



ASHLAND®

Aplicações “Classe A”

Processos RTM, BMC e SMC

06 de novembro de 2012

A Ashland e Ashland Polímeros do Brasil

ASHLAND.



**Commercial
Units**

**Ashland
Specialty
Ingredients**

**Ashland
Water
Technologies**

**Ashland
Performance
Materials**

**Ashland
Consumer
Markets**

**Leading
Products &
Services**

#1
cellulose ethers,
global leader in vinyl
pyrrolidones

#1
specialty
papermaking
chemicals

#1
unsaturated
polyester resins
and vinyl ester
resins

#2
U.S. franchised
quick-lube chain,
Passenger-car
motor oil

Sales¹

\$2.7 billion

\$1.9 billion

\$1.7 billion

\$2.0 billion

¹ (Pro Forma) for 12 Months Ended Mar. 31, 2012

Ashland Performance Materials

Compósitos



Leveza



Alta resistência



Durabilidade

Elastômeros



Pressure Sensitive

Adesivos



Resistencia



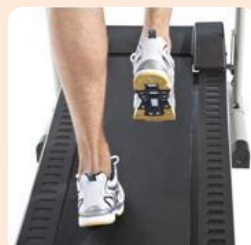
Durabilidade



Resistencia a Corrosão



Durabilidade



Resist. ao desgaste



Adesão

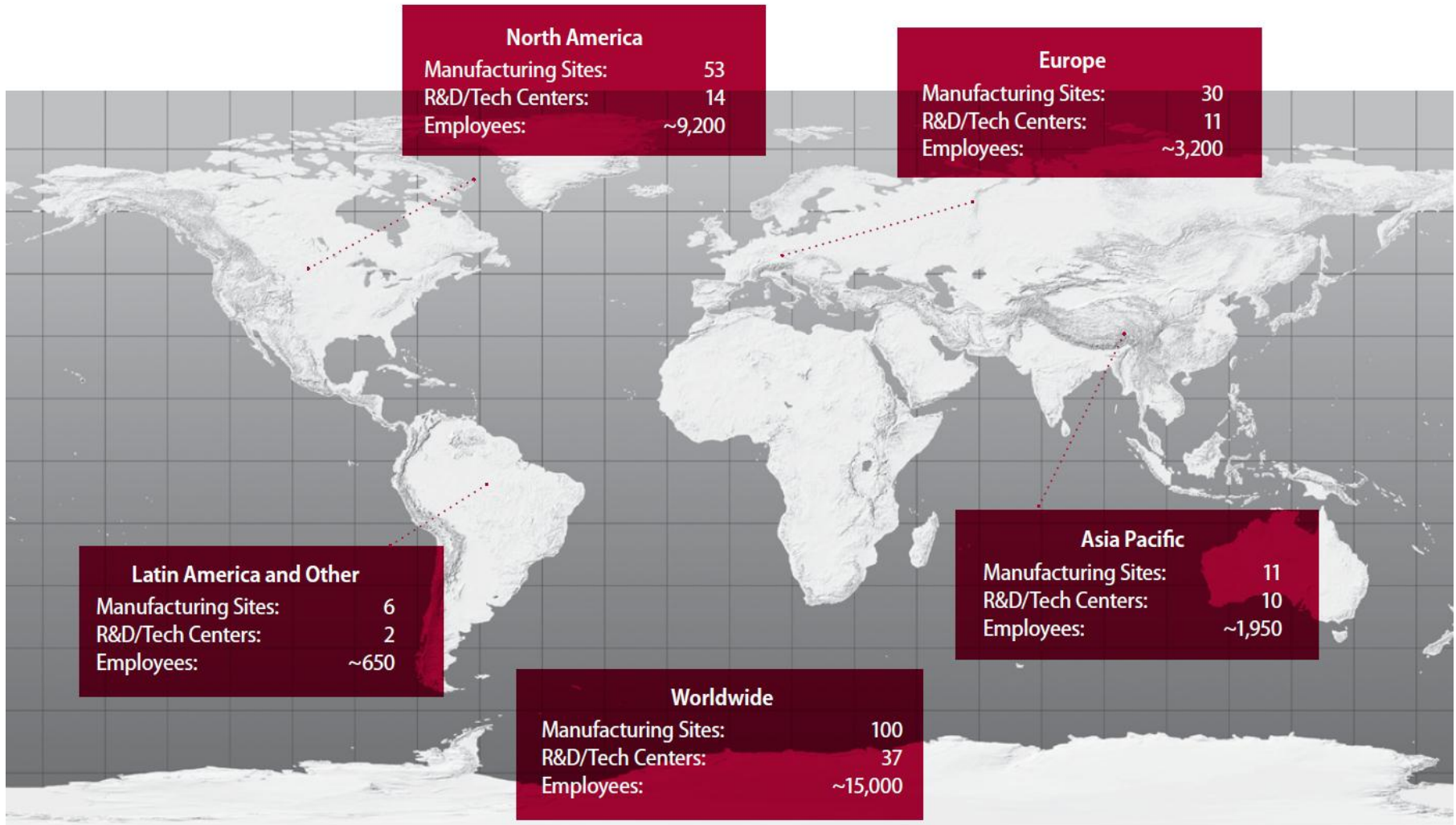


Alimentação



Transporte de massa

Nossa Presença Global



Tópicos

- Superfície Classe A
- ALSA (Advanced Laser Surface Analyser)
- ALSA Index
- “Casca de Laranja”
- DOI (Distinctness of Image)
- Soluções e Exemplos de Aplicação

Tópicos

- **Superfície Classe A**
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- Soluções e Exemplos de Aplicação

Mercado Automotivo

- Primeira impressão é que faz a diferença na compra
- Necessidade de conferir objetividade na inspeção da qualidade superficial
- Não há padrão global. Cada montadora define seu padrão
- Observação visual
- Equipamentos que auxiliam a inspeção

ALSA – Advanced Laser Surface Analyser

- ALSA Index
- Orange Peel – Casca de Laranja
- DOI – Distinctness of Image

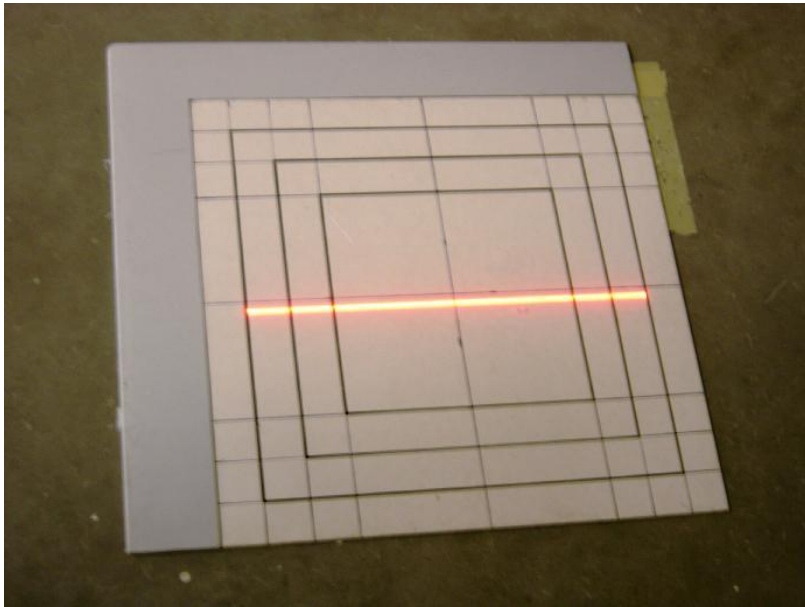
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ALSA – Advanced Laser Surface Analyser



