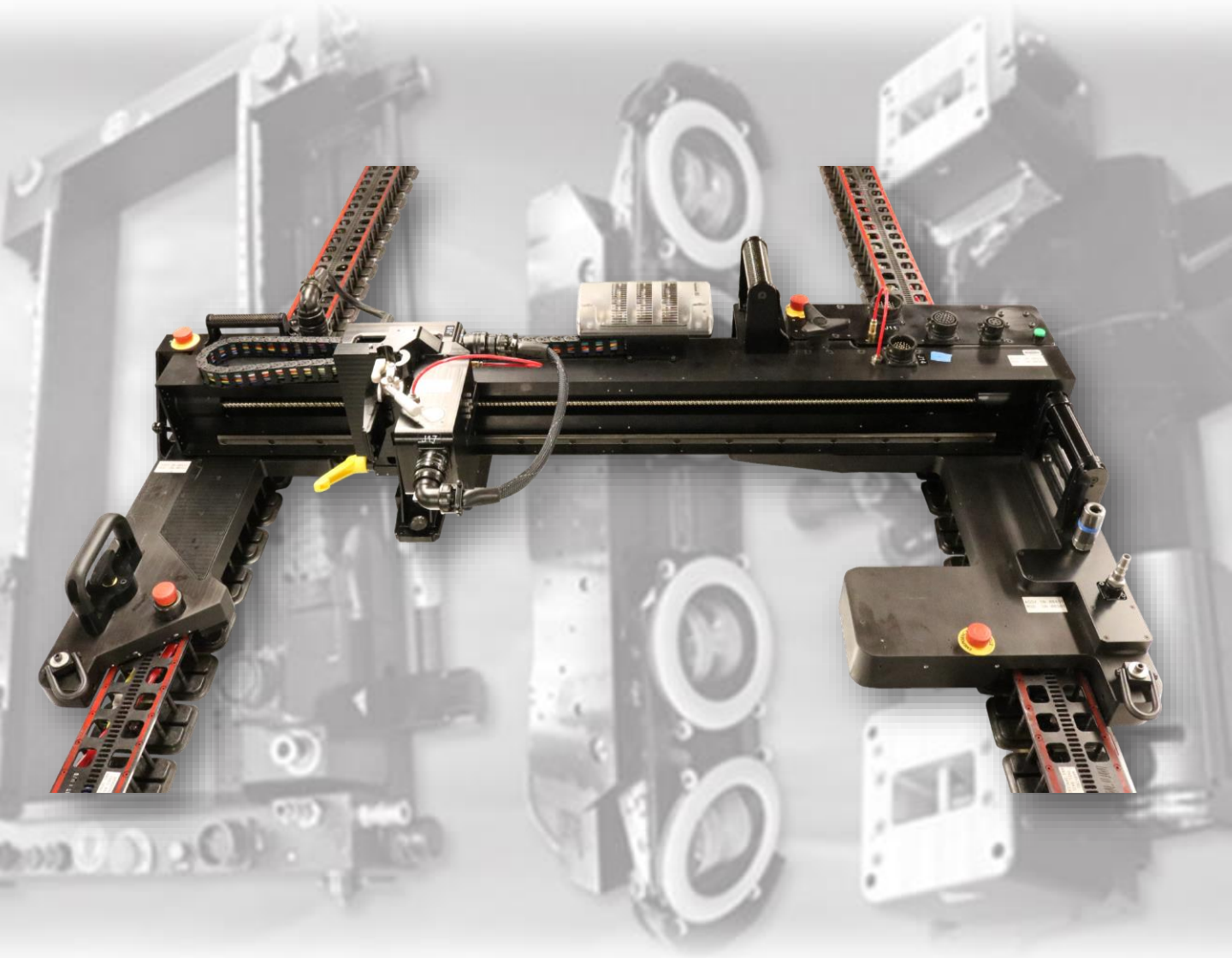




MTM ROBOTICS

Light Flextrack (LFT) System 2.7.3



Delivering New Technology to the Factory Floor



Light Flextrack (LFT) System 2.7.3

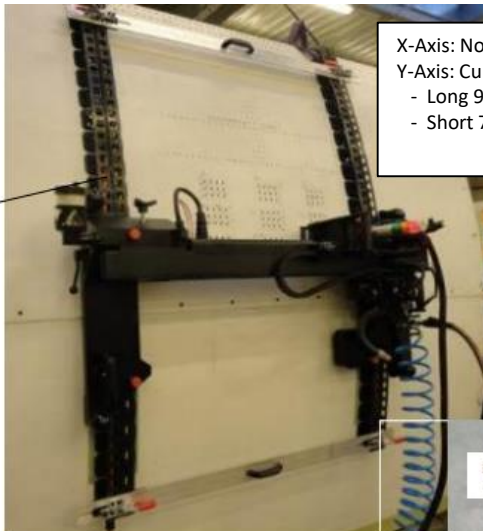
Overview

- NI SOM controller and Supports Seti Tech ADU or an Electric End Effector
- Design optimized for single curvature orbital joints
- Curvature from flat to 1.2m radius
- Modular design with wide working window of 650mm or 900mm
- Single person manual installation onto aircraft
- Integral Vision System and Through Skin Sensor

