ntpt

North Thin Ply Technology

www.thinplytechnology.com

TPT

www.tptgolf.com

History

2001
The founders develop Thin Ply Technology®, initially applicable in the manufacturing of sails.

2005
Alinghi used the technology to build the "Black Sails" for the 2007 America Cup. North Sails purchased the rights on the technology, and branded it 3Di™.

2008
North Thin Ply Technology start using Thermoset. First applications are developed with various advanced tech industries. Ultra-thin tapes are engineered for Burton and Movement.

2009
Southern Spars started using NTPT technology for manufacturing carbon masts.

2011
NTPT enters the aerospace market collaborating with Solar Impulse for their world tour.

2012
Start of F1 business with McLaren and Red Bull, then Haas and Renault

2013
First America's Cup projects with Team New Zealand

2014
Opening of Poland production site and start of collaboration with Richard Mille watches.

2017
Launch of TPT Golf

2017/2020
16 Golf Pro tour Winner, within 9 PGA

2018
Big investment in Switzerland with the opening of a Clean Room for production and significant up-grade in R&D analysis equipment

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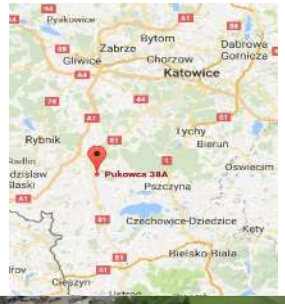
Company Organisation

NTPT LLC (US):
(i) Founders - Francois Mordasini and Gerard Gautier (controlling share)
(ii) Oakely Capital, London, UK
(iii) Windway Capital, WI, USA

NTPT Sarl,
Switzerland
HQ and R&D
15 employees

NTPT Zoo,
Poland
Manufacturing
50 employees



NTPT Sarl based in Renens, near Lausanne Switzerland, to accommodate:

- HQ
- R&D
- White room production:
  - ✓ Prepreg line
  - ✓ ATL
  - ✓ Autoclave

NTPT Zoo based in Zory, Poland to accommodate: Production of materials from UD to composite parts, with golf shaft business expansion

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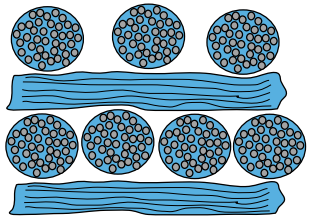
Conventional ply vs Thin ply

Standard ply weight structure

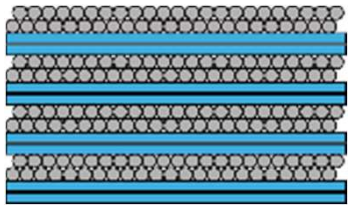
e.g ⩾ 150 gsm FAW



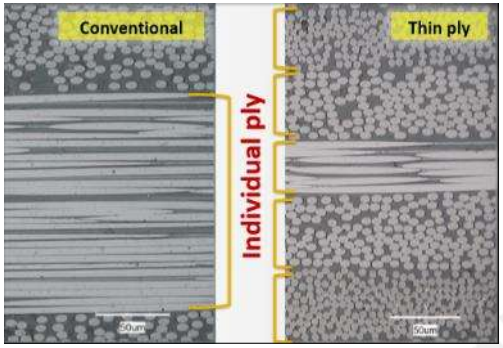
Thin ply laminates show a more homogenous structure which maximizes properties by spreading loads throughout the laminate

