

Every Gramme Counts

Light weight solutions by 3M



Edwin Eve CEng MIET MIMechE

Technical Manager, 3M Automotive Division

3M UK Ireland

Mobile: +44 7826 908050

eeve@mmm.com



About 3M

Sales Year-end 2015

Worldwide	\$30.274 billion
International	\$18.225 billion (60% of company's total)

Employees

Worldwide	89,446
United States	35,973
International	53,473

Operations

70 countries around the world
Product sales in 200 countries

Products

More than 55,000, one-third of sales from products created within the past five years

R&D and related expenditures

For 2015	\$1.763 billion
Total for past five years	\$7.482 billion



Technology



Global capabilities



Manufacturing

3M Science.
Applied to Life.™

Automotive Division

Paint



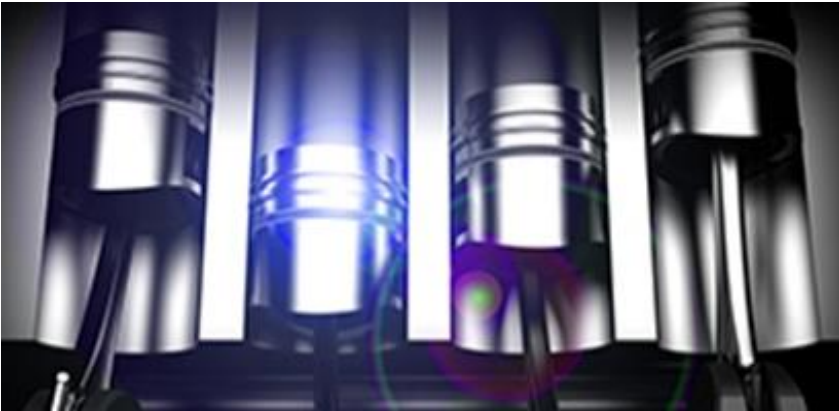
Exterior



Chassis



Powertrain



Interior

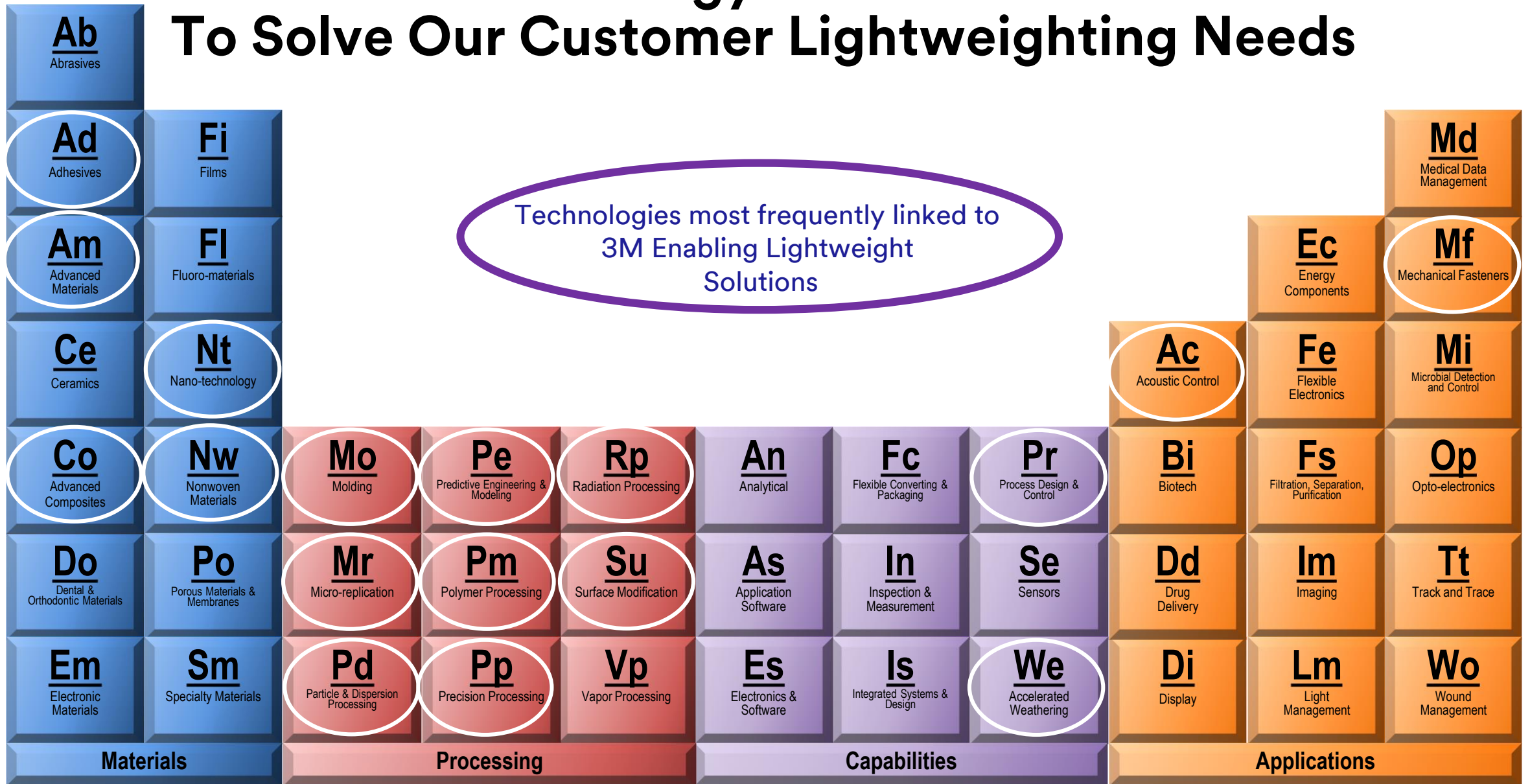


Body-In-White



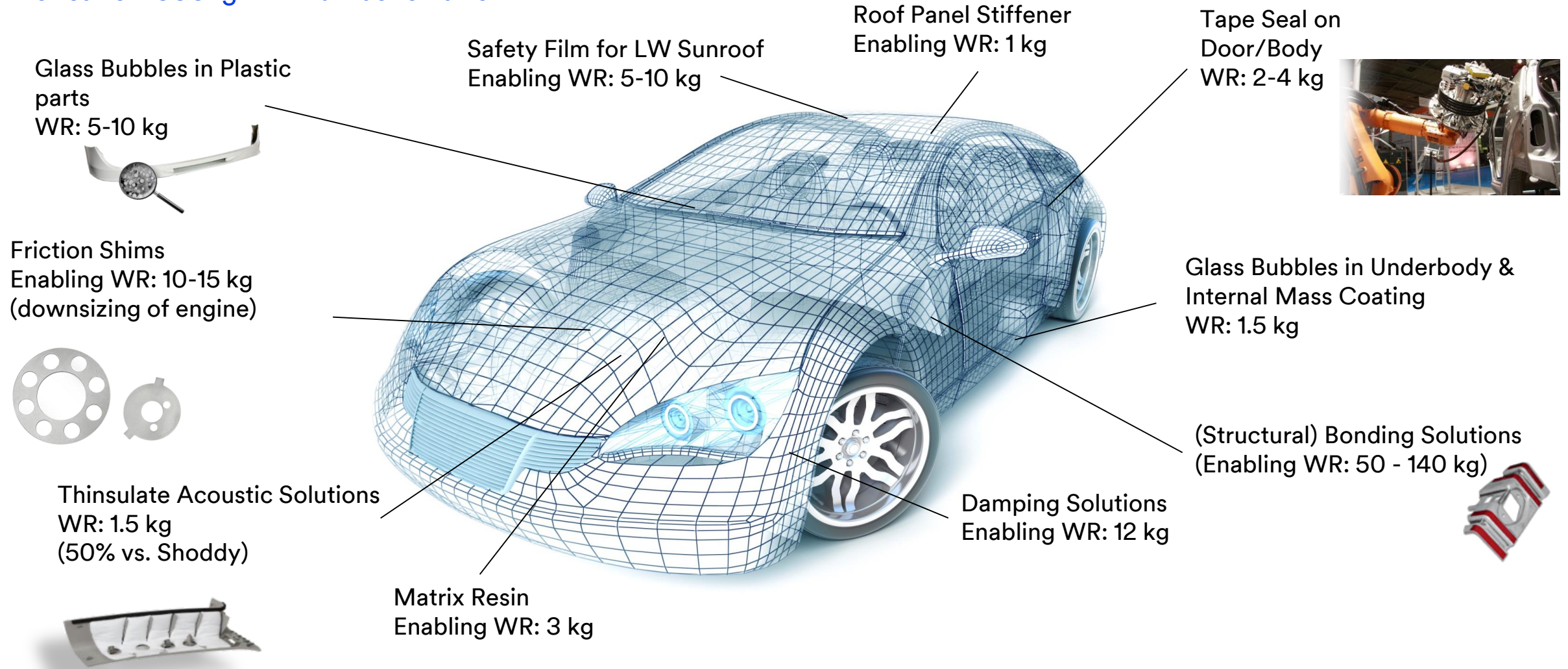
46 Technology Platforms Used To Solve Our Customer Lightweighting Needs

Technologies most frequently linked to 3M Enabling Lightweight Solutions



3M's Enabling Lightweight Solutions

Per car of 1500kg w/12% Plastic Parts



Total Potential Weight Reduction: 91-179 kg

For Vehicle Refinement.....

