



Automated preform manufacture at an affordable price

FEATURE

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Higher production rates and improved part quality at lower cost are key objectives for all composites manufacturers. A new generation of automated tape laying (ATL) machines from North Thin Ply Technology (NTPT) offers a versatile and efficient automation solution accessible to smaller manufacturers, enabling them to reduce labor costs and materials wastage, whilst enhancing part quality and retaining full design freedom. Thomas Ricard, NTPT Technical Director – Materials & Automation, discusses the benefits of the company's ATL technology and outlines some of its possible applications.

Automated tape laying (ATL), a process using computer-guided robotics to deposit prepreg tapes onto a flat or curved tool, originated in the military aerospace industry in the 1960s. Its use has since expanded to the commercial aircraft sector and today it is widely used to create high quality carbon fiber composite parts such as wing skins and fuselages. The automated process enables the manufacture of large structures in one shot, with increased accuracy, repeatability and quality, and reduced cycle time. However, this heavyweight CNC-based equipment has a high capital cost which has been prohibitive to many composites manufacturers. North Thin Ply Technology (NTPT)'s ATL equipment was developed via a different route – the marine industry – and is lightweight, less complex and lower cost, making it accessible to small and medium sized composites companies operating in a variety of markets (Fig. 1).

From sail making to composites

As a sister company to North Technology Group (NTG), a collection of companies with a strong marine heritage, NTPT operates alongside North Sails, the sail maker of choice for the majority of America's Cup, Grand Prix, ocean race boats and superyachts. In the pursuit of stronger, lightweight carbon fiber sails, NTPT started to investigate techniques for spreading carbon fiber tows around 15 years ago. The technology it developed resulted in the capability to produce extremely thin, lightweight tape pre-impregnated with thermoset adhesive. However, it would require many

thousands of these individual, difficult-to-handle tapes (in some cases more than 30,000!) to manufacture a sail. It was clear that to enable a practical and economic sail making process the deposition of these tapes onto the mold had to be automated. Therefore, in parallel with its spread tow research NTPT began to develop its first ATL equipment. Following a three-year R&D program the technology was transferred to North Sails where it was scaled up



FIGURE 1

Multiplast, the builder of Groupama Team France's America's Cup yachts, employs NTPT's ATL technology to optimize lay-ups and fiber orientations in the aft wing flaps, removing critical weight high up in the yacht's wing rig.

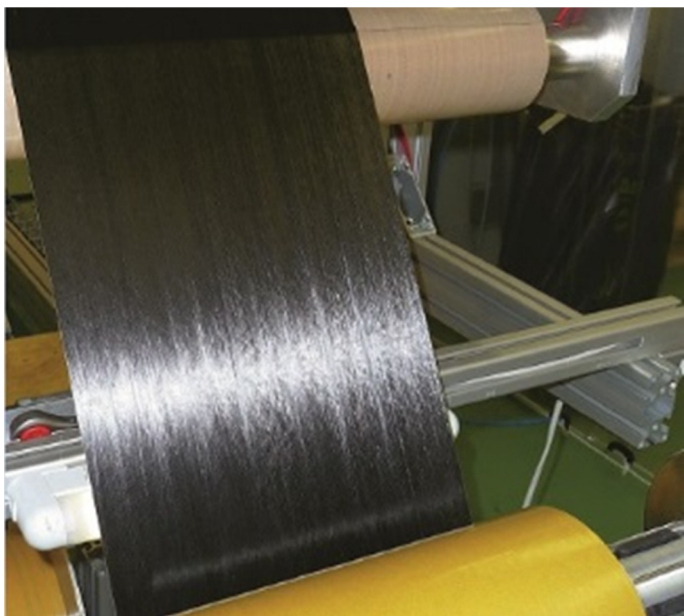


FIGURE 2

NTPT is a leading manufacturer of lightweight prepreg materials.

into an industrial process, now known as 3Di™. This patented sail making technology produces the world's fastest and most durable sails.