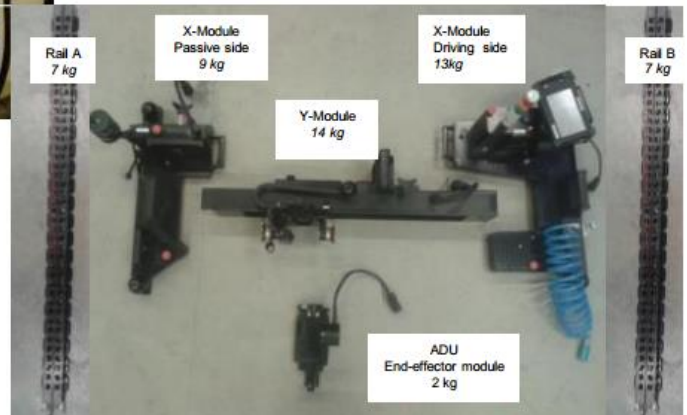
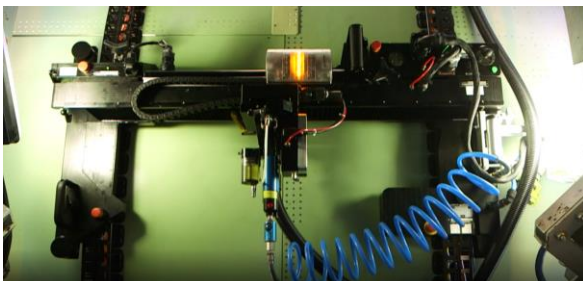
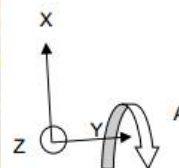
Working Surfaces

| | |
|------------------|--|
| Surface Finish | Typical aircraft skin finishes including smooth, painted, raw metal, and shiny painted and raw finishes. |
| Surface Geometry | The skin must have single curvature with the rail mounted normal to the axis of curvature. There may be panel overlaps of up to 5mm thickness. Normalization of the End Effector to surfaces is dependent on adjusting the height of the rails off the skin. |
| Materials | Aluminum 2024-7075. Other materials upon review by MTM |

Flexible
vacuum rail
directly mounted
on the structure



X-Axis: No Limit. Rails Can Be Coupled Together.
Y-Axis: Currently Two Options
- Long 900mm
- Short 700mm

