Material Data Cards for Adhesives

- APPLUS+ RESCOLL BONDING DAYS 2025
- **Daniel CAMPOS MURCIA / Maxime OLIVE**

Applus+ Group

Applus+ is a global leader in inspection, testing and certification. Driven by our passion for progress and technological development, we'll keep moving towards a more sustainable future alongside our customers; re-enforcing our mission and company motto: **Together beyond standards.**

26,000+
People

€ 2,058M
Revenue

65+
Countries in all continents

Accredited
By main international entities

Energy & Industry Division

€ 1,084M revenue

16,000+ personnel

Laboratories Division

€ 264M revenue

2,589 personnel

Automotive Division

€ 392M revenue

4,300 personnel

IDIADA Division

€ 331M revenue

3,158 personnel

Applus laboratories

Applus RESCOLL

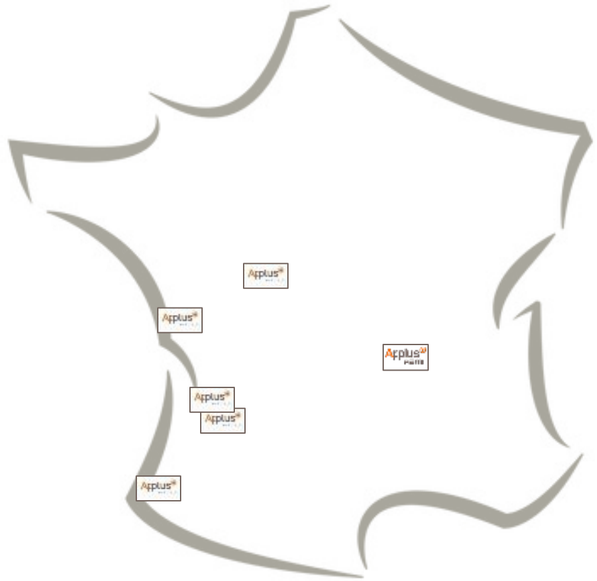
12000 M²
LAB SURFACE

30 M€
TURNOVER

> 1000
CUSTOMERS

> 2M€
ANNUAL
INVESTMENT

200
EMPLOYEES



TESTING | INNOVATION STUDIES | PRODUCTS

Applus DatapointLabs

Applus laboratories

OVERVIEW OF DATAPOINTLABS

ITHACA, NY
USA

Experience

- 30+ years of experience in materials testing and characterization
  - ISO 17025:2017 accredited, operating on an end-end digital platform
  - Nadcap accredited [Aerospace / Defense] (Metallic/Non-Metallic Materials Testing)

Operations

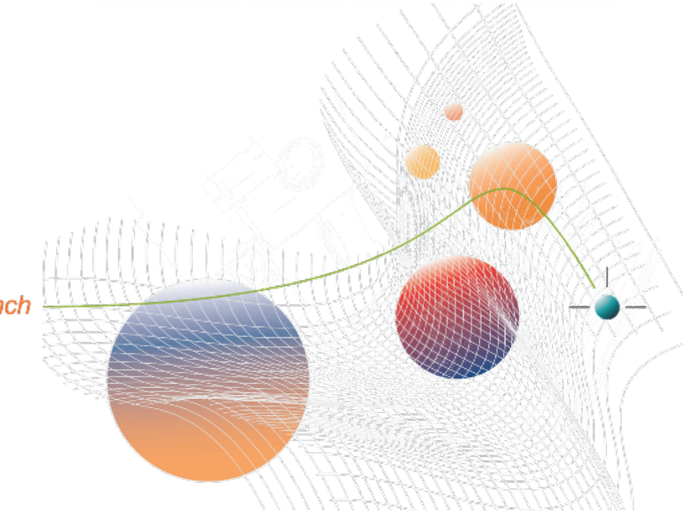
- Testing 2000+ materials per year
- Standard 5-day turnaround
- Comprehensive one-stop testing capability
  - +200 unique tests: all aspects of mechanical, thermal and rheological characterization

Capabilities

- Materials: plastics, composites, foam, rubber, metals, additive materials, films, adhesives
- May be characterized over a wide range of temperature and environmental conditions (elevated/cryogenic, heat aging, moisture conditioning, weathering, fluid exposure, in-vivo)
- Characterize non-linear and post-yield behavior, dynamic situations (drop, crash, impact), hyperelasticity (rubber, foams), time-based behavior (creep, stress relaxation, viscoelasticity)

+

TestCart
TestPaks
CAETestBench



Nadcap
Administered by PRI
ACCEPTED
Certificate# 17231205927
Non Metallic Materials Testing