Lighter structures = more NVH required

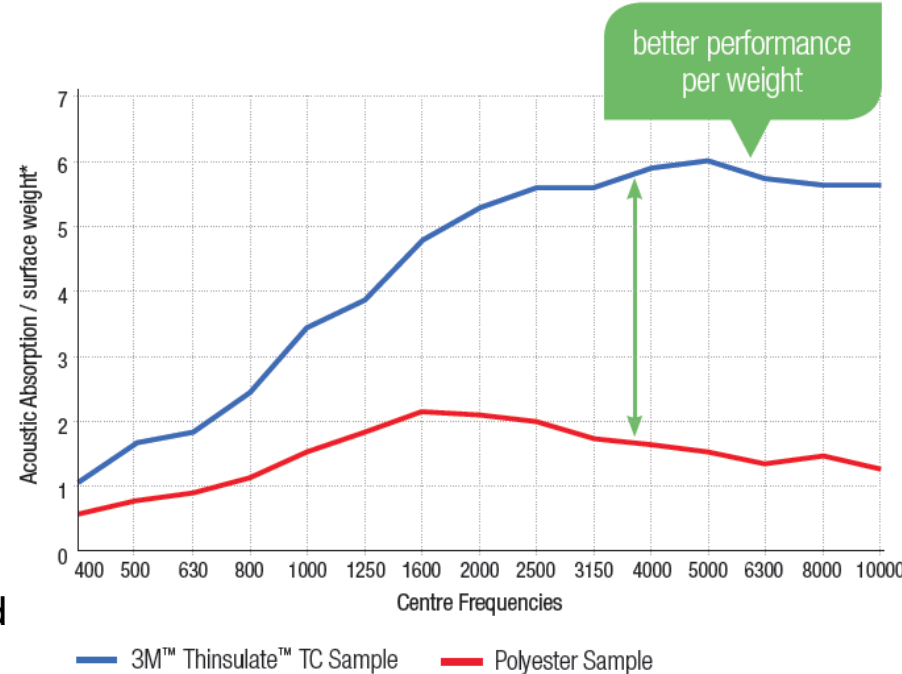
3M™ Thinsulate™ Acoustic Insulation

Non woven acoustic absorber

Advantages.....

- Easily compressed to fill cavities
- Suitable for wet environments
- Lightweight

> 50%-75% weight efficiency compared to alternative absorbers



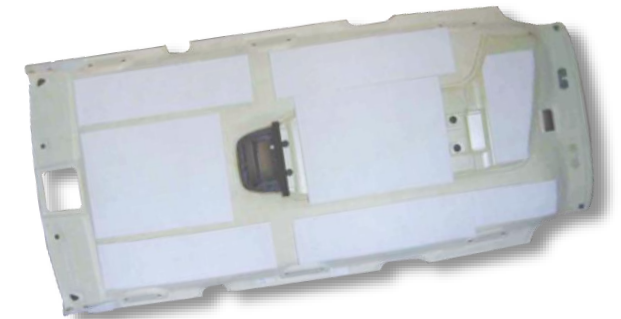
Thinsulate™ Acoustic Insulation offers more acoustic absorption per unit weight than many other technologies



Wheel Arch



Pillar



Roof Liner

For Plastic Moulding Mass Reduction...

3M™ Glass Bubbles

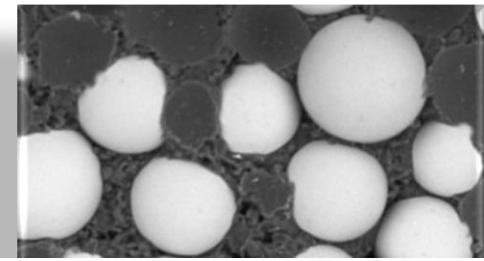
Low density filler in thermoplastics, thermosets, bulk or sheet molded composites, coatings and structural foams and elastomers.

Approx. 80% lighter compared to mineral fillers
 10-15% cycle time reduction in injection molding
 SMC Class A approval at several OEMs

Less shrinkage and warpage

No investment in new equipment required

Up to 30% mass reduction,



Other Additives
(e.g. CaCO₃, Talc, etc.)

3M™ Glass Bubbles

Glass bubble volume is considerably different when compared to an equal weight of higher density mineral fillers.