ALSA – Advanced Laser Surface Analyser



Dados do ALSA

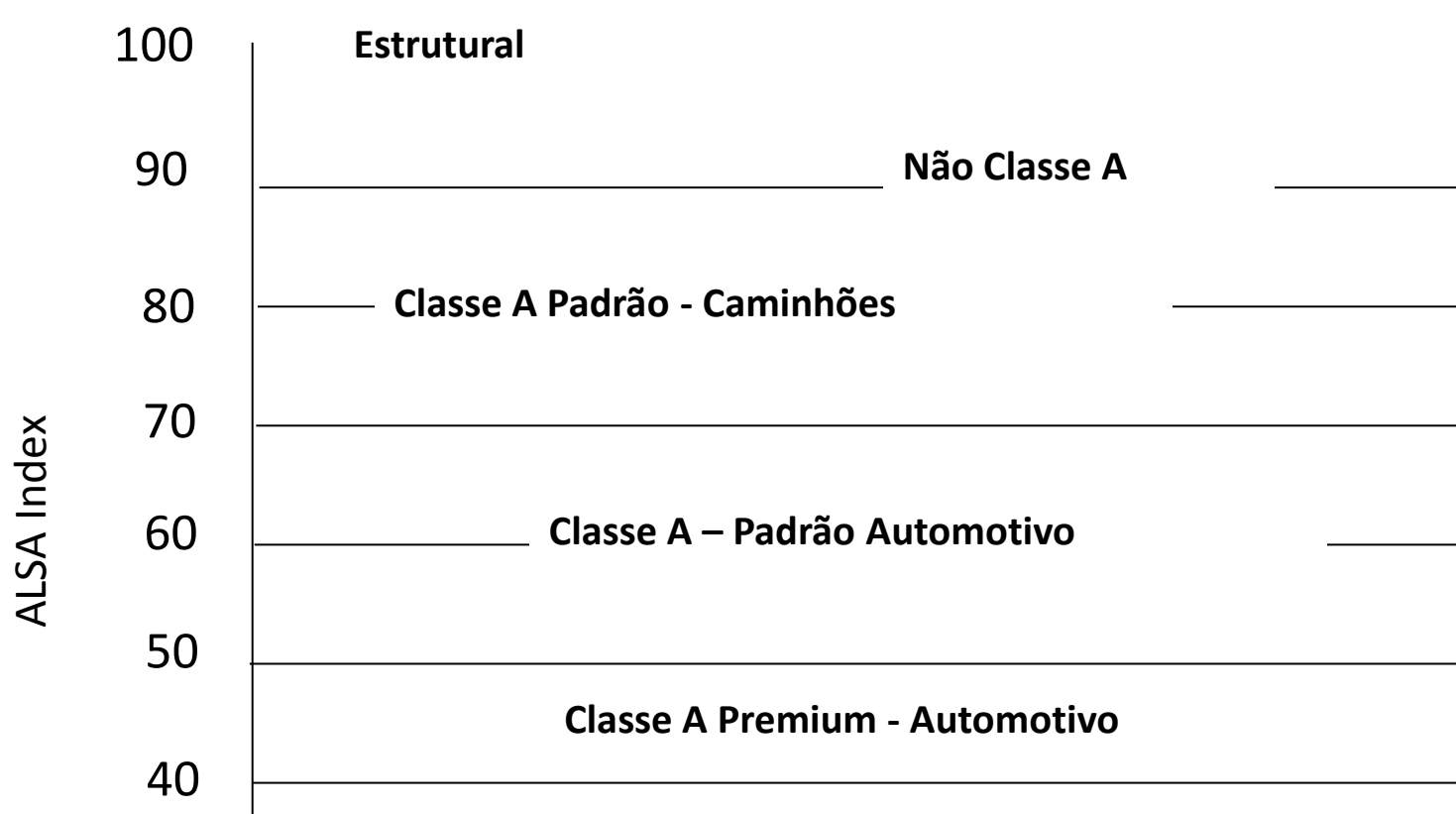
The screenshot displays the 'Main Screen' of the ALSA software. The interface is organized into several functional areas:

- Control Panels:** Located at the top left, these include 'ALSA Model' (Floor, Table), 'Part Type' (Flat, Curved), 'Recall and View Summary Data', 'Print Results' (Auto, Manual), 'Threshold' (Auto, Manual) set to 120, 'Save Summary Sheet and Clear', and 'Maximum Light Line' with a 'Clear' button.
- Live Video:** A window on the top right showing a dark field with a bright central spot.
- Scan Results:** A large black area on the bottom left filled with numerous horizontal, multi-colored lines representing scan data.
- Navigation and Action Buttons:** A vertical column of buttons on the bottom right includes 'Scan Part', 'Line On', 'Average the Part Data' (with a note 'No. of Panels to Average = 1'), 'View Current Summary Data' (with a note 'Lines Left on the Summary Sheet = 39'), 'View the Raw Line Data', 'Print Results', 'Print Graph', and 'Laser Set-Up' (with a note 'Line Width is 10").
- Scan Summary:** A panel on the far right bottom containing the following data:
 - Date/Time: 4/27/2006 8:14:53 AM
 - Part ID
 - Target Panel
 - ALSA Index: 71.1
 - Orange Peel: 7.5
 - DOI: 83.2
 - Exit button

Tópicos

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ALSA INDEX



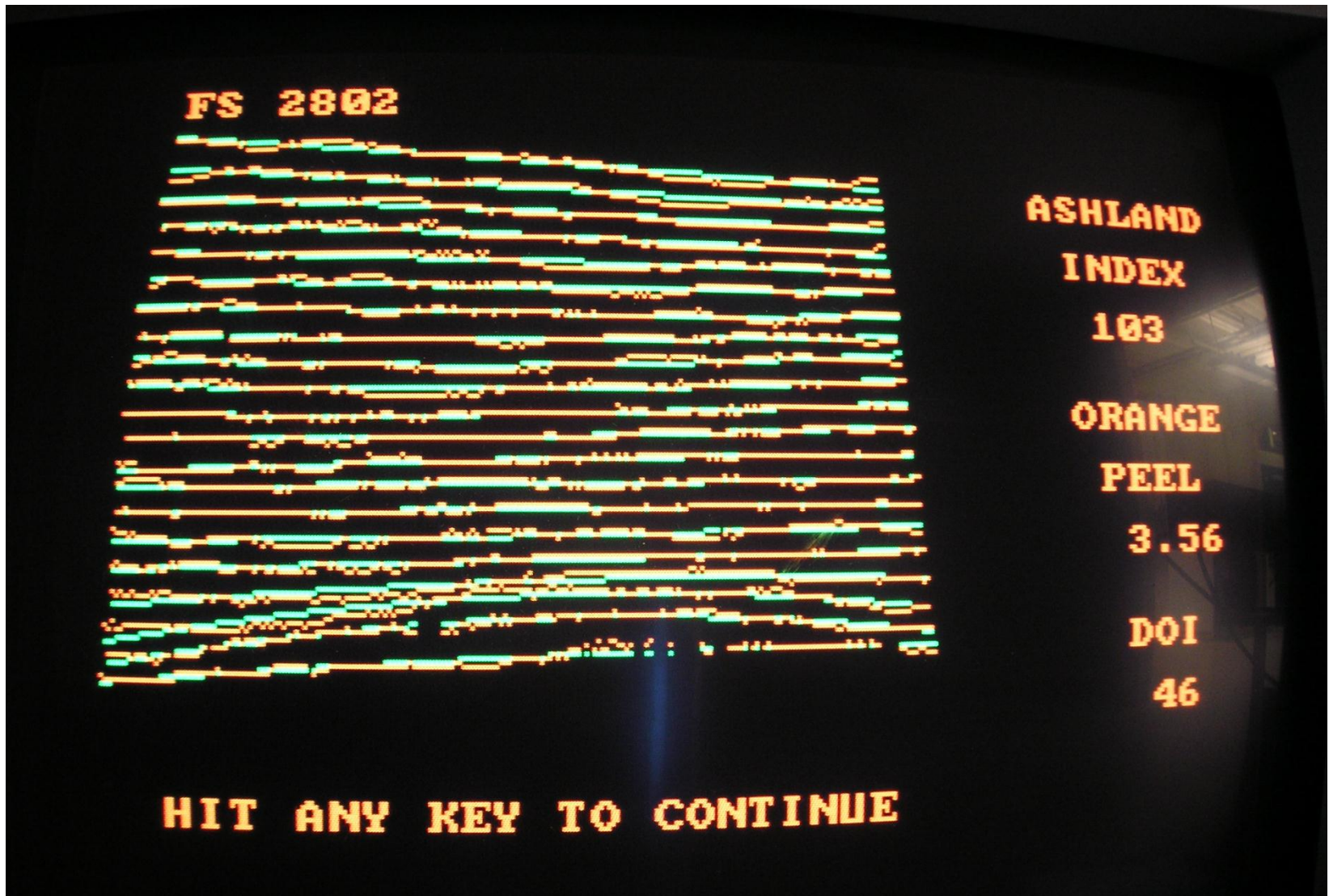
ALSA = Advanced Laser Surface Analyzer

- ALSA Index – Equivalente a escala LORIA®
- É considerado Classe "A" valores menores que 85