ISO
ISO 17025

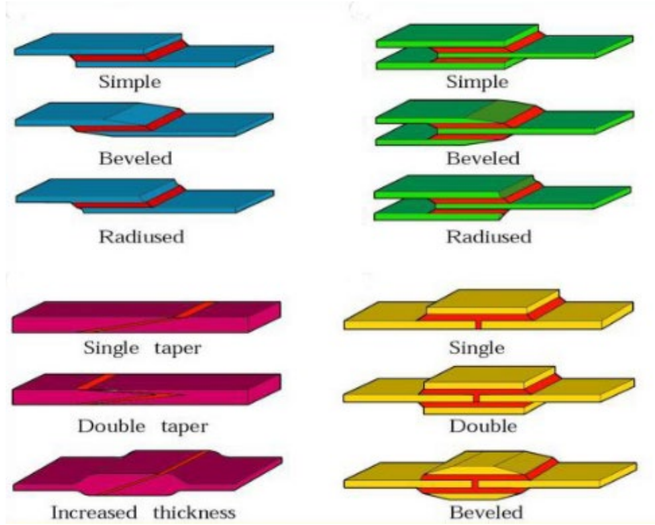
https://www.datapointlabs.com/

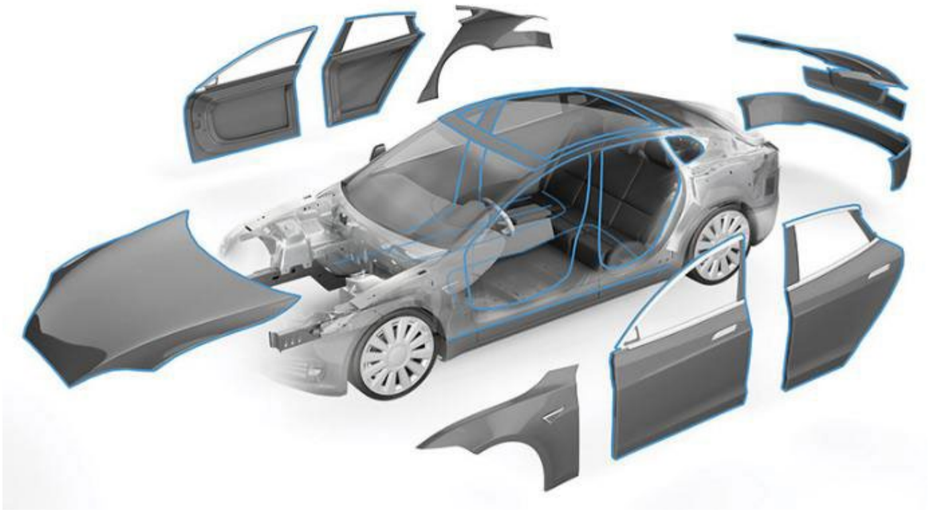
Widespread use of structural adhesives in more critical applications

Prediction of adhesive performance is mandatory but associated with high design costs and cycle time …

Finite Element Analysis (FEA) emerged as a great solution to

- *Model the adhesive and assembly in various conditions*
- *Reduce design cycle time and optimize joint design with limited numbers of experiments*





Source : Adhesives.org

Simulation implies to feed the model with data

Definition of set of tests or test packages to build the data set

Realization of tests in various configurations, different loading modes

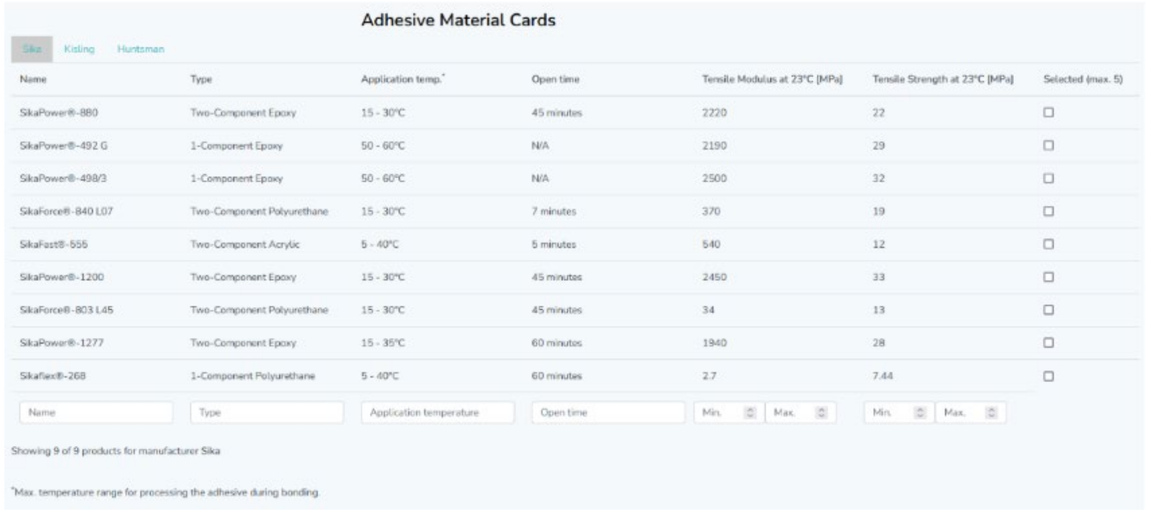
Examples of such data sets available for commercial adhesives… can be seen as extended technical data sheets

These data set can be used to run simple design calculations

eg CALCBOND

Data sets representative of standard lab conditions:

- substrates
- thickness
- curing
- …



Adhesive Material Cards

Sika | Kisling | Huntsman

Name	Type	Application temp.*	Open time	Tensile Modulus at 23°C [MPa]	Tensile Strength at 23°C [MPa]	Selected (max. 5)
SikaPower®-880	Two-Component Epoxy	15 - 30°C	45 minutes	2220	22	☐
SikaPower®-492 G	1-Component Epoxy	50 - 60°C	N/A	2190	29	☐
SikaPower®-498/3	1-Component Epoxy	50 - 60°C	N/A	2500	32	☐
SikaForce®-840 L07	Two-Component Polyurethane	15 - 30°C	7 minutes	370	19	☐
SikaFast®-555	Two-Component Acrylic	5 - 40°C	5 minutes	540	12	☐
SikaPower®-1200	Two-Component Epoxy	15 - 30°C	45 minutes	2450	33	☐
SikaForce®-803 L45	Two-Component Polyurethane	15 - 30°C	45 minutes	34	13	☐
SikaPower®-1277	Two-Component Epoxy	15 - 35°C	60 minutes	1940	28	☐
Sikaflex®-268	1-Component Polyurethane	5 - 40°C	60 minutes	2.7	7.44	☐
Name	Type	Application temperature	Open time	Min. Max.	Min. Max.	

Showing 9 of 9 products for manufacturer Sika

*Max. temperature range for processing the adhesive during bonding.

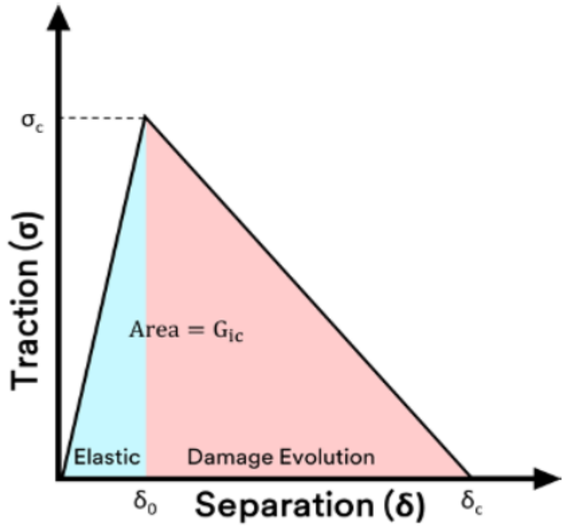
Source :
Calcbond

In addition, bonding is a multimaterial technology

Low thickness joints and interfaces must be considered with suitable models

Damage and failure propagation must be also addressed in the models

-> Introduction of Cohesive Zone Models



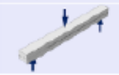
Source : 3M

Need for bond simulation with up-to-date models

With data from tests on samples as close to real life

Available in a plug and play format

… ready to import in your favorite FEA software

Physical Effect	Test Name	Test Sketch	Material Parameter	Description	Symbol	Unit
Elasticity	Uniaxial Tension Test		Young's Modulus and Poisson's Ratio	Resistance to elastic deformation and transverse contraction in tension	K_I, K_{II}, K_{III}	MPa
Damage Initiation	Thick Adherend Butt Joint Tension Test		Tensile Strength	Maximum stress in laterally constrained tension	σ_I	MPa
	Thick Adherend Shear Test		Shear Strength	Maximum stress in shear	$\tau_{II} = \sigma_{IE}$	MPa
Damage Evolution	Tapered Double Cantilever Beam (TDCB) Test		Mode I Fracture Energy (Critical Energy Release Rate)	Resistance to crack propagation in Mode I (opening mode)	G_{IC}	$\frac{N}{mm} = \frac{kJ}{m^2}$
	End-Notched Flexure (ENF) Test		Mode II Fracture Energy (Critical Energy Release Rate)	Resistance to crack propagation in Mode II (shear mode)	$G_{IIC} = G_{IEC}$	$\frac{N}{mm} = \frac{kJ}{m^2}$

TestCart

Comprehensive online catalog and order system for +200 unique tests characterizing physical, thermal and flow properties of materials for use in R&D and product development
metals, plastics, composites, rubber, foam, rubber, films

TestPaks®

Material testing and material parameter conversion to generate +180 material cards for 36 simulation (CAE) programs, including finite-element analysis, crash and drop-test simulations, injection-molding and other process simulations

CAETestBench™

Validate your simulation against a physical part, created and tested using a rigid protocol, which can be accurately replicated in your solver – probe simulation accuracy and quantify its ability to replicate the test
Validations range from simple tensile modes to more complex, multi-axial modes, impact and failure