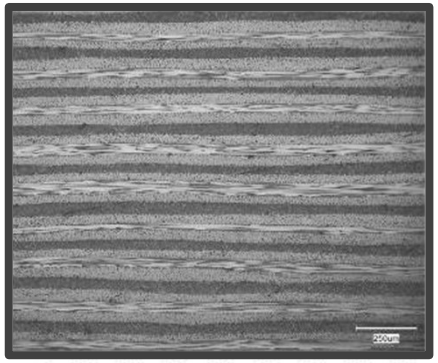
Thin ply weight structure

⩽ 75 gsm FAW



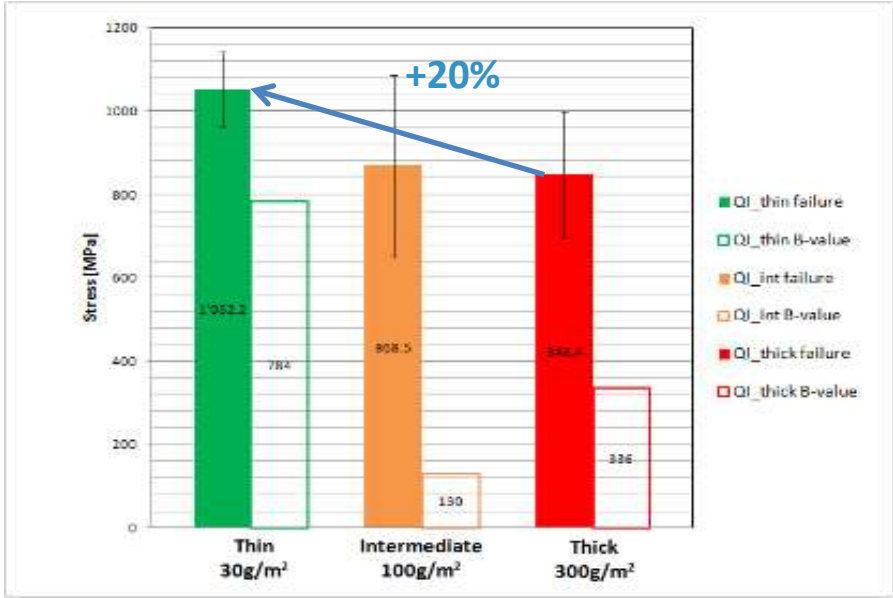
Cross section of laminate made with 150 gsm FAW plies





Cross section of laminate made with 50 gsm FAW plies

Improved Compressive Strength



- Thin plies show a more uniform microstructure.
- Improved average compressive strength of 20%
- B-values demonstrating that the design allowable is:
  - 75% of average for thin ply
  - 16% of average for intermediate
  - 40% of average for thick ply
- The more consistent and uniform structure of thin plies means higher compressive strength but mainly less variability so less "knock-down".

Thin - 30g/m2

Intermediate - 100g/m2

Thick - 300 g/m2

Samples:

Autoclave processing
Cured at 80° C

M40J – Epoxy
55% fibers by weight
(74% by volume)

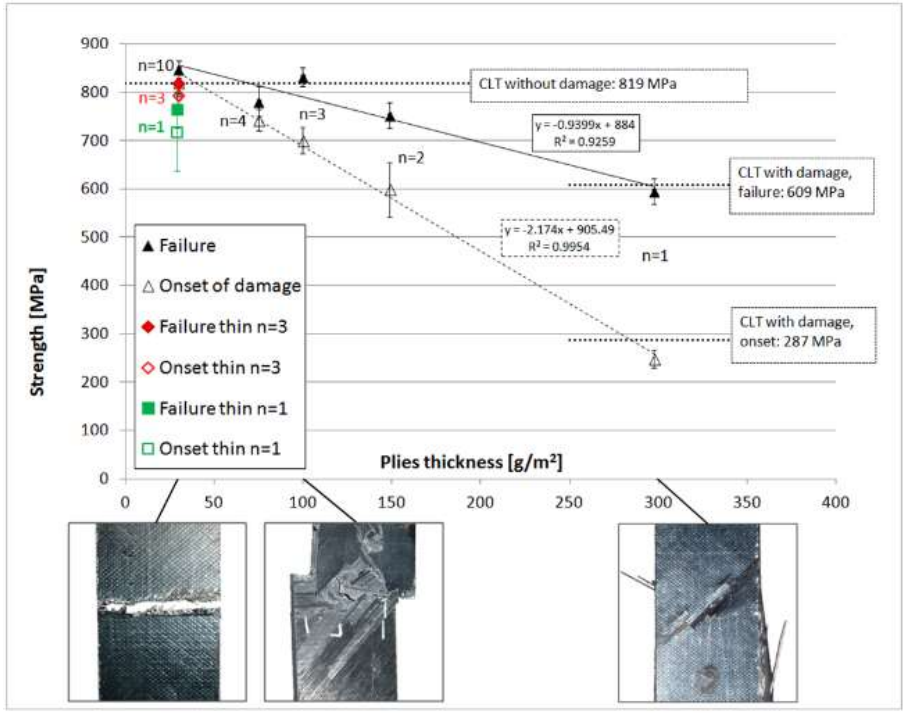
Unidirectional – UDs.