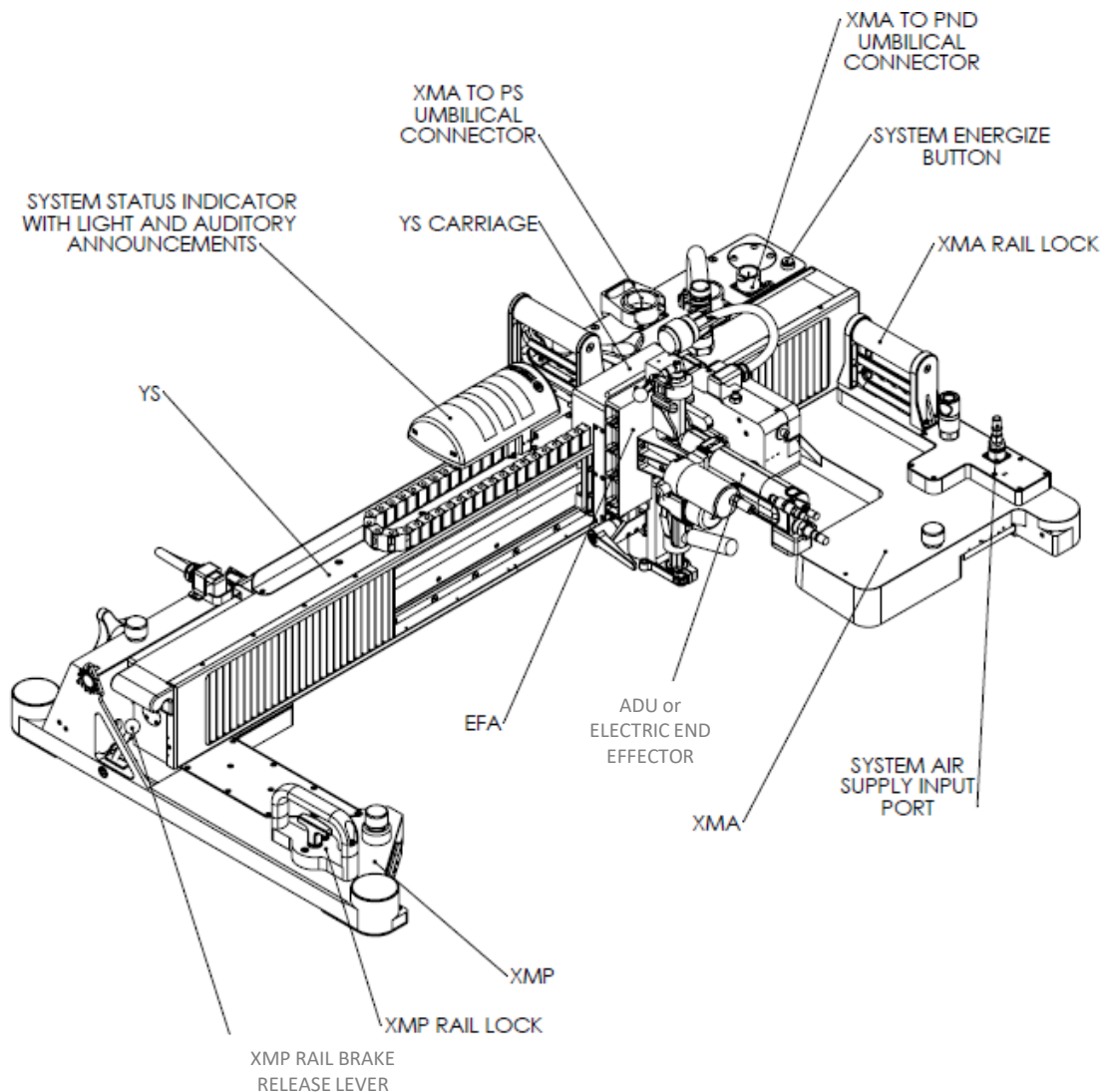




Light Flextrack (LFT) System 2.7.3

Overview

- Ability to disassemble and reassemble by one person in less than 5 minutes.
- No module weighs more than 33 pounds (15kg)
- Easily transported across factory without having to call in a crane, in creasing productivity.
- Modules can be replaced without having to repair the entire robot or perform expensive repairs.

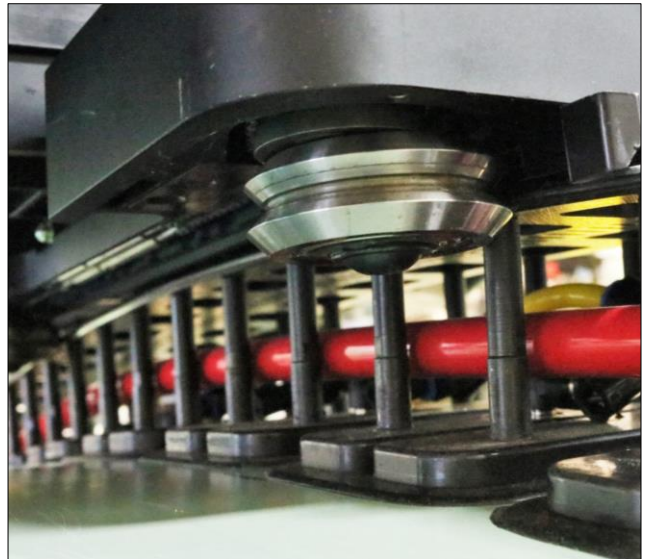




Light Flextrack (LFT) System 2.7.3

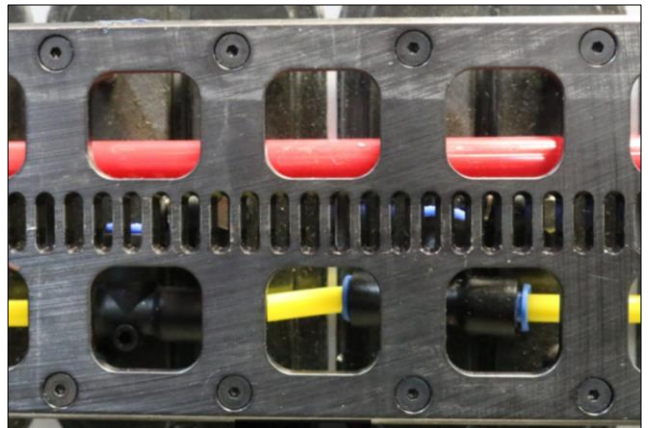
Flextrack Overview

The Flextrack system is essentially a flexible rack and pinon rail system that a robotic carriage uses to travel on to preform drilling operations. Specialty suction cups designed by MTM Robotics are integrated under the Flextrack rail and hold robotic carriages accurately to the fuselage skin. Flextrack rails have the ability to conform to flat or curved surfaces.