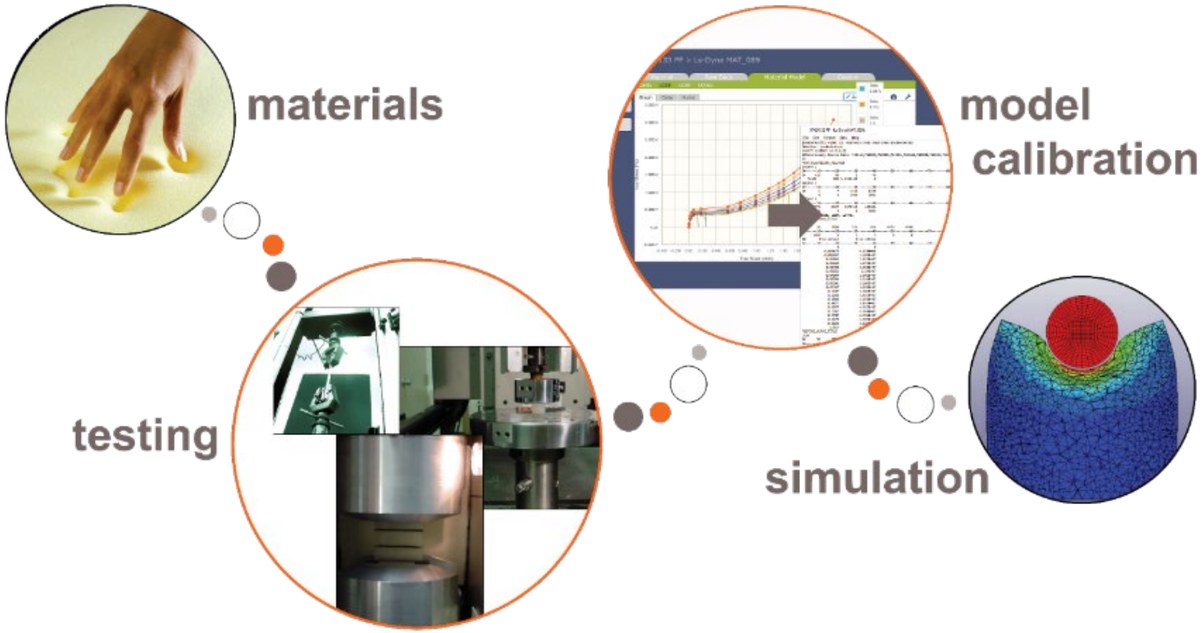
"from expert materials testing to CAE-ready material cards"

Material properties for your CAE

- What is included?
  - Specific material testing for CAE material model requirements
  - Conversion of raw test data to material model parameters
  - Solver-formatted, CAE-ready material file
  - Material card validation (Optional)

Universal TestPak available for some common material models

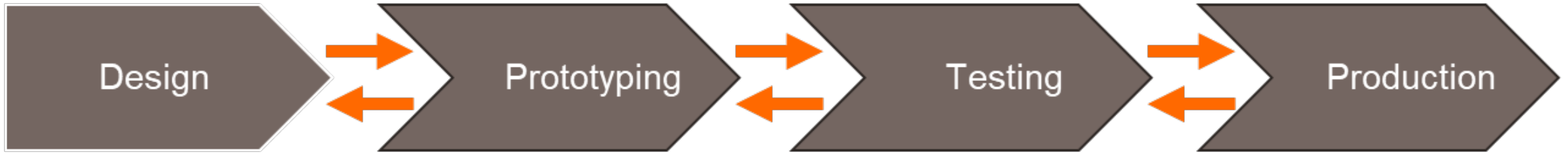
- What do they consist of?
  - Single set of material tests; material files for multiple CAE solvers
  - Particularly attractive for material suppliers serving OEM customers requiring data for CAE



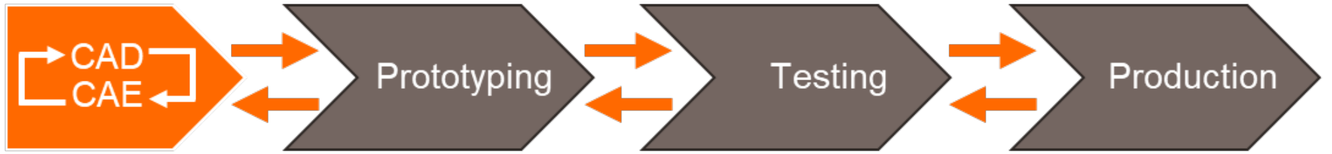
New product development means new materials

- Traditional prototyping is
  - Iterative
  - Time-Consuming
  - Costly
  - Resource-Intensive

Traditional product development process (multiple physical iterations)



CAE-driven product development process (multiple virtual iterations)



UP TO 35% IN TIME SAVING

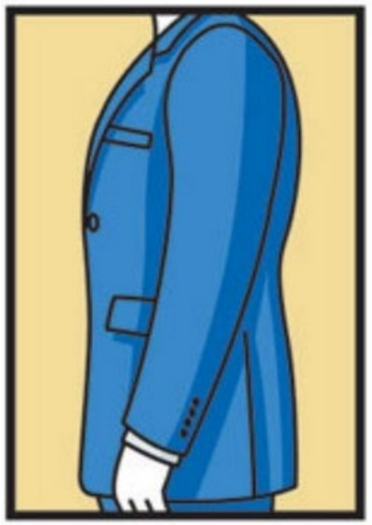
Our digital services can simplify and improve this transition, reducing the number of physical prototypes thanks to the accurate material models and digital twins.