Densities of Common Fillers (g/cc)	
Alumina trihydrate (ATH)	2.42
Aluminum oxide	3.97
Barium sulphate	4.5
Calcium carbonate	2.71
Carbon black	1.8
Clay	1.8 – 2.6
Glass fiber	2.5
Ground or flake glass	2.5
Gypsum (calcium sulfate)	2.32
Mica	2.6 – 3.2
Quartz flour	2.65
Solid glass spheres	2.4 – 2.8
Talc	2.7 – 2.8
Titanium dioxide	4.17
Wollastonite	2.87 – 3.09
Wood and nut shell flour	0.19 – 1.6
Zinc oxide	5.61
3M™ Glass Bubbles	0.125 – 0.6

Vehicle – Porsche 991GT3RS
 Application – Rear Apron
 Material – Polyurethane
 Weight saving – 23% (thickness increased slightly) 0.90 density, reduced from 1.26,

For Multi-Materials Joining.....

3M™ Taped Seal on Door/Body

Double sided tape with excellent adhesion to demanding lacquers and plastic parts, 100% seal

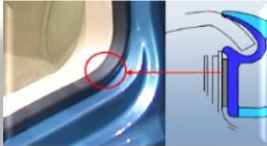
Used on door or body seal of cars

Weight reduction compared to conventional (metal) fastening systems- casting/extrusion changes incl.

Improved NVH against clipped systems

Reduced risk of corrosion

Up to 4 kg/car



Fully automated process

3M™ Acrylic Foam Tape

Viscoelastic PSA tape with excellent adhesion to demanding lacquers and polymers.

Use on exterior trim and internal plastic mouldings

Weight reduction compared to mechanical fixings

Handle high CTE differences- 3X thickness of tape

Enabled the addition of electronics into thinner wall bumpers for example- no read-through

