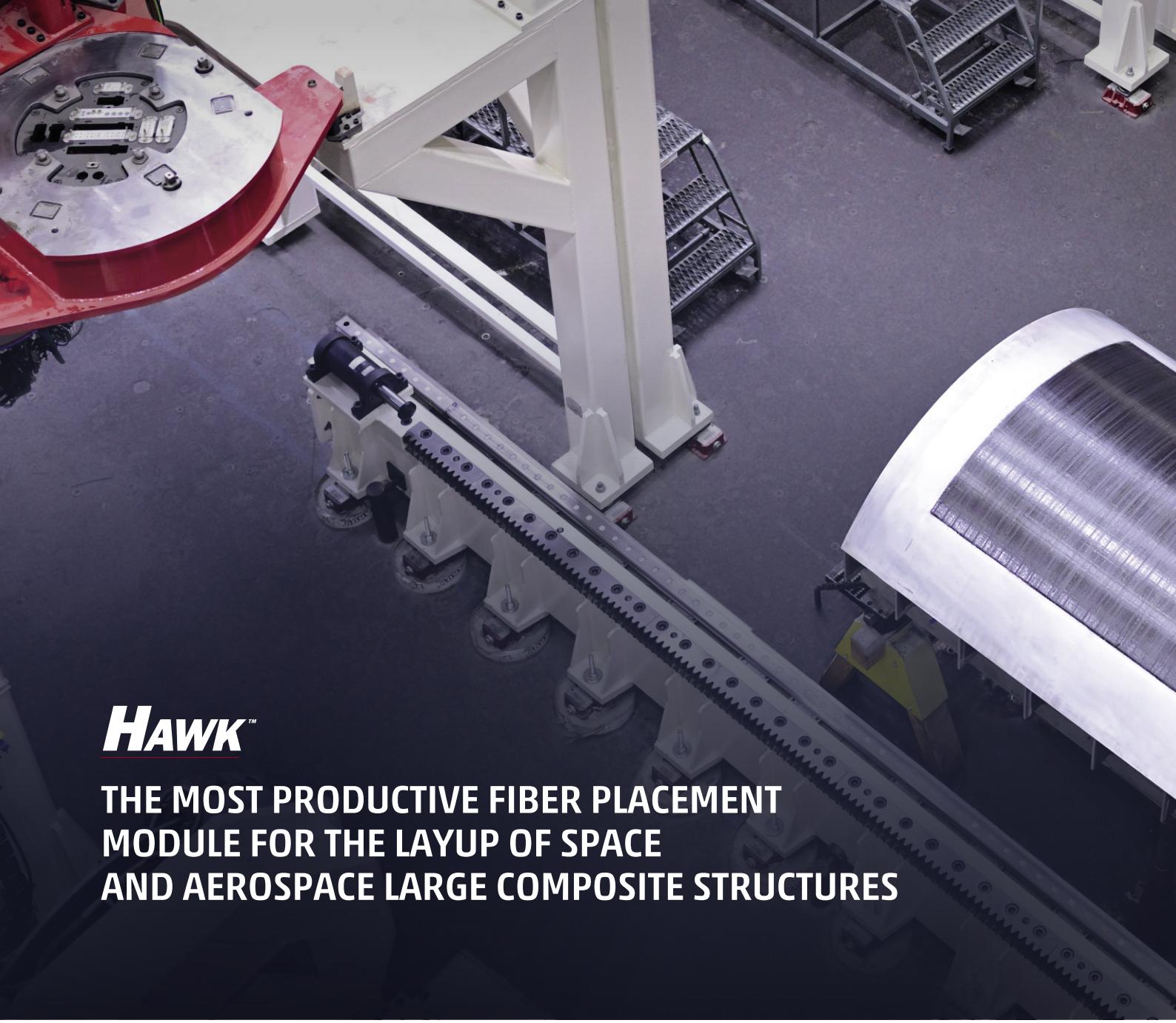
INGERSOLL

Machine Tools

HAWK™

The Most Productive Fiber Placement Module



HAWK™

THE MOST PRODUCTIVE FIBER PLACEMENT MODULE FOR THE LAYUP OF SPACE AND AEROSPACE LARGE COMPOSITE STRUCTURES