SMC Classe A



SMC Estrutural

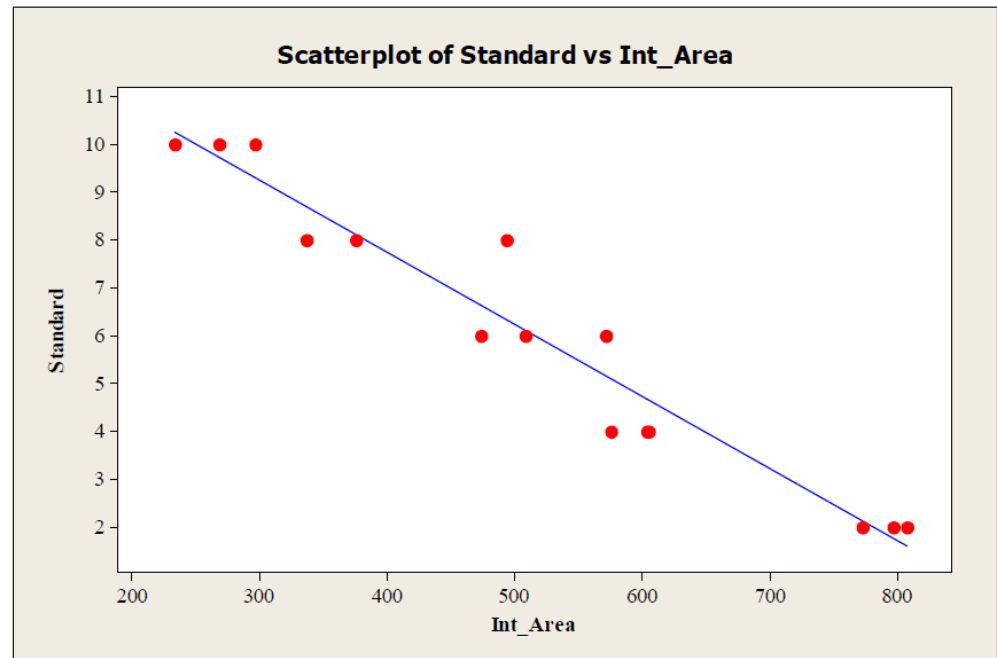


Tópicos

- Superfície Classe A
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- DOI (Distinctness of Image)
- Soluções e Exemplos de Aplicação

Orange Peel – Casca de Laranja

- Padrão Du Pont
- Valores de 1 a 10
- Painéis de baixo brilho podem causar leitura falsa



Tópicos

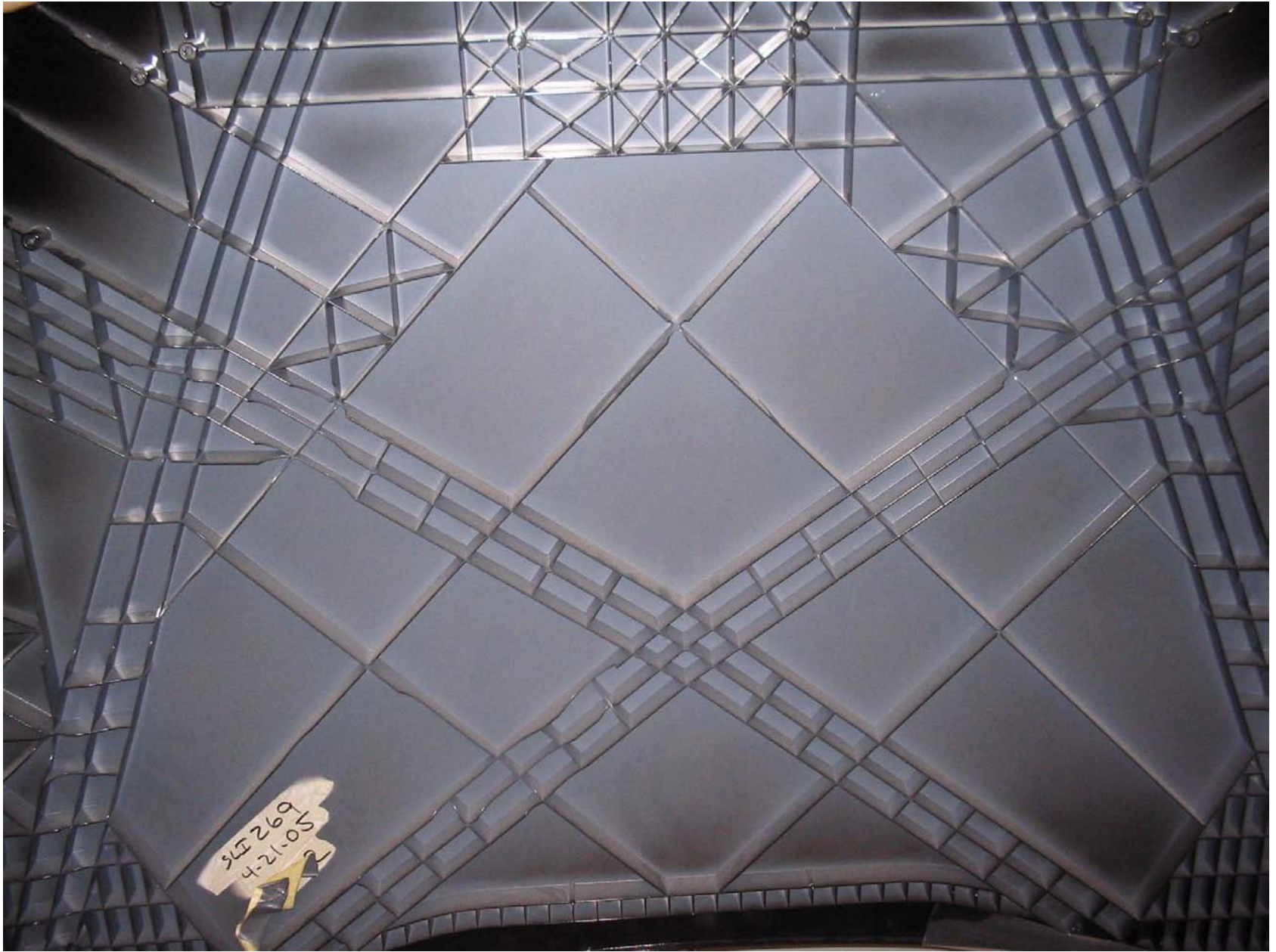
- Superfície Classe A
- ALSA (Advanced Laser Surface Analyser)
- ALSA Index
- “Casca de Laranja”
- **DOI (Distinctness of Image)**
- Soluções e Exemplos de Aplicação

DOI - “Distinctness of Image”

- Define a clareza da reflexão de uma imagem no painel (placa)
- Número de 1 a 100
- 100: espelho

Classe A





90-12-4
4-21-05

Tópicos

- Superfície Classe A
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- DOI (Distinctness of Image)
- **Soluções e Exemplos de Aplicação**

Soluções para RTM (Resin Transfer Material)

- Recursos Renováveis (ENVIREZ Q 11500 INF)
- Baixa Contração (AROTRAN BR 6500)
- Classe A Premium (AROPOL NLN 71500 INF)



Soluções para BMC e SMC

(Bulk Molding Compound e Sheet Molding Compound)

- Sistemas

- PHASE EPSILON 50411

- AROTRAN 700/755

EXEMPLO DE APLICAÇÃO



- General Motors
- Modelo: Corvette
- Aplicação: Várias
- Tecnologia SMC
- Material:
 - AROTRAN® Phase Epsilon
- Peso das peças: acima de 9 kg cada



EXEMPLO DE APLICAÇÃO



- DaimlerChrysler
- Modelo: Dodge Viper
- Aplicação: Várias
- Tecnologia: SMC
- Material:
 - AROTRAN® Phase Epsilon (capô)
- Peso da peça: 21 kg.