Skin composition :
Thin = 20 plies at 0°
Int. = 6 plies at 0°
Thick = 2 pies at 0°
Core :
Wood at ± 45°

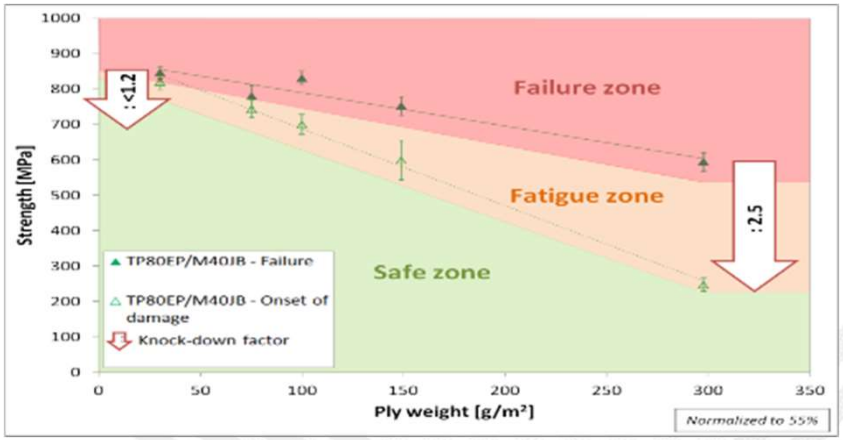
Sample dimensions :
440 x 20 x 32 mm

4 point beam being to ASTM D5467*

Tensile on QI Laminates



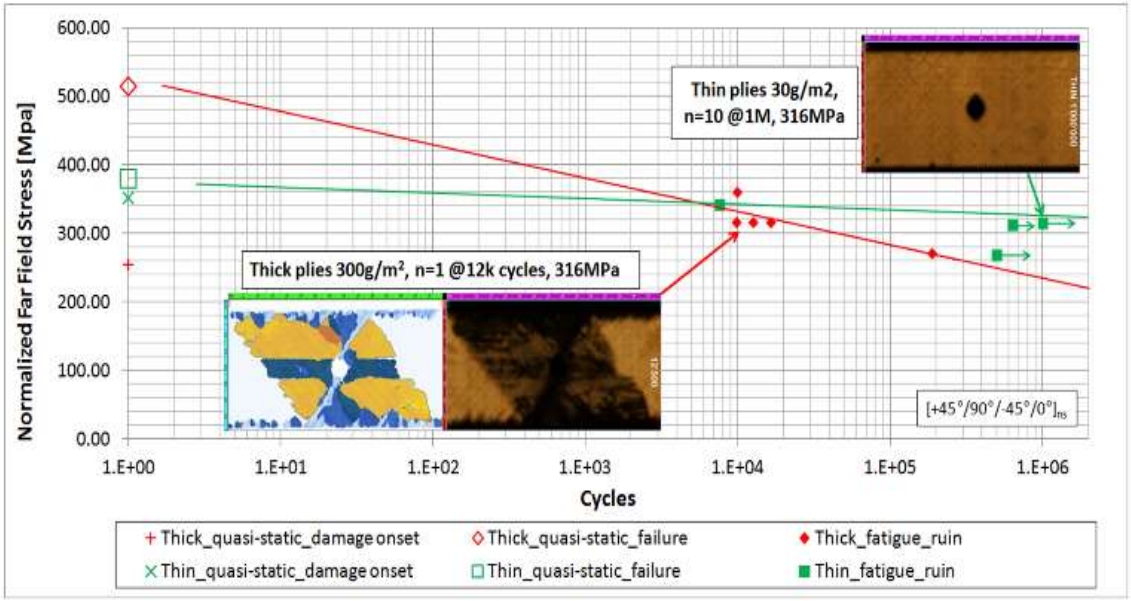
- Failure mode shows all fibers working in unison for the thin ply laminate.
- Clear trend line of higher strength as ply weight decreases, 30gsm vs 300gsm have:
  - 25% higher strength at break
  - Nearly 3x higher strength at onset of damage
- Considerably lower knock-down with thin ply, close to zero for the 30gsm ply