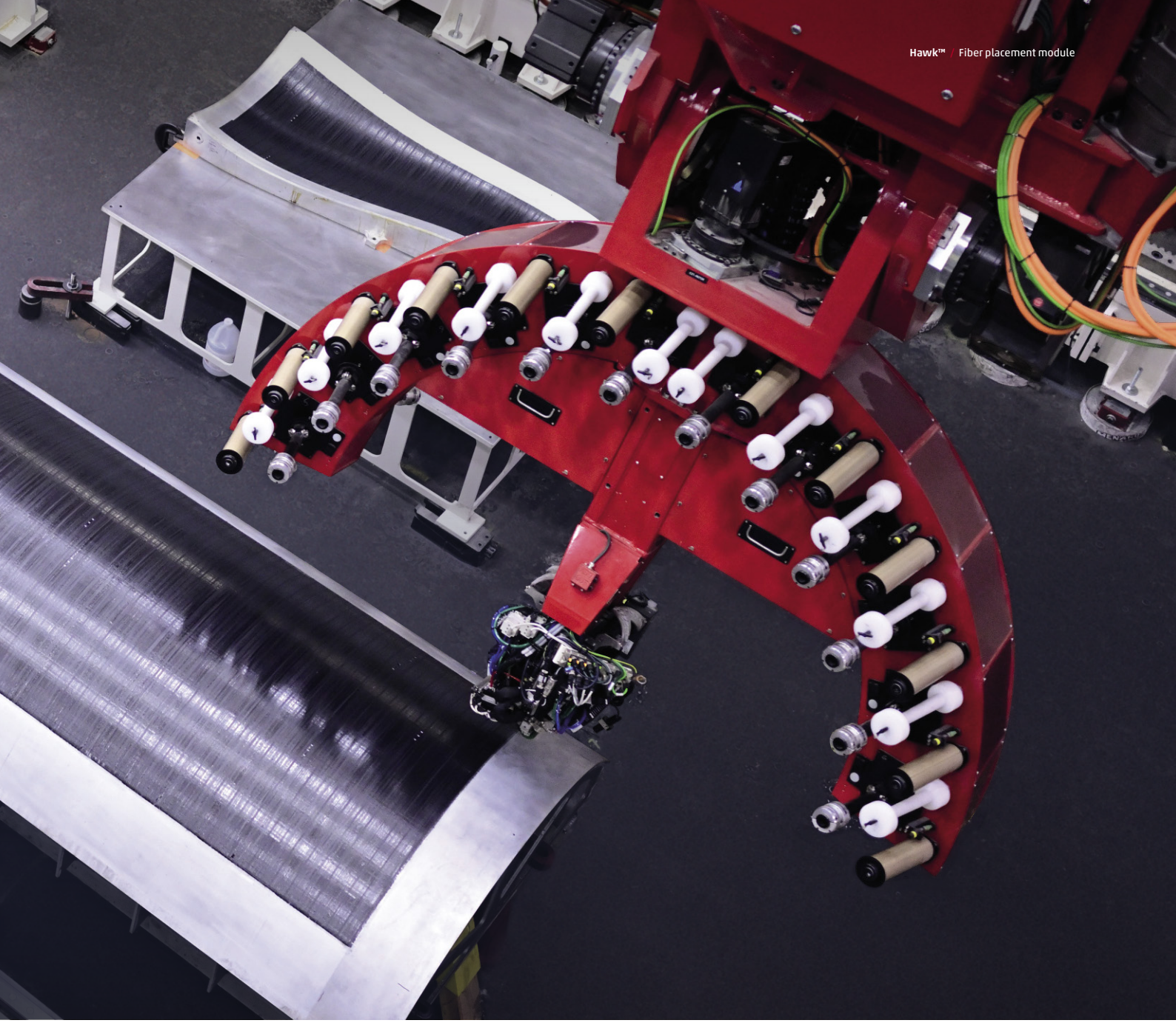
Hawk™ is Ingersoll Machine Tools' new Fiber Placement Module engineered for **high productivity and high reliability** layups of large aero and space structures: wings, fuselages, rocket-stages, fairings...