EXEMPLO DE APLICAÇÃO



- General Motors
- Modelo: XLR
- Aplicação: Portas, Capô
- Tecnologia: SMC
- Material:
 - AROTRAN® Phase Epsilon
- Peso das peças: Acima de 9 kg (várias)



EXEMPLO DE APLICAÇÃO



- General Motors
- Modelo: Hummer H2
- Aplicação: Hood
- Tecnologia: SMC
- Material:
 - AROTRAN® Phase Epsilon
- Peso da peça: 17 kg.



Caso Histórico

Fabricante de Resinas

ASHLAND

Frotista



Fornecedor do Capô



Fabricante do caminhão

TLM SMC – Montagem do Capô



TLM SMC – Desempenho de adesão



Veículo da Frota



Soluções para BMC e SMC

(Bulk Molding Compound e Sheet Molding Compound)

Resinas base

- ENVIREZ 10411
- AROPOL MR 13031
- AROPOL Q 6585
- ARAZYN 17.0

Aditivos “low profile”

- LP 4016
- Q 701
- NEULON T Plus
- NEULON 520
- NEULON 2431

B-side

- AROTRAN 201
- AROTRAN 286 e 285
- AROTRAN 269
- AROTRAN 225

EXEMPLO DE APLICAÇÃO

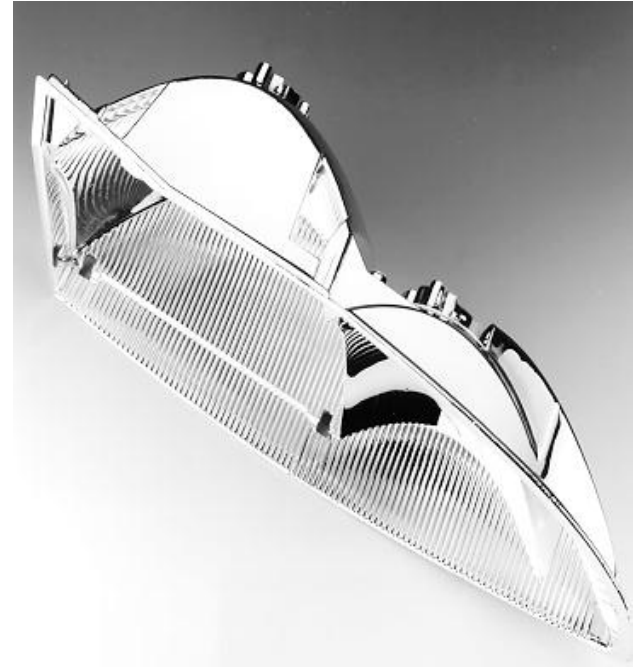


- John Deere
- Modelo: 9650 Combine
- Aplicação: Cobertura do Motor
- Volume: 3,500 pç/mes
- Tecnologia: SMC
- Material:
 - ENVIREZ® sistema de resinas a base de recursos renováveis
- Peso da peça: 16 kg.

EXEMPLOS DE APLICAÇÃO



EXEMPLOS DE APLICAÇÃO



EXEMPLO DE APLICAÇÃO

Lincoln Aviator “aka” U231



EXEMPLO DE APLICAÇÃO

Ford Ranger “Edge”



EXEMPLO DE APLICAÇÃO

Ford Excursion “Tri-Door”



EXEMPLO DE APLICAÇÃO

Ford F-150 Step Side



EXEMPLO DE APLICAÇÃO

Ford Thunderbird



EXEMPLO DE APLICAÇÃO

Ford Thunderbird - Roof and Chimsel



EXEMPLO DE APLICAÇÃO

Chevrolet C6 Corvette



EXEMPLO DE APLICAÇÃO

GM Step Assist



EXEMPLO DE APLICAÇÃO

Chevy Avalanche



EXEMPLO DE APLICAÇÃO

Chevy Camaro Spoiler



EXEMPLO DE APLICAÇÃO

Hummer H2



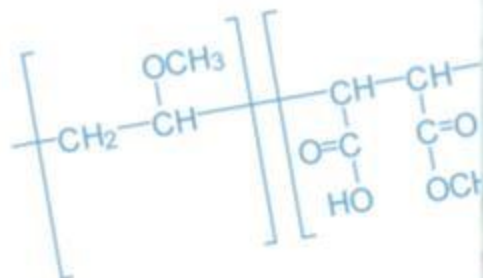
EXEMPLO DE APLICAÇÃO

International NGV



Como a Boa Química Trabalha

Suas idéias.



Inovação com significado.

Nossas idéias.



ASHLAND®

Pliogrip™ Structural Adhesives for Bonding Composites


November 5, 2012

Michael J. Barker

Research Fellow

Ashland Performance Materials

Contents

- **Ashland's Strength Bonding Composites**
 - **Adhesive Technology Definitions**
 - **Structural Adhesives**
 - Adhesive Types
 - Selection Considerations
 - Technology
 - **Case Studies**
- 

Ashland Performance Materials

- **Resins**

- Unsaturated Polyester Resins
- Epoxy Vinyl Ester Resins
- SMC / BMC Resins
- RTM Resins
- Low Profile Additives
- Fire-retardant resins
- Gelcoats

- **Pliogrip Structural Adhesives**

- 2-K Polyurethanes
- 2-K Epoxy
- 2-K Acrylics
- Aftermarket products

- **Market Share**

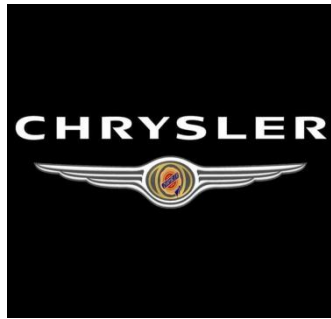
- 80-90 % SMC Truck Hood Bonding
- 50-60% Automotive and Heavy Truck Bonding

Comprehensive Knowledge of Composites & Adhesives



Pliogrip Structural Adhesives

- 45 years of experience bonding in some of the most demanding applications
- Trusted and chosen by dozens of leading OEMs for bonding of composite parts




A **PACCAR** COMPANY



A **PACCAR** COMPANY

and many others...

A close-up photograph of a hand using a syringe to apply adhesive to a car wheel hub. The hand is positioned on the left, holding the syringe and applying the adhesive to the hub area of a silver alloy wheel. The wheel is on the right side of the image. The background is a blurred view of the car's body panels, showing a mix of red and silver colors. The text "Structural Adhesive Definitions" is overlaid on the left side of the image.

Structural Adhesive Definitions

Definitions

- An **adhesive** is a non-metallic substance that is able to bond the substrates by adhesion (surface forces) and cohesion (internal strength)
- **Structural adhesives** represent a class of chemical bonding agents where the strength of the adhesive is greater than the strength of the substrates that are bonded together
 - The bonded structure must perform under a variety of extreme environmental conditions and load



Definitions

2-Part Adhesive	Reactive components are kept separate until ready for use
Pot Life	Time after mixing the two parts in which an adhesive must be applied
Open Time	Timeframe after adhesive application to achieve good wetting of the second part
Green Strength	Time required for the adhesive to achieve green strength allowing further handling of the bonded part (varies with temperature and chemistry) typically 0,35- 0,7 MPa
Cure Time	Time required for the adhesive to reach its ultimate strength (varies with temperature, chemistry and substrate)

A blue semi-truck with a white trailer is driving on a road. The truck is the central focus of the image, moving towards the viewer. The background shows a hilly landscape with green grass and trees. The text "Advantages of Adhesive Bonding" is overlaid on the truck's hood and windshield area.