The importance of using the Right Material Card

Standard “Off-the-shelf” Material Card

- Material to be calibrated may be similar but not identical to the standard, reducing simulation accuracy
- Test data from textbooks or standardized tests lose relevance outside their contexts
- Standard models usually can't be transferred to other software or adjusted for different simulations settings

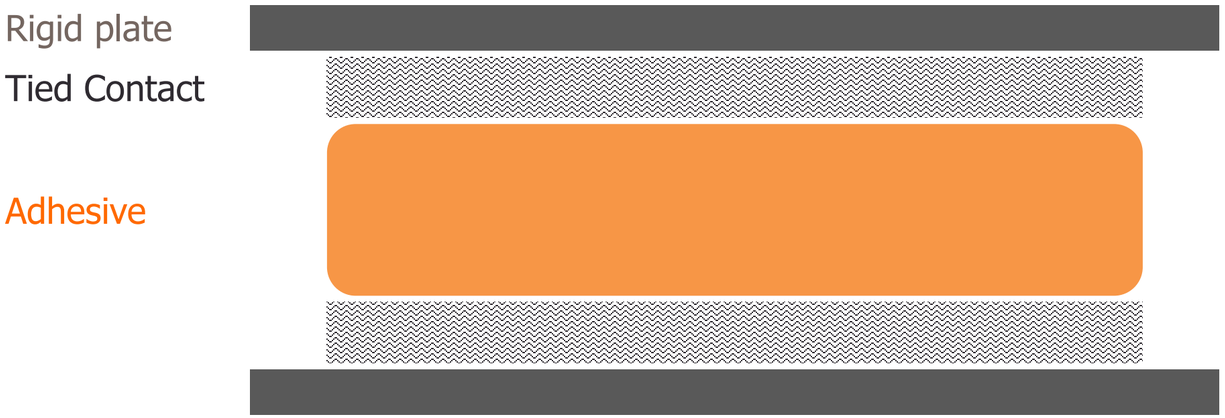
Tailor-made Material Card



- Each material is distinct, with properties influenced by both the material and forming conditions
- Test data come from specialized tests tailored to the application, covering factors like temperature, humidity, strain rate, and material orientation
- Material cards are calibrated for specific software and simulation settings, including non-physical parameters

The material cards are the foundation upon which the simulation is built. A proper material card is necessary to ensure success

Adhesive model Roadmap: Rescoll and DatapointLabs Joint Venture



1. **Adhesive model + Rigid substrate + Tied connection**
   - Simple to calibrate
   - Good accuracy of the adhesive behavior
   - Failure within the adhesive

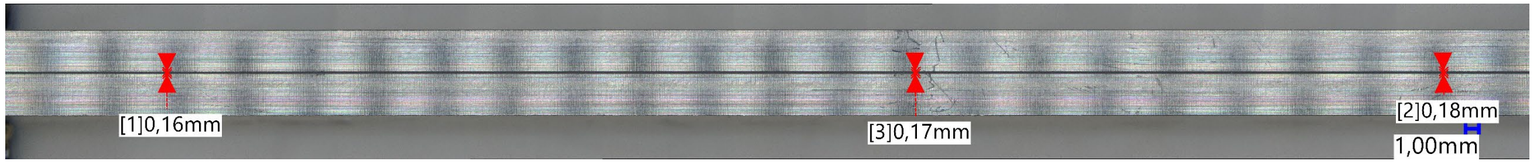
2. **Adhesive model + Substrate model + Tied connection**
   - More complex to calibrate
   - More testing needed
   - Better accuracy on the prediction of the union behavior
   - Failure withing the adhesive or the substrate

3. **Adhesive model + Substrate model + Cohesive zone model**
   - More complex to calibrate
   - Best accuracy on the prediction of the union behavior
   - Failure withing the adhesive, the substrate or the cohesive zone