Enabling technology to allow the use of (dissimilar) lightweight materials



Parking Sensors



Headlamp cleaning systems

3M™ Structural Tapes

1K Epoxy adhesive in tape form

Structural bonding of (dissimilar) materials / composites

Easy application - no special equipment required

Manual or automated application

Constant process and quality

Corrosion prevention

Enabling technology to allow the use of (dissimilar) lightweight materials

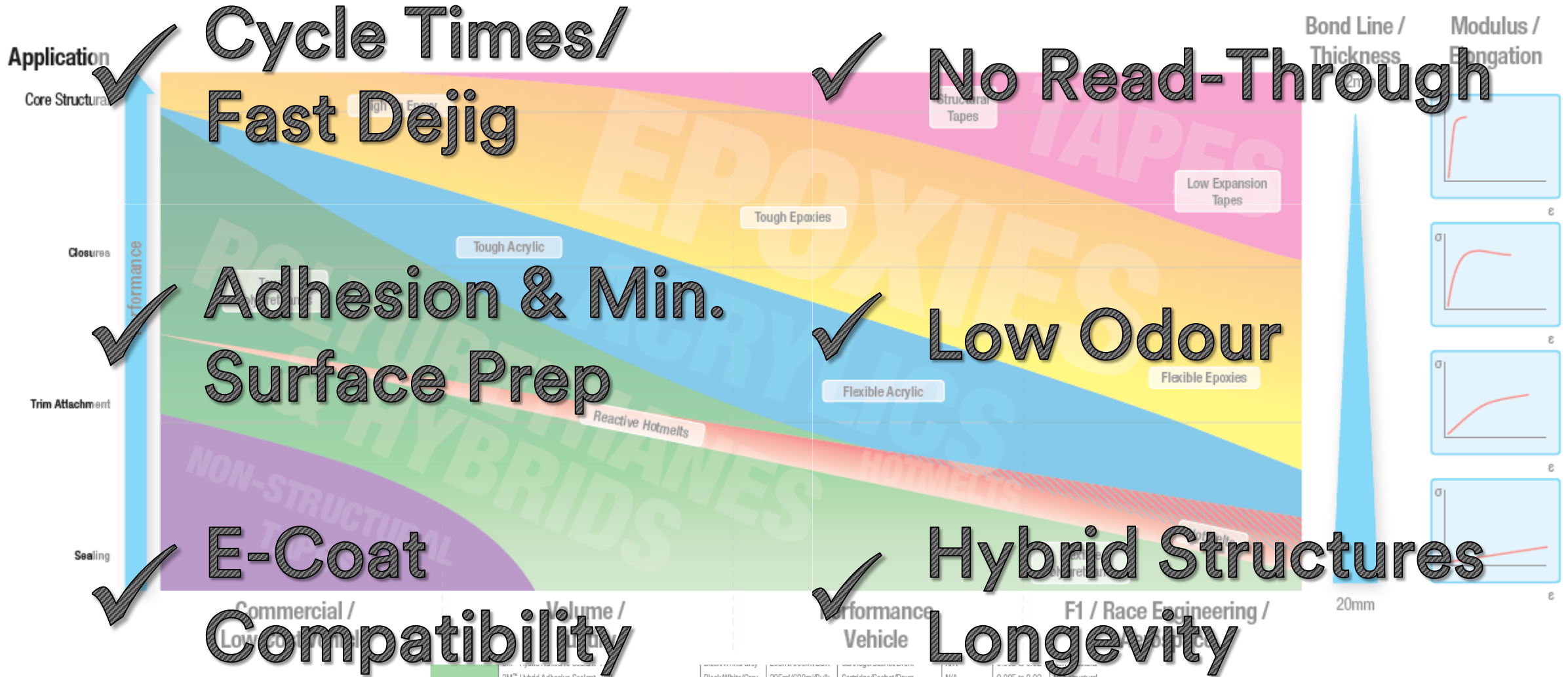


Van door bracket



3M Product Portfolio for Multi Material Joining

Non structural	Adhesive	Colour	Size/Thickness	Packaging	Dejig time (1mp)	Modulus	Strength
Structural Tapes	3M™ Automotive Structural Adhesive Film SAF 6068	Red	0.15/0.40mm	Roll/Die-Cut	after bake	2.3	Structural



Sealant	Adhesive	Colour	Size/Thickness	Packaging	Dejig time (1mp)	Modulus	Strength
3M™ Hybrid Adhesive Sealant 760	Black/White/Grey	295ml/600ml/Bulk	Cartridge/Sachet/Drum	N/A	0.005 to 0.02	Non structural	