Spurred on by this success NTPT then considered the potential of using its spread tow technology to create a composite prepreg using epoxy resin. The extremely lightweight, thin prepreg tape produced was just as difficult to handle by hand and a second generation ATL technology was developed. Further iterations of the machinery followed as NTPT continued to develop its thin ply prepreg range, today branded Thin Ply Technology® prepreg (Fig. 2). During this development phase NTPT determined to make its ATL machine simple, lightweight and low cost, and this meant focusing on the creation of flat (2D) preforms rather than 3D preforms in order to keep the price and complexity of the equipment down. The resulting ATL machine lays down plies of unidirectional (UD) prepreg tapes to create 2D multiaxial prepreg preforms designed to be assembled on a 3D mold. Up to eight plies can be placed in each preform, with any angle of orientation (0–360° in increments of 1°). NTPT uses its ATL technology in-house for the manufacture of preforms using its own thin ply prepreps, but also designs and manufactures machinery packages for clients. The equipment can be used with NTPT's prepreps or any other prepreg tapes (thin ply or conventional) available on the market.

Flexible, adaptable equipment

Whilst NTPT works with customers to design a bespoke ATL solution that will best fit their requirements, machines are built from a set of customizable standard components (Fig. 3).

The equipment consists of:

1. The ATL gantry and head. The computer-controlled ATL head applies each tape on a specified axis and cuts it to a specified length. The layers of tape are built up to produce a multiaxial stack of plies to provide the required performance in the final part.

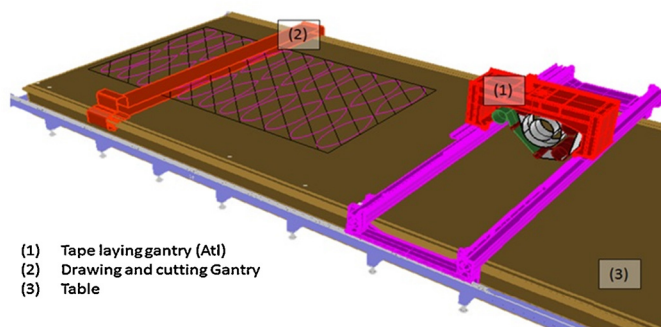


FIGURE 3

The standard components of NTPT's ATL machine, also known as a 'prepreg plotter'.

2. The cutting and drawing gantry. This is equipped with a drag knife and a rotating cutter and nesting software cuts the preforms to the required shape for the mold. Cut accuracy is ± 1 mm and the cutting speed is approximately 1 m/s, depending on the material type, the preform area weight and the size and radius of the cuts. The maximum preform areal weight for cutting is 1200 g/m².
3. The table. This is a standard cutting table equipped with up to three volumetric pumps, positioned below the table, that generate suction to hold the prepreg paper (or release film) on the table when the tapes are laid. The table is made up of aluminum profiles and vacuum panels and is separated into three zones in which suction can be switched on or off as required.

NTPT offers three standard ATL products with plotting surfaces (defined as the area on which tapes can be laid in any direction and cut at any angle) ranging from 9 m² up to 63 m². A 20 m table is standard, but longer lengths are available on request.

The ATL equipment is offered with a full selection of design, kitting, and draping software, including:

- TPTDesigner, a user interface for defining multiply preforms on a given geometry;
- TPTNester, a program to organize the preforms on the ATL table and to generate the CNC files for the ATL;
- TPTTracker, which controls and archives the work done by the ATL in real time; and
- TPTStockMaster, a data-based program to control, visualize, organize and edit the stock of composite components, such as rolls of prepreg. The remaining shelf life for each item is recorded.

A typical machine specification is shown in Table 1.

To ensure the best integration within the client's production facilities a dedicated NTPT project manager is assigned to each individual ATL installation project. Following the installation, NTPT will train the client's employees in use of the equipment and software. The ATL technology package is in constant development and customers acquiring ATL technology packages enjoy a close working relationship with NTPT.

Reduced costs, increased quality

The use of NTPT's ATL equipment to produce multi-layer, near net shape preforms (Fig. 4) has a number of advantages over manual lay-up of UD tape:

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