Designed to maximize **reliability**, **ergonomics**, **and productivity** while also offering extremely large working volumes, Hawk™ is uniquely positioned as the equipment of choice for **high throughput** applications.

With its unique bundle of **short / untwisted tow path** and **ergonomic / modular subassemblies** Hawk™ provides a defect-free layup with minimal maintenance and effortless spool loading/threading. Hawk™ can place a **wide variety of fiber reinforced materials**, from the most common to the most challenging, including epoxies, BMI, thermoplastics, carbon fiber, glass fiber, and more. Programming, simulation, optimization, and diagnostics are performed through Ingersoll proprietary software.

Hawk™ is offered in 4 to 24 tow varieties (1/8", 1/4", or 1/2" wide) with these multiple configurations being **automatically exchanged** and operated to increase the quality and the productivity of your lay-up process.

Hawk™ size and configuration can be easily tailored and optimized to fit the customer's process and meet their end-user needs.



Hawk™ / Fiber placement module

BENEFITS

Productivity

Reduce the manufacturing time guaranteeing high deposition rates (m/min - lbs/h)

Quality

Obtain a layup free of defects, with consistent and repeatable tolerances

Capacity

Layup large and extra-large structures

Versatility

Possibility to add a new manufacturing processes when they become necessary

Feasibility

Layup mild curvature, locally flat surfaces using all main fiber reinforced materials

High ROI/ Low TCO

Limited Technology Acquisition Costs and Low Operating Costs

HAWK™

FEATURES AND BENEFITS

01 02

Productivity

FEATURES:

- 100 m/min max layup feedrate
- Add/cut tow end positional accuracy: ±2 mm at 40m/min
- Short/untwisted tow path