Key Features

- Quick and easy single operator setup
- Simple addition of rails using rail splices
- Works on up to a 47in radius (1200mm)
- Non-marking vacuum cup



Dimensions & Working Envelope

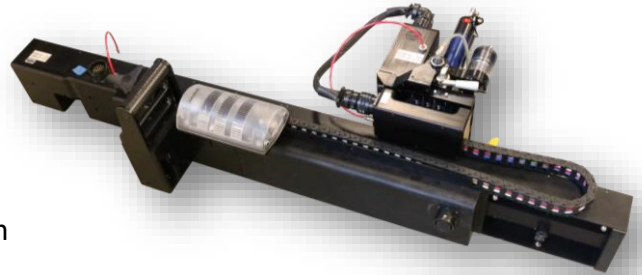
| | |
|--|--|
| Standard rail length (Custom sizes upon request) | 72 in (1.8m) |
| Typical rail weight | 2.6 lbs per ft (1.2 kg per 305mm) |
| Vacuum cup size | 5 in x 3 in (127mm x 76mm) |
| Air supply (Based on standard 72in rail) | 170 lpm (6 cfm) per rail segment @ 6 bar (85psi) |



Light Flextrack (LFT) System 2.7.3

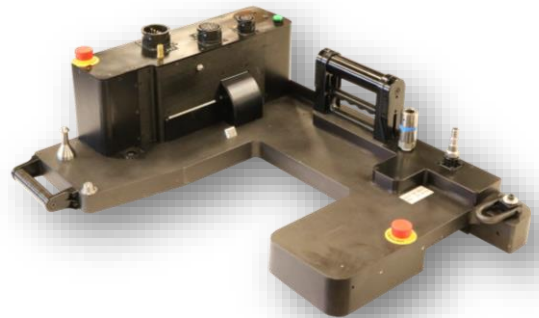
Y Module Bridge

- Available in two working windows, 650mm and 900mm (shown)
- One person installation
- Feedback sensors help ensure proper installation onto the Active X and Passive X modules.
- Integrated Through Skin Sensor and Vision System
- Supports variety of End Effectors



Active X Module

- NI SOM controller
- One person installation
- Feedback sensors help ensure proper installation onto rail and to Y Spine



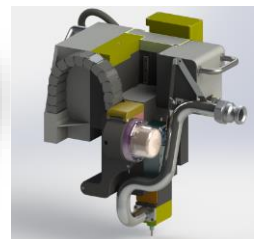
Passive X Module

- No drive motor
- One person installation
- Feedback sensors help ensure proper installation onto rail and to Y Spine



End Effector: Positive Feed Motor (i.e. ADU) or Electric Spindle

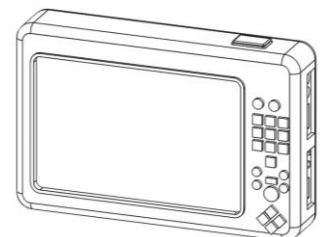
- ADU Option: Precise ADU mount allows ADU's to be swapped out while maintaining positional accuracy.
- Electric End Effector Option: Allows advanced control over the drilling process.
- One person installation



Pendant Display Interface (7" Screen)

- Windows 7 OS
- Robust IP 65 enclosure, MIL-STD 810 G/F certified
- Hot swappable batteries
- RAM Mount

