld-line
- ✓ Eliminate Mechanical Fasteners and Molded-in Sinks
- ✓ Shear Joint Design with Gap Filling Properties
- ✓ No Particulate Generated

Process Capability

- ✓ Precise Heat Delivery @ Joint Line
- ✓ No Surface Pre-treatment required
- ✓ Near Zero Reject Capability
- ✓ Weld Process Controls

Leak Proof

Real $ Saving Opportunities'

High Pressure

Strong Structural Joints

Emabond Solutions – New Headquarters

Quality & Services

Turn-key Capabilities

- ✓ Application Engineering
- ✓ Prototype welding service
- ✓ New Product Development
- ✓ Production Welding Equipment and Application Tooling
- ✓ Emabond Resin Manufacturing
- ✓ Job Lot Assembly
- ✓ Injection Molding of customer parts

Certifications

IATF16949-2016

ISO9001-2015

Wrap-up

Plastics have revolutionized the way parts are made …

Consider the Emabond Process as an option for your next

Design for Assembly challenge

Open Discussion – Questions ???

THANK YOU

Emabond™

Your Welding Solutions Team!

Visit us at:
www.emabond.com

decorating & assembly .....DIVISION.....