3M™ Polyurethane Adhesive Sealant 540	Black/White/Grey	310ml/600ml/Bulk	Cartridge/Sachet/Drum	N/A	0.005 to 0.02	Non structural	
3M™ Polyurethane Adhesive Sealant 550FC	Black/White/Grey	310ml/600ml/Bulk	Cartridge/Sachet/Drum	N/A	0.005 to 0.02	Non structural	
3M™ Polyurethane Adhesive Sealant 560	Black/White/Grey	310ml/600ml/Bulk	Cartridge/Sachet/Drum	N/A	0.005 to 0.02	Non structural	
3M™ Polyurethane Adhesive Sealant 590	Black/White/Grey	310ml/600ml/Bulk	Cartridge/Sachet/Drum	N/A	0.005 to 0.02	Non structural	
3M™ Polyurethane Adhesive Sealant Accelerator AC61	White	45ml/22L	Sachet/Pail	30 mins	0.005 to 0.02	Non structural	

Multi-Material Joining- Difficult to Bond Surfaces

Increased lightweighting can mean increased use of difficult to bond materials

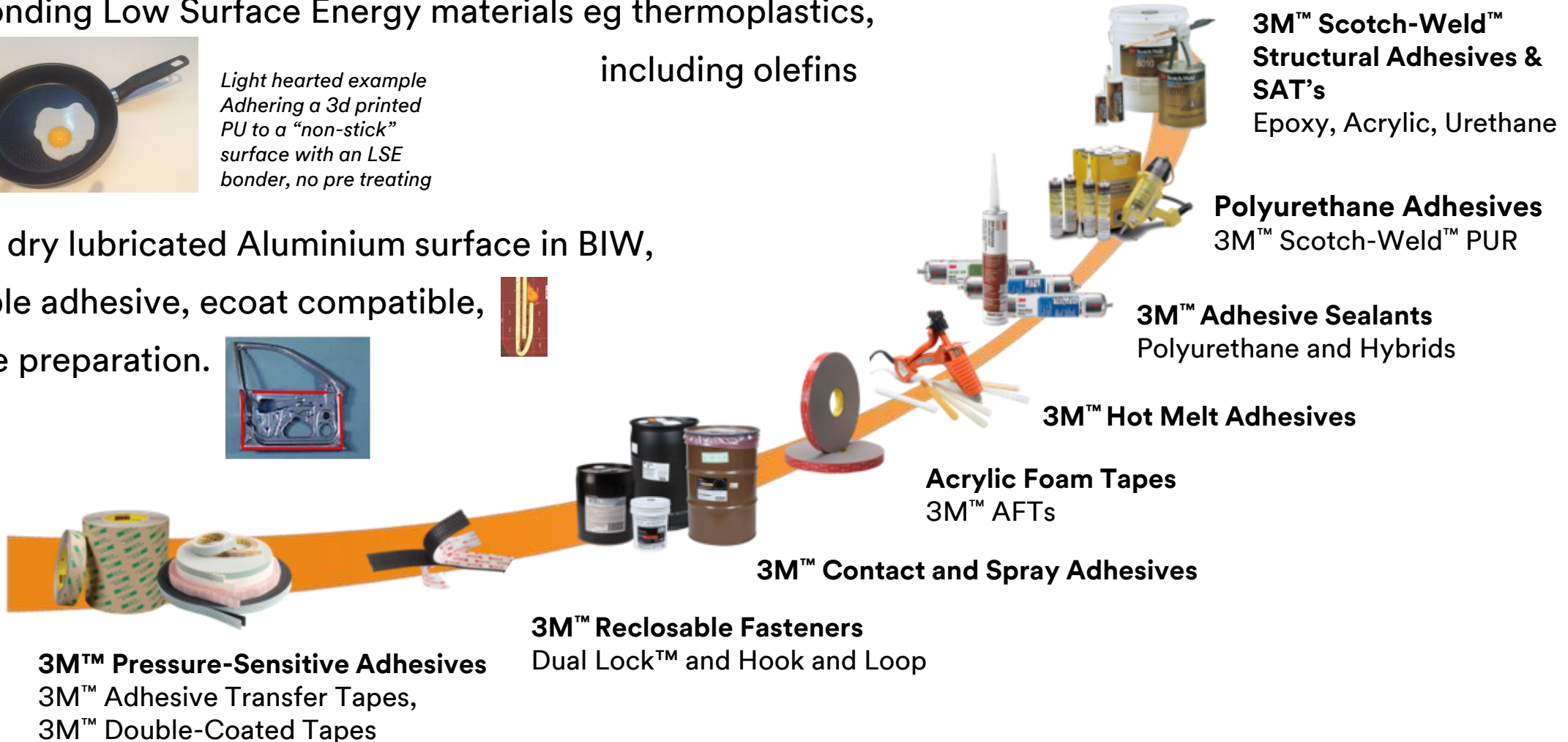
EXAMPLE 1- bonding Low Surface Energy materials eg thermoplastics,