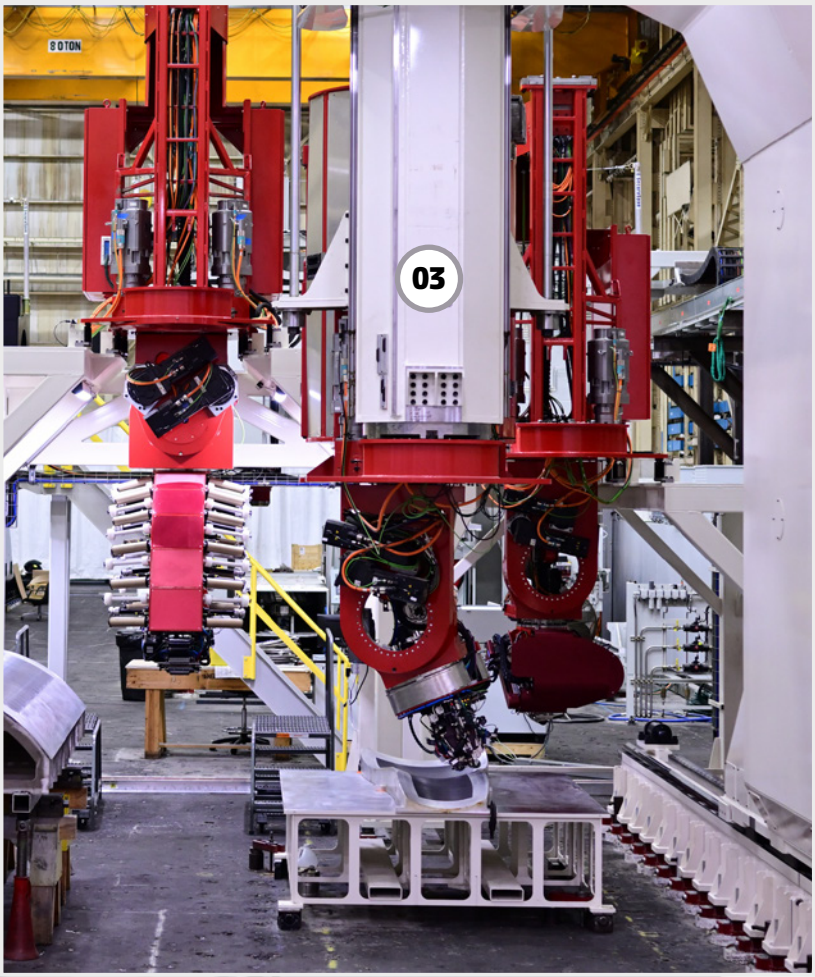
01

Feasibility

FEATURES:

- Tows heating technology: Infrared (Arc-flash technology, optional)
- Miss add and cut detection system (MCAD, optional)
- In-situ inspection via Ingersoll ACSIS™ (Automated composite structures inspection system)