Advantages of Adhesive Bonding

Advantages of Bonding

- Surface distortion minimized, (no rivet or welding marks)
- Stress is distributed uniformly over bond-area
- Strong, age, fatigue and crash-resistant bonds
- Excellent chemical resistance
- Proven technology
- Increased productivity
- Suitable for bonding a variety of materials
- Enables bonding of dissimilar materials

What Can Pliogrip Bond?

Compatible Substrates:

- Polyester & Vinyl Ester Composites (“fiberglass”)
 - RTM (resin transfer molding)
 - Open Mold
 - HLU (hand lay up)
 - HSU (hand spray up)
 - Infusion
 - SMC (sheet molding compound)
 - FRP (fiber reinforced plastic)
 - Pultrusion
- Thermoplastics
 - ABS, Nylon, TPO, LGFPP
- Carbon Fiber Reinforced Plastic (CFRP)
 - Usually “prepreg” in epoxy resin
- E-coated Steel, E-coated Aluminum
- Cold Rolled Steel, (CRS) and Aluminum
- Primed Glass



Application Areas for Structural Adhesives

- Automotive, Truck, Bus
- Farm Equipment
- Heating, Ventilation and Cooling
- Marine
- Construction
- Military Equipment
- Off-Road Vehicles
- Recreational Vehicles
- Sporting Goods
- Automotive Repair
- Maintenance Shops
- General Assembly
- Aftermarket Parts



A large semi-truck is shown driving on a road, viewed from a low angle. The truck is dark-colored with a prominent chrome grille and headlights. The text "Adhesive Technology" is overlaid in the center of the image in a bold, black, sans-serif font. The background is a bright, hazy sky, and the road surface is visible in the foreground.