*Light hearted example
Adhering a 3d printed
PU to a "non-stick"
surface with an LSE
bonder, no pre treating*

including olefins

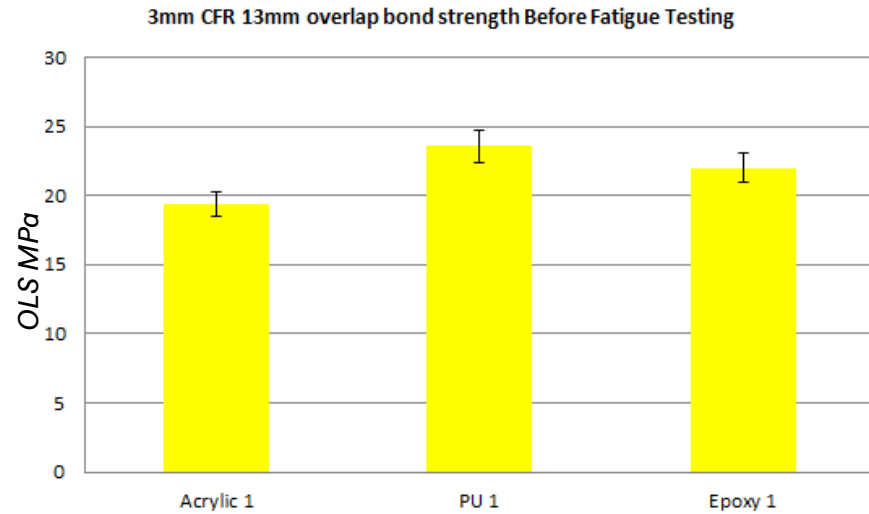
EXAMPLE 2 - a dry lubricated Aluminium surface in BIW,
induction curable adhesive, ecoat compatible,
with no surface preparation.