Fatigue on Open Hole Tensile

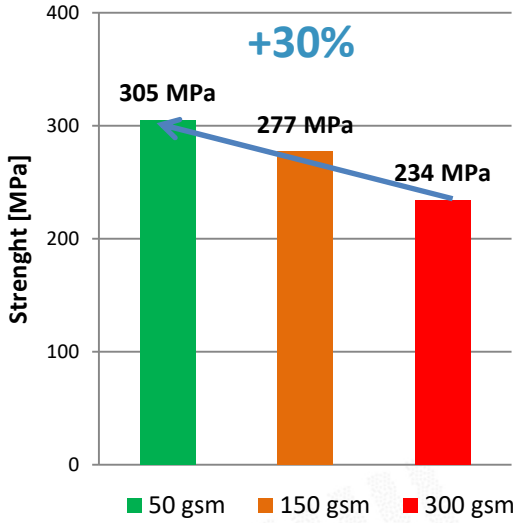
Thick plies samples break after 80'000 cycles

Thin plies samples, no damage is seen at 1'000'000 cycles – **test stopped**



Open Hole Compression

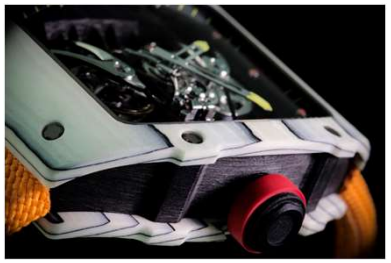
OHC show 30% increase in strength for thin ply vs thick ply (50g vs 300g)



Thin Ply laminate transfer load around holes more efficiently increasing usable strength

Thin Ply Benefits

- Enhanced mechanical properties:
  - 0° Compression (less buckling)
  - For all multiaxial testing (as In Plane Shear, QI tensile, ⋯)
  - Fatigue



- Enhanced laminate design space, allowing for greater variation of ply orientation.

- Higher safety margin for strength-driven components due less distinct fibre/resin rich areas meaning fibres are more consistently loaded.

- Many different fibre types, matrices and fibre weights available which open room for design, potential to use “hybrid” laminate (mix of fiber modulus).

- High resolution parts can be machined due to the homogeneity of thin ply laminates/blocks.

Thin Ply Development in SuCoHs

- Toughened Cyanate ester resin
  - In close collaboration with Christian Brauner's team from FHNW
  - All generations of formulations were tested to assess various processing criteria.
  - Development of the process in parallel of the characterisation. The challenge was to develop a procedure to mix the various components at high temperature in good heath and safety conditions.

  → We now have a good knowledge of all criteria to implement larger scale production if required.

- PFA (Poly Furfuryl Alcohol)
  - In close collaboration with Transfurans
  - The production process and procedure was taillored to fulfil the specific needs of this product.
  - The required quantities were made and fullfiled the needs of the others partners involved.

Thank You !

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