- Cooled head to reduce contamination

Multi-process platform



03

High ROI/ Low TCO

FEATURES:

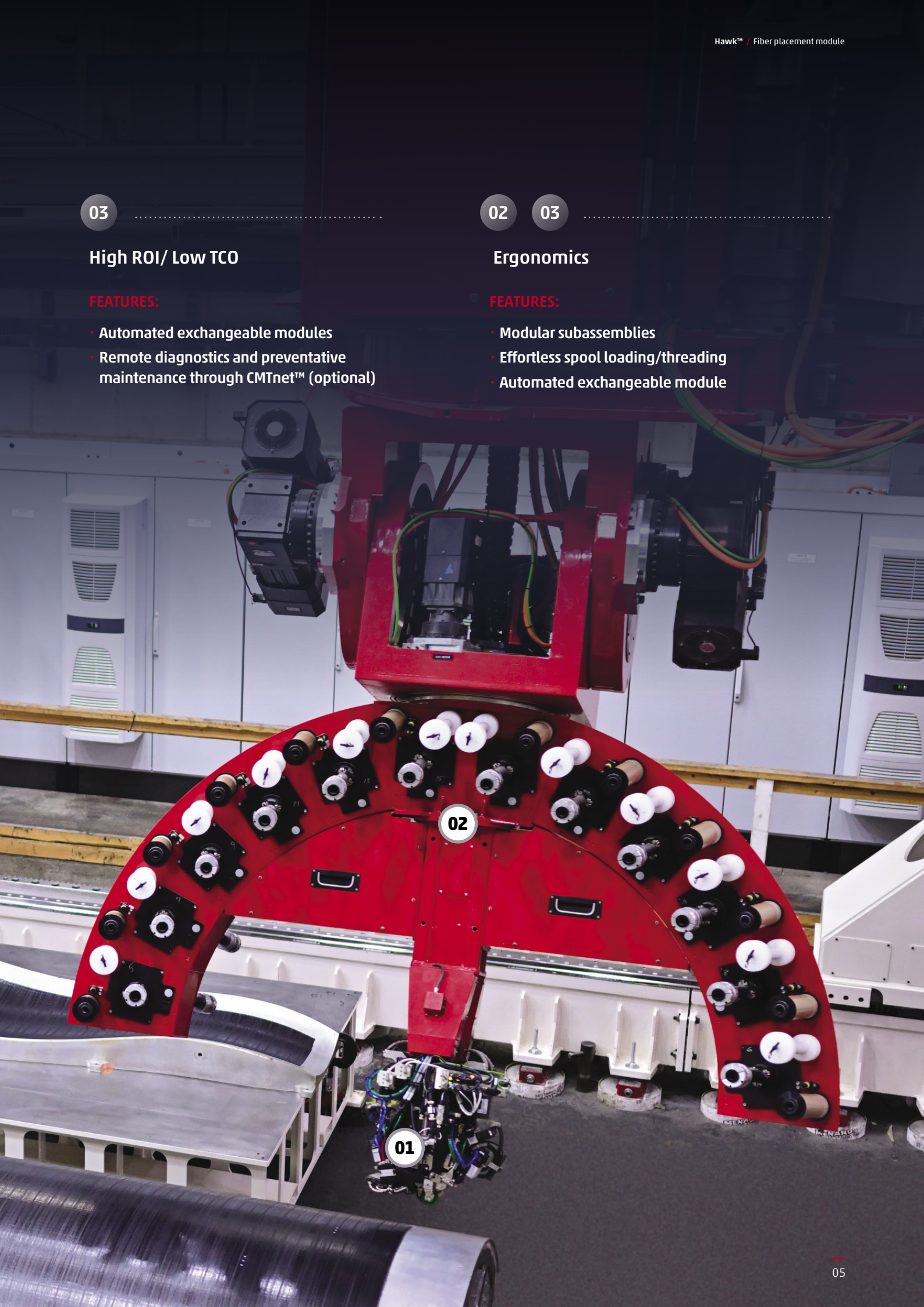
- Automated exchangeable modules
- Remote diagnostics and preventative maintenance through CMTnet™ (optional)