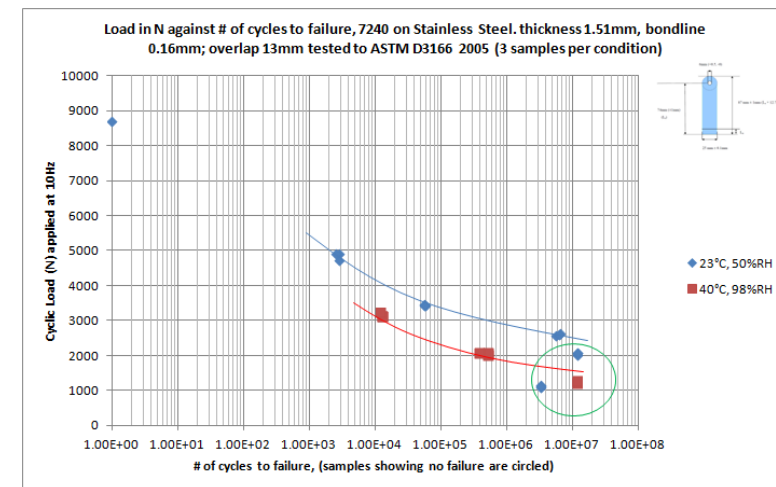
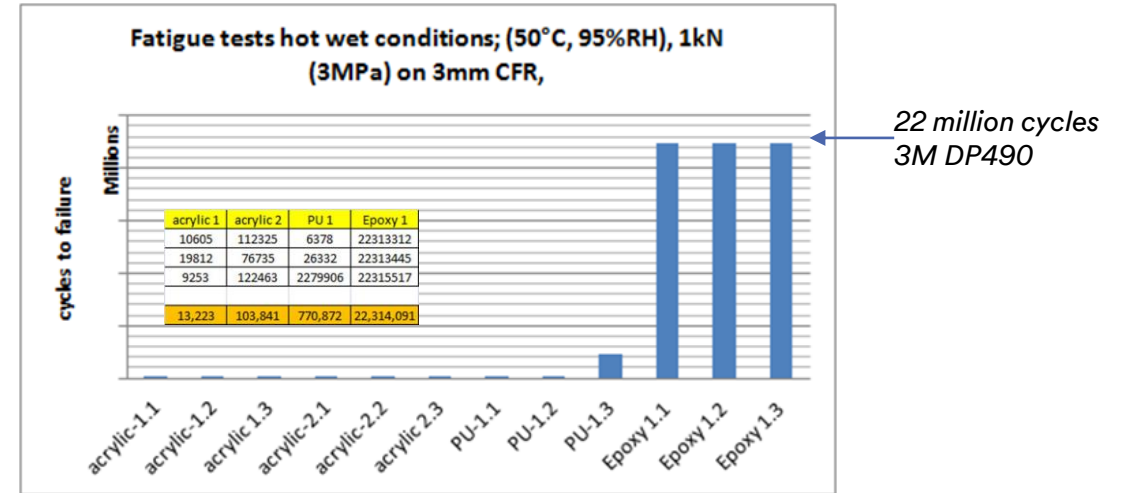
It is important that full assessments are made of any application, materials differ.

Multi-Material Joining – Durability/Fatigue

Quasi-static overlap shear tests tell you about initial strength alone



But what about long term performance?



These and the other test results you see where carried out in the UK adhesives & tapes lab

Multi-Material Joining – Solving Read Through Effects

Read through on composites and thinner structures can have multiple causes

Example solution : Use of a 3M™ Acrylic Foam Tape in by itself or in combination with an adhesive

Read-through lab assessment CFRP.....

Customer read-through solved..... Combination of adhesive selection and surface preparation method

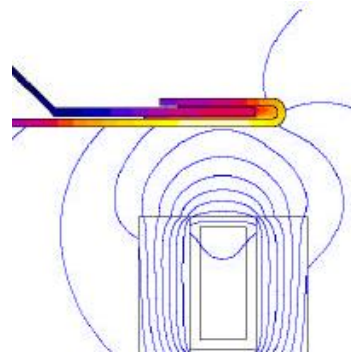


Multi-Material Joining - Cycle Time Optimisation

Techniques for quick dejig/fast cycle times.....

Use a combination superfast adhesive or PSA tape with another adhesive

Induction cure for initial lock-up



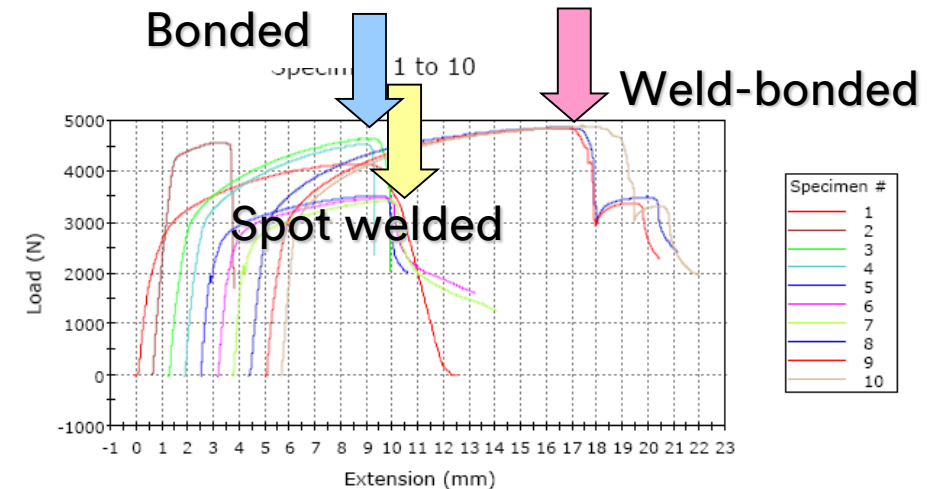
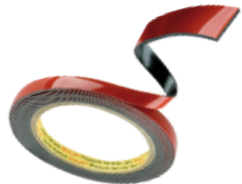
Information and pictures courtesy of EFD Induction, Wolverhampton UK