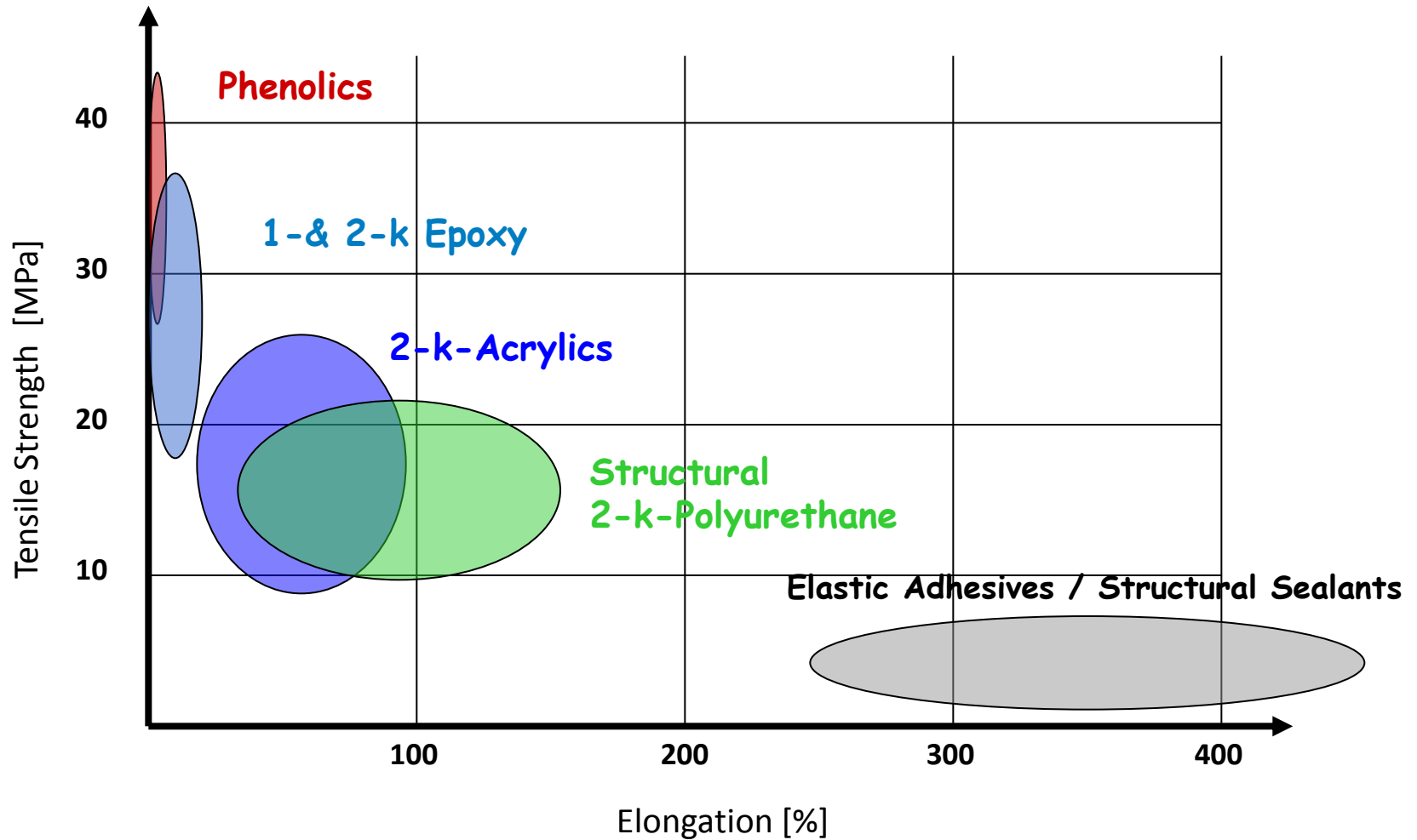
Adhesive Technology

Three Different Chemistries



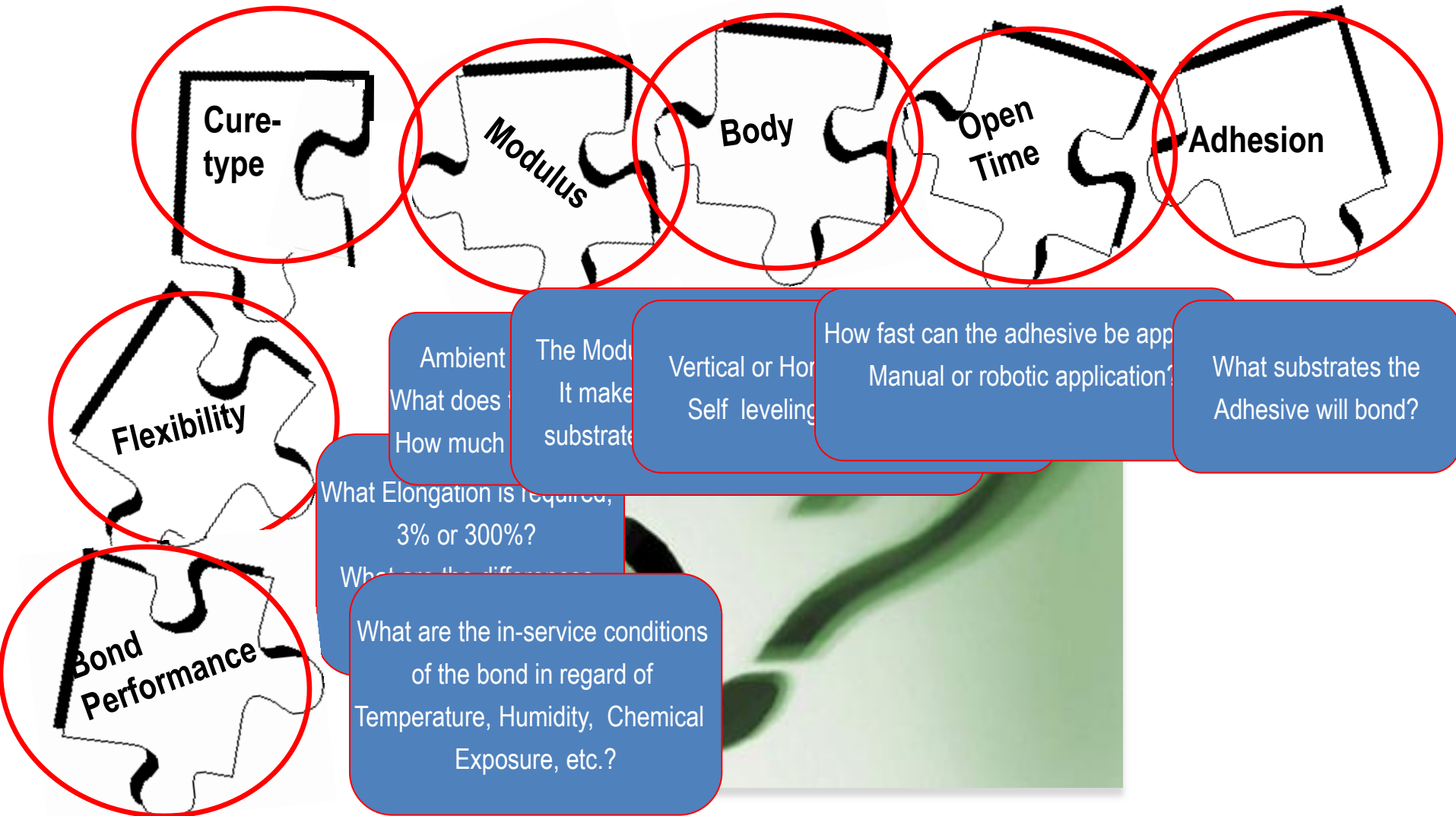
Acrylic Polyurethane Epoxy

Adhesive Type Vs. Bulk Mechanical Properties



PLIOGRIP® Structural Adhesives

Adhesive Selection



Pliogrip Technologies “When to Use”

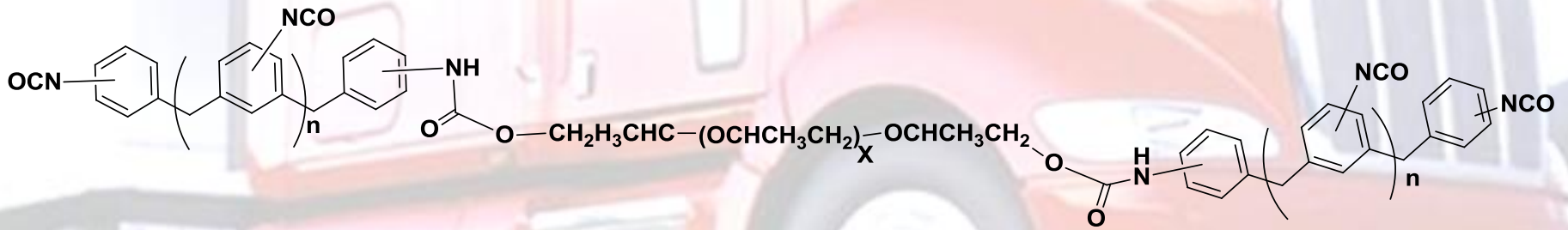
Adhesive Technology	Features	Benefits
Polyurethane	<ul style="list-style-type: none"> • RT or heat cure response • Quick green strength • Excellent SMC and primed metal adhesion • Gravity Feed • Paintable 	<ul style="list-style-type: none"> • Minimize cycle time • Custom formulations • OEM approved • Lower cost equipment
Epoxy	<ul style="list-style-type: none"> • Temperature resistance • $\geq 149^{\circ}\text{C}$ • Hot strength $\geq 121^{\circ}\text{C}$ • Long open time • Bare metal bonding • Paintable 	<ul style="list-style-type: none"> • High temperature paint bake • High temperature applications • Large part assembly • Multiple substrates
Acrylic	<ul style="list-style-type: none"> • Excellent adhesion to FRP • No surface prep on metal • Good with many plastics • Good room temperature cure • No post bake required • Long open time 	<ul style="list-style-type: none"> • Eliminates heated fixtures • Eliminates oven cost • Reduced up-front investment • Good sag resistance

Pliogrip Products Have Passed the Following OEM Specifications

- Caterpillar
- Chrysler MS-CC631
- Ford ESB M11P27-A
- Ford WSB M11P27-B
- Freightliner 49-00093
- GM 3629M67
- GM 3652M
- GM 6449G
- Honda Specification
- International TMS-6900
- Mack Truck 5GT53
- Paccar CMT0038
- Volvo 800
- BMW



Polyurethanes



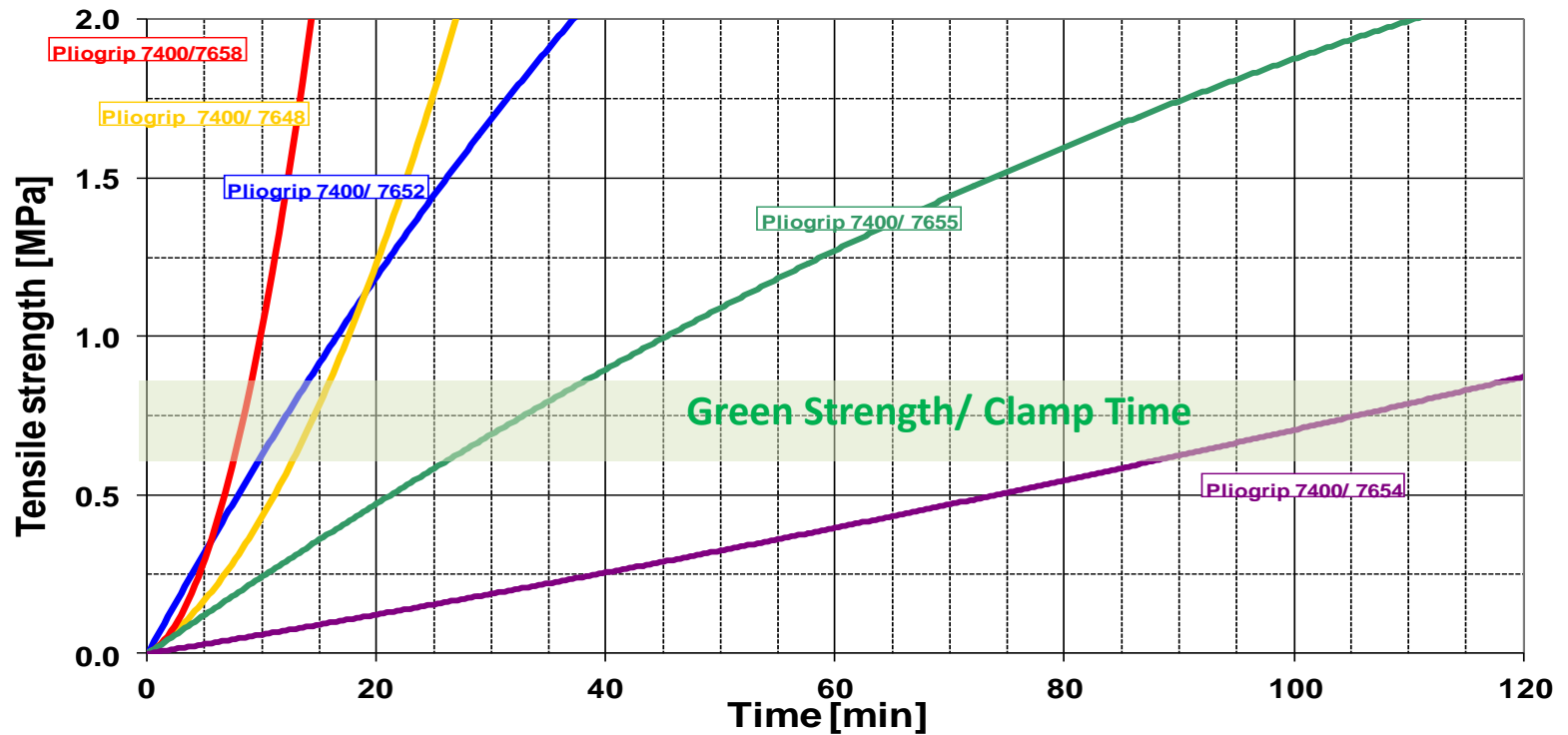
Pliogrip™ 7400 Polyurethane

- Room temperature cure system
- May be heat accelerated
- Meter-mix dispense or cartridges
- Bonds composite & primed metals
- Requires Primer/ Surface Prep or Post Bake
- Sandable to a smooth finish
- Popular as repair material
- Self-leveling versions
- 1:1 volume
- Open times from 1.5min to 35min