02 03

Ergonomics

FEATURES:

- Modular subassemblies
- Effortless spool loading/threading
- Automated exchangeable module

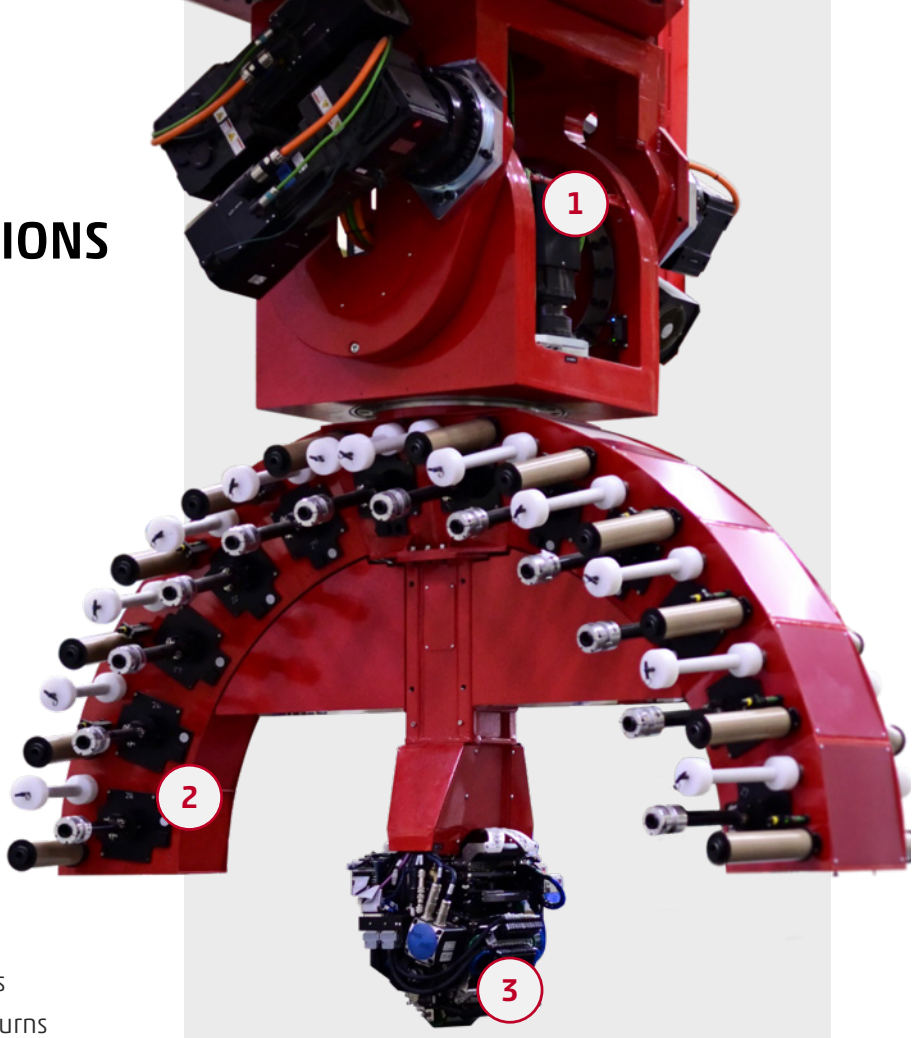


HAWK™

MODULE CONFIGURATIONS

Each one of the different Hawk™ module configurations consists of 3 main subassemblies:

- **Wrist**
- **Creel**
- **Head**



1. Wrists

The Wrist is **Hawk™** 3 polar axes assembly (C, A, C1) that - summed to the 3 linear axes of the Mongoose™ Hybrid gantry (X, Y, Z) - turns the Hawk™ Head into a 6 axes positioned end effector (point, direction, orientation and normal)[1]

Wrist (Rotary Axes):

	C	A	C1
Axis designation	**Roll**	**Bend**	**Roll**
Travel range	**+/- 225°**	**+/- 92°**	**+/- 185°**
Axis feedrate - min/max	**0-20 RPM**	**0-20 RPM**	**0-20 RPM**
Acceleration rate	**200deg/sec²**	**200deg/sec²**	**200deg/sec²**

[1] In the case of the Robotic FP™, the wrist polar axes are substituted by the robot's 6 axes

2. Creel

The Creel is **Hawk™** spools storage and spools management subassembly. The Creel and Head together are rotating with Wrist axes and moving as a single unit in order to completely avoid **tow-length-variability/tow-twisting** between the Creel and the Head. Depending on the configuration selected, the Creel comes with:

Short / untwisted tow path
Effortless spool loading/threading
Spools number: from 4 to 24
Spool max size: 3" (ID) x 8" (OD) x 11" (width)
Spool max weight: 15.5 lb
Individual tow tension control
Automated backing film material removal

3. Head

The Head is **Hawk™** tow placement end-effector, capable of accurate deposition of wide variety of fiber reinforced materials, from the most common to the most challenging, including epoxies, BMI, thermoplastics, carbon fiber, glass fiber, and more.

The **Hawk™** Head has been designed and is cooled to minimize contamination by carbon fiber and resin. In addition, the Head is built with quick exchange and interchangeable components in order to minimize the time required for maintenance.

Depending on the configuration selected, the Head comes with:

Tows numbers: from 4 to 24, actuated individually, symmetrically and asymmetrically
Tows size: 1/8", 1/4, 1/2"
Tows compaction force system: from 50 to 500 lbf (programmable)
Tows heating technology: infrared (standard, and arc-flash, optional)
Tow catches modules to avoid pullback
Tow add module with quick exchange
Tow cut module with quick exchange
Self-adjusting compliance travel: ±20 mm
Conformable set of tow compaction rollers
Cooling for the components in contact with fiber to minimize resin build-up
Feed axis tow wrap detection system

Miss Add and Cut Detection System (MCAD, Optional)
Remote diagnostics and preventative maintenance through CMTnet™ (optional)
In-situ inspection via Ingersoll ACSIS™ (Automated Composite Structures Inspection System)
True bi-directional layup capability
100 mm minimum add length
100 m/min max layup feed-rate
Add/cut tow end positional accuracy: ±2 mm at 40m/min
Max tow acceleration: 4 m/sec^2
0.5 degree ply orientation accuracy
Tool probing through touch-free laser system

APPLICATION SECTORS

SPACE & AEROSPACE

DEFENSE & NAVAL

UNIVERSITIES & RESEARCH CENTER

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Ingersoll Machine Tools, Inc.
707, Fulton Avenue
Rockford, 61103 Illinois
USA
Tel. +1 815 987 6000
info@ingersoll.com

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www.ingersoll.com