TESTING

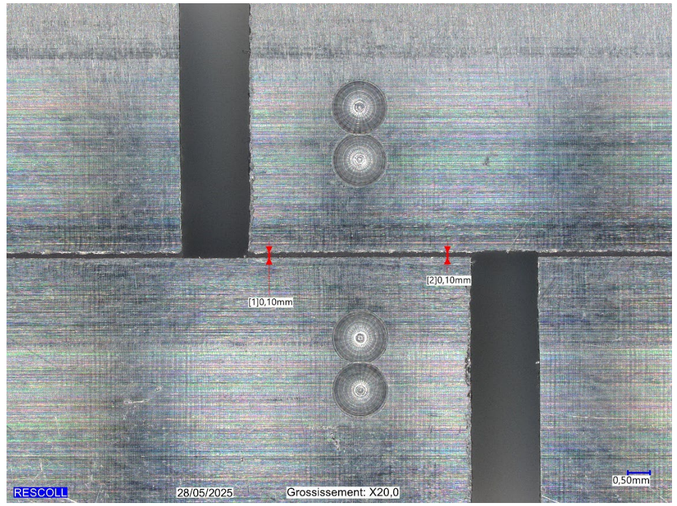
Materials

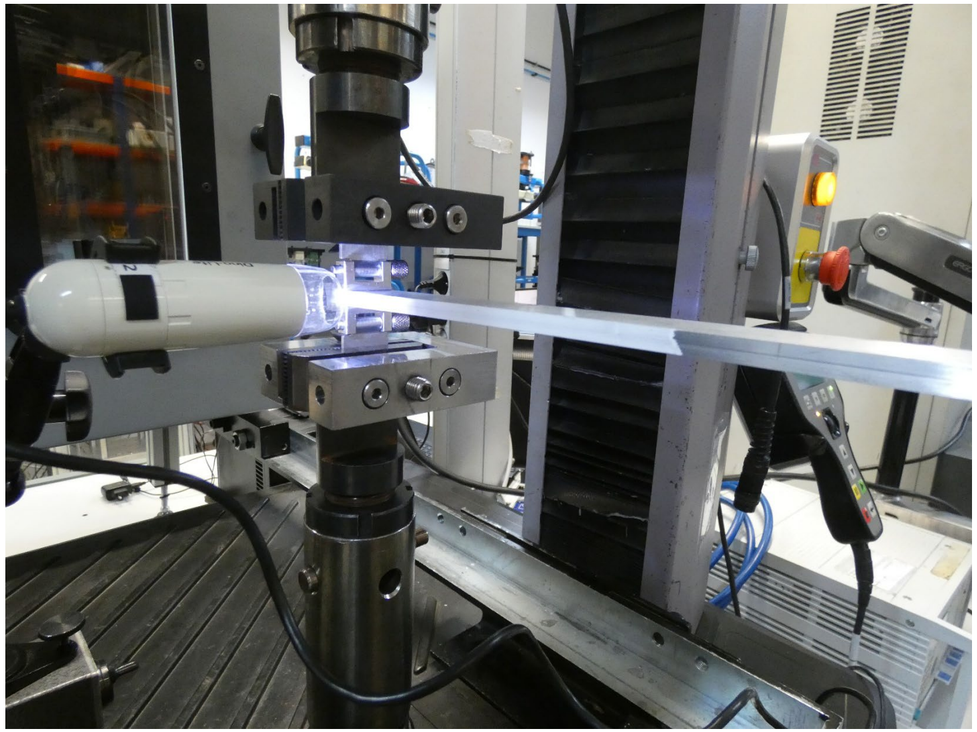
- Al 2024 sandblasted, degreased and etched
- 3M Scotch Weld 3901 Metal Primer
- 3M Scotch Weld 2216 (flexible 2K epoxy)



Test Plan

Test	Standard
Bulk tensile	ISO 527-2
Thick adherend shear test (TAST)	ISO 11003-2
Mode 1 fracture toughness	EN 6033