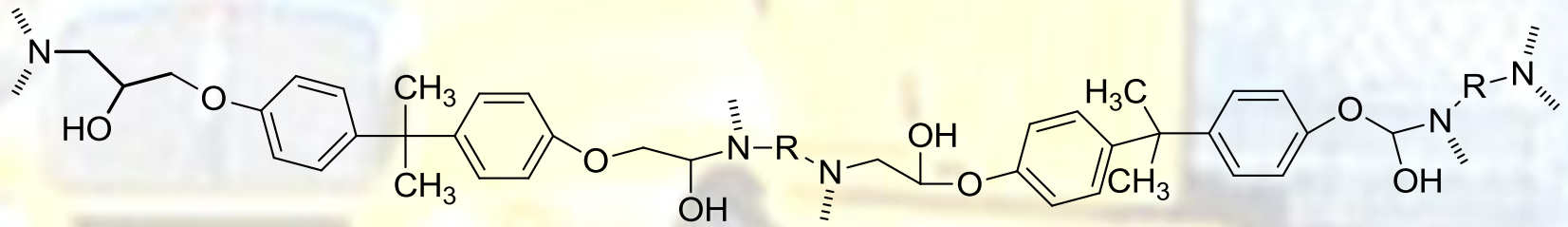
curative	open time @ 23C	color	body level	clamp time	sand time
7651	1.5 min	green	non-sag	5 min	10 min
7652	3.5 min	green	non-sag	10 min	30 min
7648B	5 min	black	non-sag	20 min	60 min
7653	5 min	green	self-leveling	20 min	50 min
7655	7 min	green	non-sag	20 min	70 min
7654	35 min	green	non-sag	90 min	2.5 hrs

Pliogrip™ 7400 Polyurethane Cure Response at 22C

Vary Curative



Epoxies



PLIOGRIP® 5500 Series

Epoxy Structural Adhesives

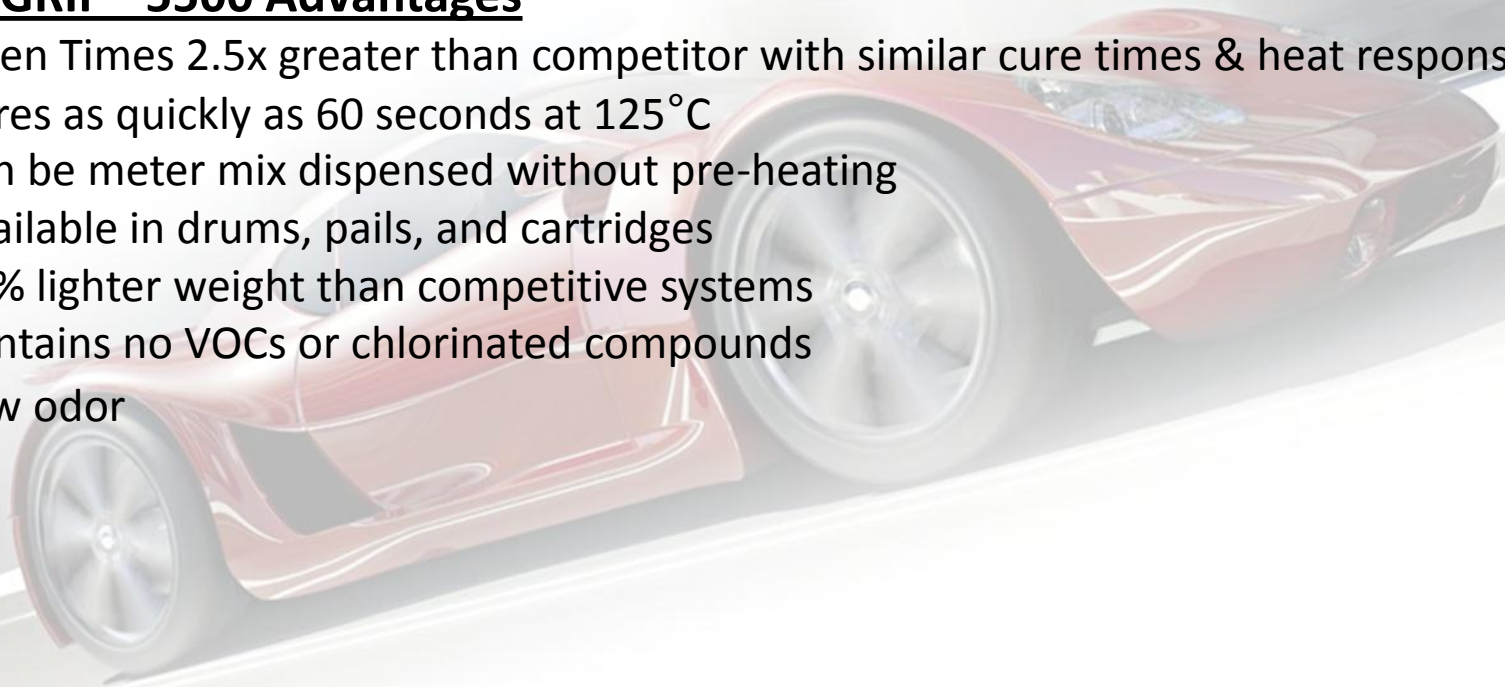
Formulated for bonding SMC, composites, and metals

Compatible with Ashland's AROTRAN® resins

Withstands automotive e-coat, powder prime, and paint oven temperatures

PLIOGRIP® 5500 Advantages

- Open Times 2.5x greater than competitor with similar cure times & heat response
- Cures as quickly as 60 seconds at 125°C
- Can be meter mix dispensed without pre-heating
- Available in drums, pails, and cartridges
- 10% lighter weight than competitive systems
- Contains no VOCs or chlorinated compounds
- Low odor

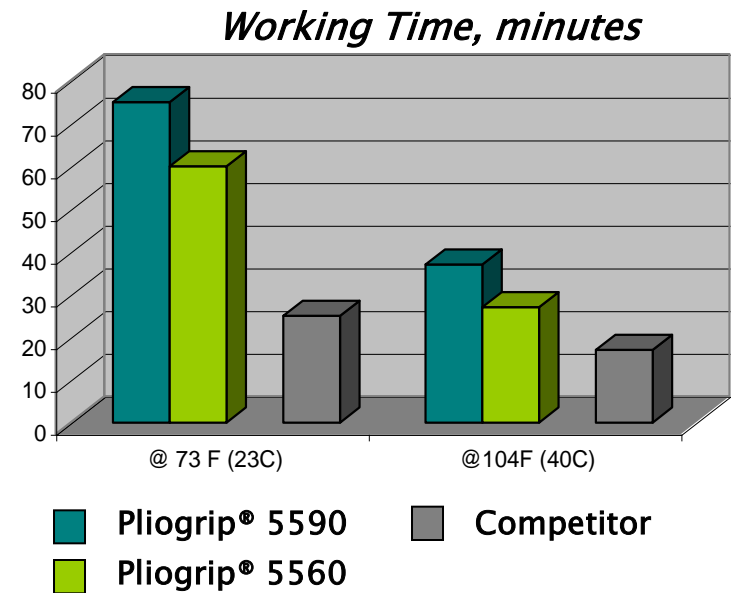


PLIOGRIP® 5500 Series

Epoxy Structural Adhesives

Typical Properties

	PLIOGRIP® 5590	PLIOGRIP® 5560	Competitor
Time to 0,3 MPa @ 18 C, hours	3.5	2.5	3.0
Time to 0,7 MPa @ 126 C) min	1.5	1.0	1.5
Specific Gravity, mixed	1.36	1.31	1.51
Tensile strength, MPa	42	39	42
Young's Modulus, MPa	3325	2730	5290
Elongation at Break, %	3.7	8.0	1.2
Odor	slight	slight	strong
Chlorinated Compounds	no	no	yes