Combination Weld-Bond or Riv-bond

Weld-Bonded Fatigue Samples;
No failures >32 MM cycles at 1kN; 50°C; 98% RH, 10Hz

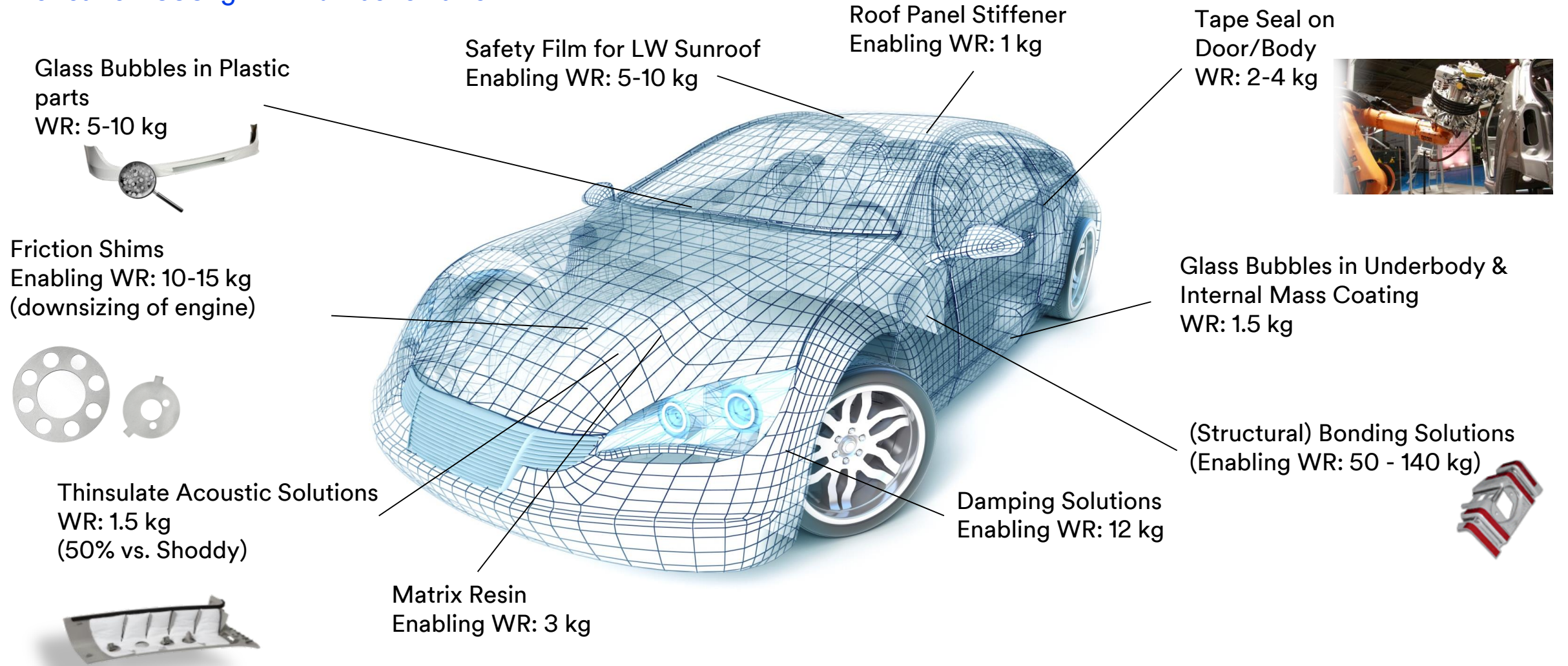


Both welded and bonded samples failed at less than 2.5million cycles



3M's Enabling Lightweight Solutions

Per car of 1500kg w/12% Plastic Parts



Total Potential Weight Reduction: 91-179 kg

Acknowledgements



Bernard Sikkel PhD
Senior Specialist,
Application Engineering



Jeff Kapp
Advanced Specialist,
Application Engineering



Abs Master
Global Key Account Manager



Darren Hall
Technical Sakes Manager
Glass Bubbles

3M Science.
Applied to Life.™

Thank you...



Edwin Eve CEng MIET MIMechE

Technical Manager, 3M Automotive Division

3M UK Ireland

Mobile: +44 7826 908050

eeve@mmm.com