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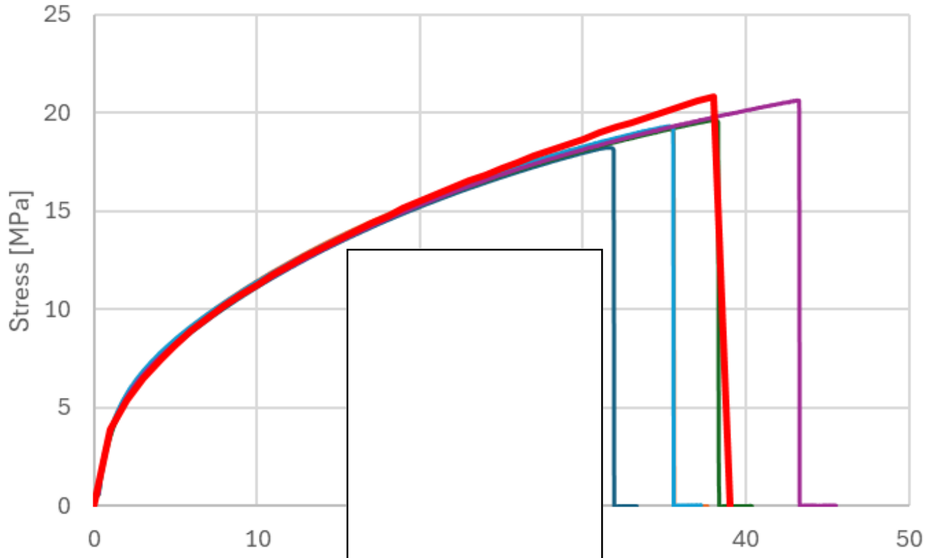
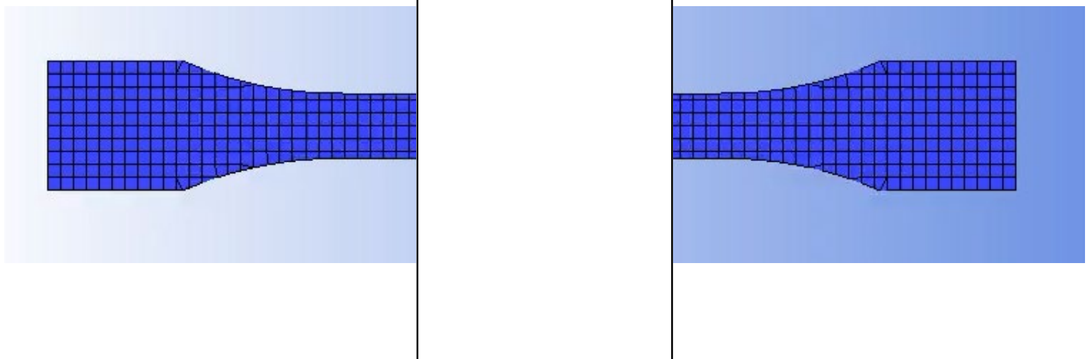
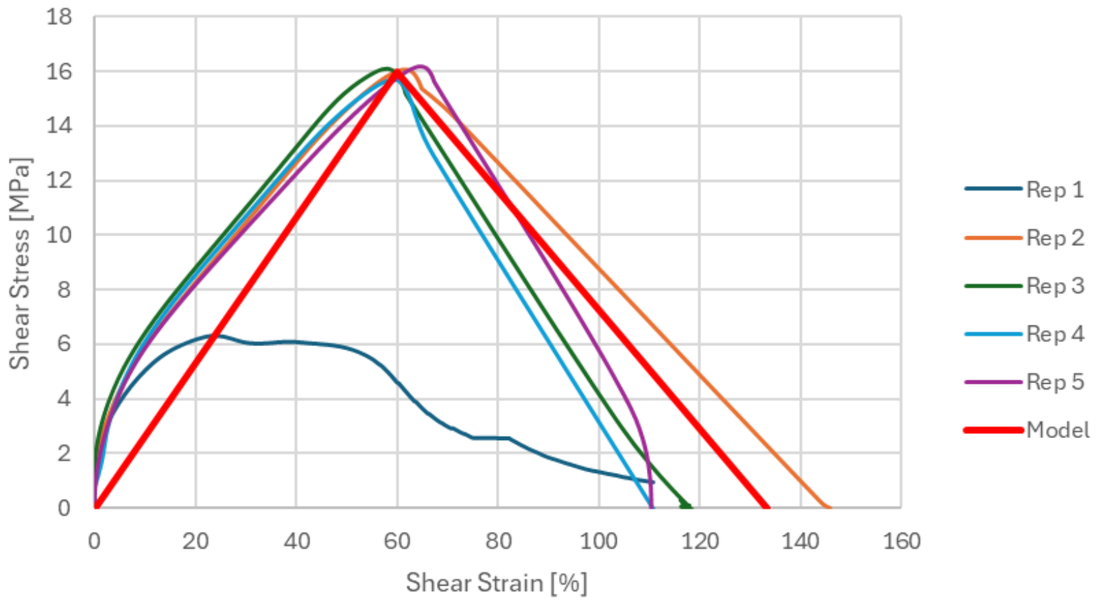
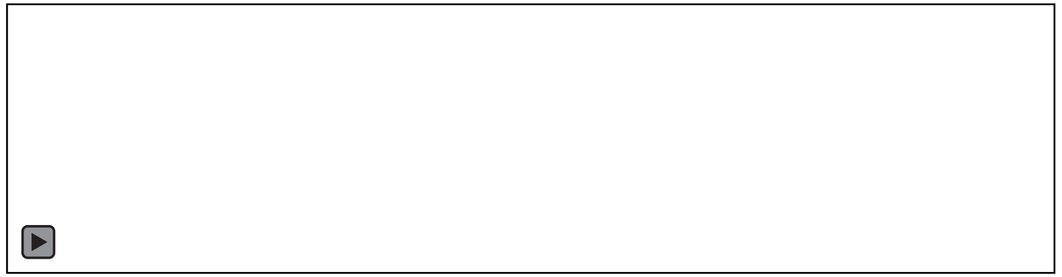
Bulk Material