Improved Productivity With Addition of Heat

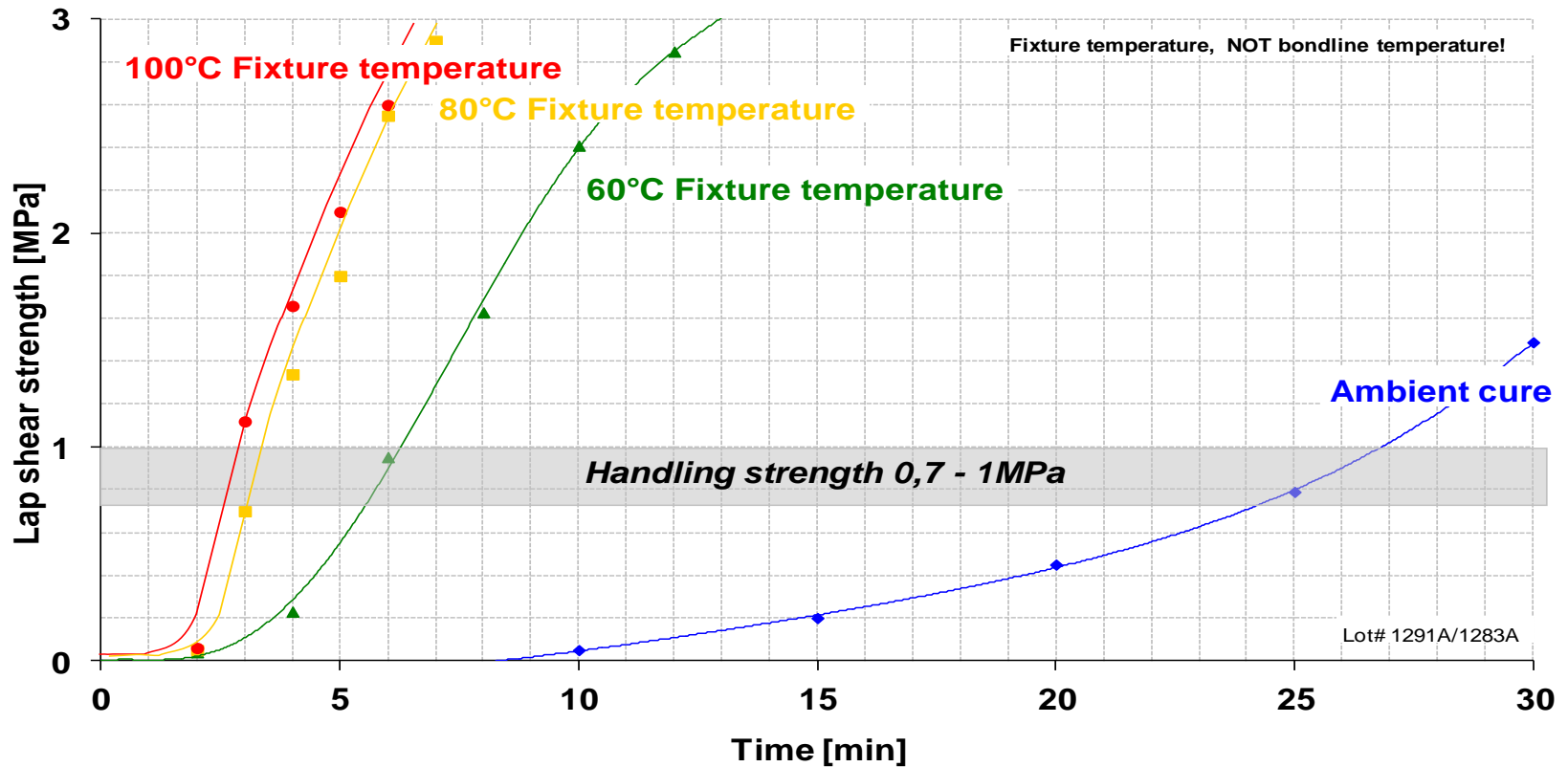
Technologies for Applying Heat to the Bond Line

- **Conductive Heating:** Heating Plates Contacting Parts to be Bonded
- **Infra Red, (IR)** Heating of the Parts by IR-Lamps - Radiant Panel Heating
- **RF-Heating:** RF Causes Dipoles in the Adhesive to Create Internal Heat
- **Induction Heating:** Magnetic Field Causes Metal (in the Adhesive or as one of the Substrates to Heat)
- **Hot Air Impingement:** Hot Air Directed at Bond Line

Time to Green Strength Enhanced by Adding Heat

- High Volume Production
- Various heating Techniques available
- Low shrinkage

PLIOGRIP® Two-part Polyurethane General Cure Response with Heat



Case Studies



Heavy Duty Truck Application Example

Class 8 SMC Hoods North America



- Class 8 Heavy Trucks in North America (>15,000 kg) primarily employ multi-piece hoods produced from polyester sheet molding compound (SMC)
- Hoods are produced by tier 1 suppliers specializing in high-volume SMC production
- Pliogrip holds 80% market share in SMC bonding of CL8 truck hoods in North America
- **Pliogrip 9100 urethane** adhesive is most popular product
 - Achieves 2 minute fixture cycle time with 120°C bond line temperature
 - No scuffing or primer is required while still meeting demanding OEM specifications
- Use of specialized heated fixtures with PG9100 can facilitate annual SMC production volumes of 75,000+ pieces per year

Light Vehicle Application Example

SMC Body Panels and Closures



Pontiac Solstice



Saturn Sky

**Quarter Panel, Fender , Door Ring, Rear Surround, Rear Tub
Bonded with Pliogrip 7400 Urethane**

Light Truck Application Example

SMC Pickup Truck Box

Ford Explorer SportTrac – Pliogrip 7400

- Multi-Piece Pickup Box consists of:
 - Floor Panel & Bins
 - Box Inners, RH & LH
 - Head Board
- Body Sides right hand & left hand
- Tonneau Cover two piece, articulated
- Grille Opening Reinf.



Polyurethane – Application Example



Application Pallets
Used to Position Parts
in Robot Cell

ASHLAND®

With good chemistry great things happen.™

Pliogrip® Technology Selector Guide

General Performance Category	Attribute	Epoxy	Acrylic	Urethane
Temperature	Temperature Resistance 300°F	***	0	*
	Hot Strength 250°F	***	*	*
	RT Cure Response	*	***	**
	Heated Cure Response	**	0	***
Typical Product Characteristics	Open Time (Long)	***	***	**
	Production Friendly	**	*	***
	Sag Resistance	***	***	***
	Durability	***	**	**
	Chemical Resistance	***	**	**
	Resistance to Changes to Ambient Conditions	***	**	**
	Ease of Deroping	**	**	***
	Large Bead Size	**	***	**
	Shelf Life	***	*	***
	Mix Ratio Tolerance	***	***	*
	Non-flammable	***	0	***
	Elongation	0	***	***
	Relative Strength	***	**	**
	Economics of Use	**	**	***
Substrate Adhesion	Contaminated Surface Adhesion	**	***	**
	Bare Metal Adhesion	**	***	0
	Coated Metal Adhesion	***	**	***
	Bare Aluminum	**	***	**
	SMC Adhesion	**	*	***
	Spray-up / Lay-up	**	***	*
	Nylon	0	*	***
	TPO (Treated)	**	*	***
Gel Coat	**	***	*	