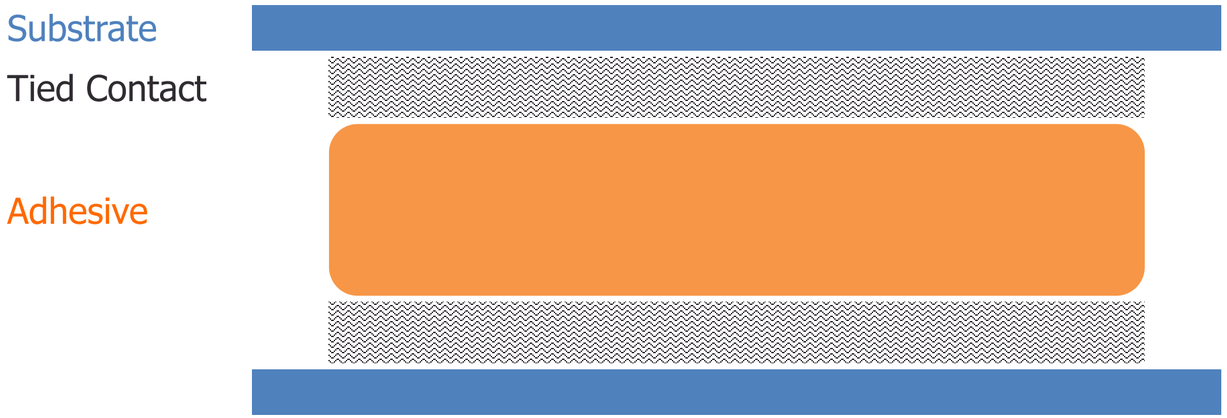


Bonded Union – TAST CLOSED UP





Adhesive model Roadmap: Rescoll and DatapointLabs Joint Venture



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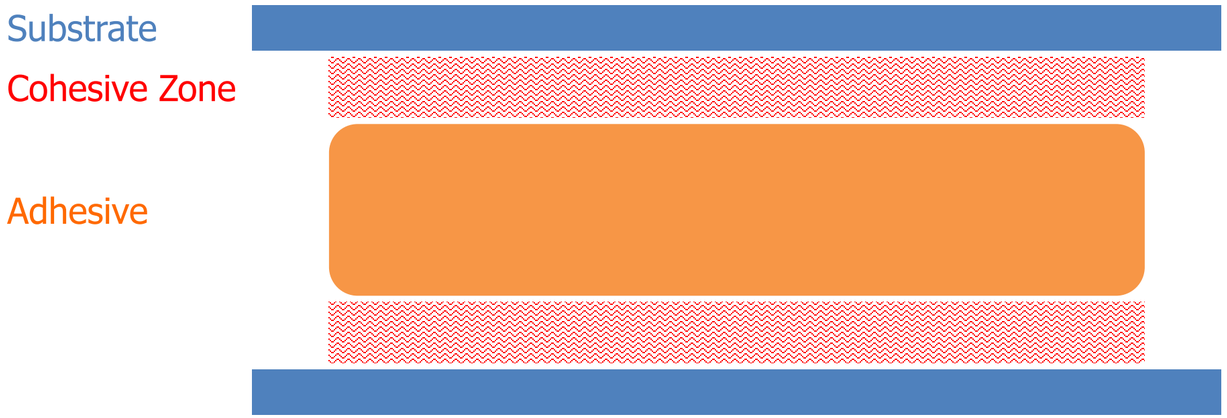

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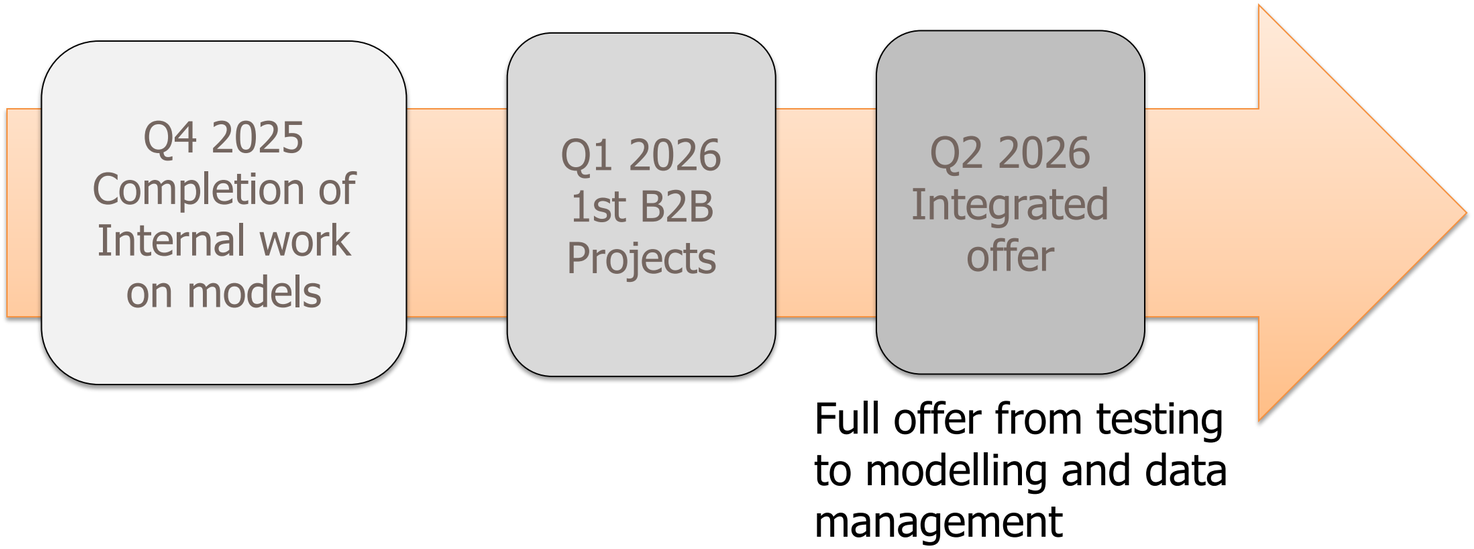
Adhesive model Roadmap: next steps



Let's start working together, share your needs and applications!

Thanks!

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