Pendant
Screen

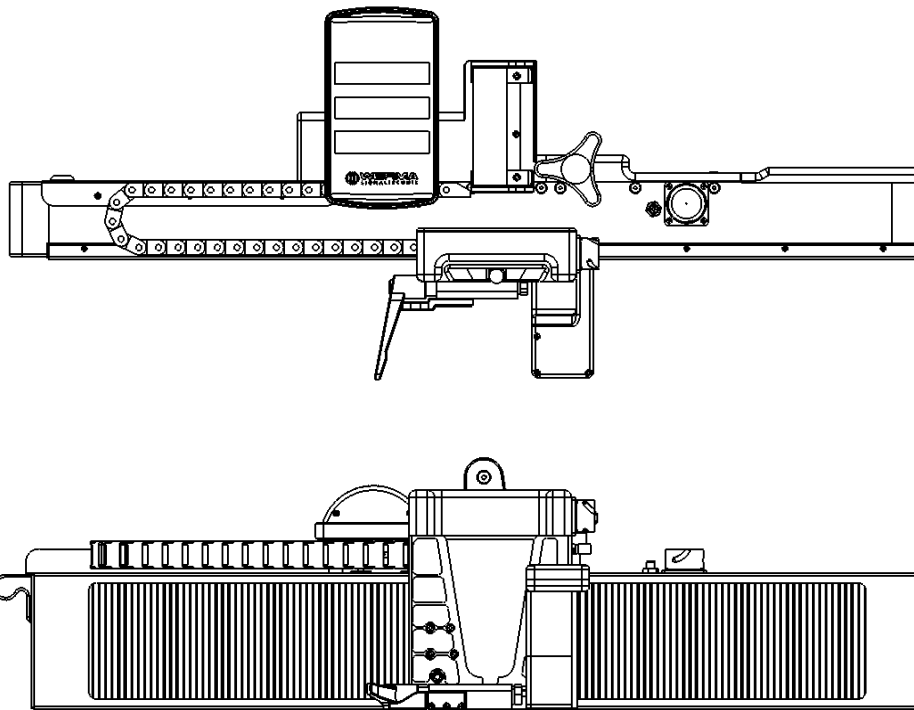




Light Flextrack (LFT) System 2.7.3

Y Module (900mm Y-Axis Stroke)

The Y Module supports all Y-Axis functionality. It spans between the Active X Module and the Passive X Module. It has a dovetail interface for quickly interfacing with the End Effector. It also houses a Cognex camera for index referencing. The length can be customized to accommodate a wide variety of applicators.



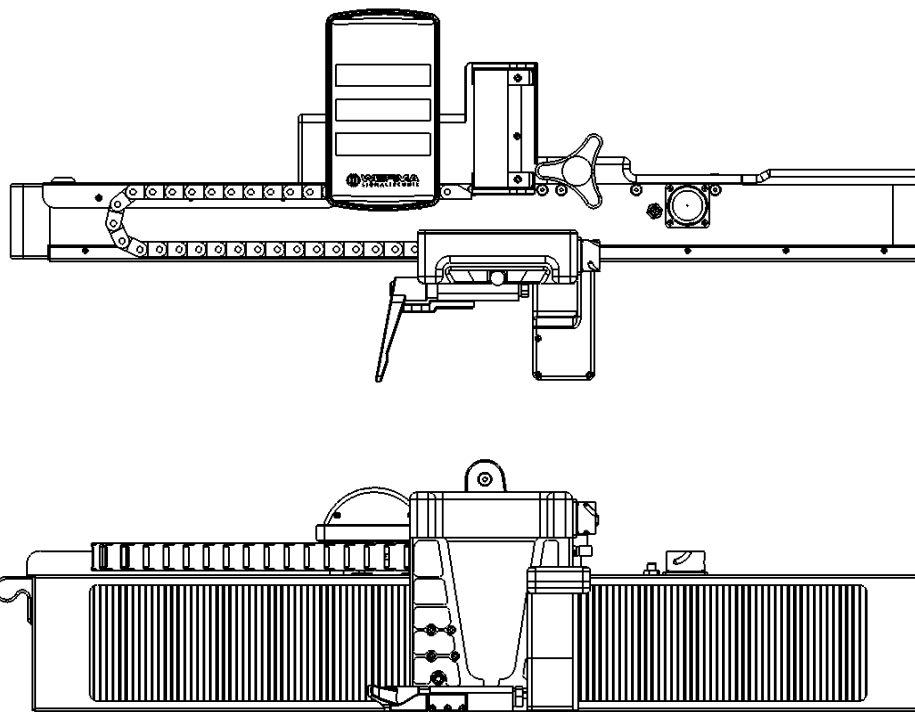
| Dimensions (900mm Stroke) | |
|---------------------------|---|
| Weight | 15 kg |
| Size (mm) | 380 X, 1340 Y, 226 Z |
| Major Elements | |
| Camera for Indexing | Cognex |
| Y-Axis Drive System | Precision Ball Screw w/ Industrial Brushless DC Servo Motor |
| End Effector Interface | Locking Tapered Dovetail |



Light Flextrack (LFT) System 2.7.3

Y Module (480mm Y-Axis Stroke)

The Y Module supports all Y-Axis functionality. It spans between the Active X Module and the Passive X Module. It has a dovetail interface for quickly interfacing with the End Effector. It also houses a Cognex camera for index referencing. The length can be customized to accommodate a wide variety of applicators.



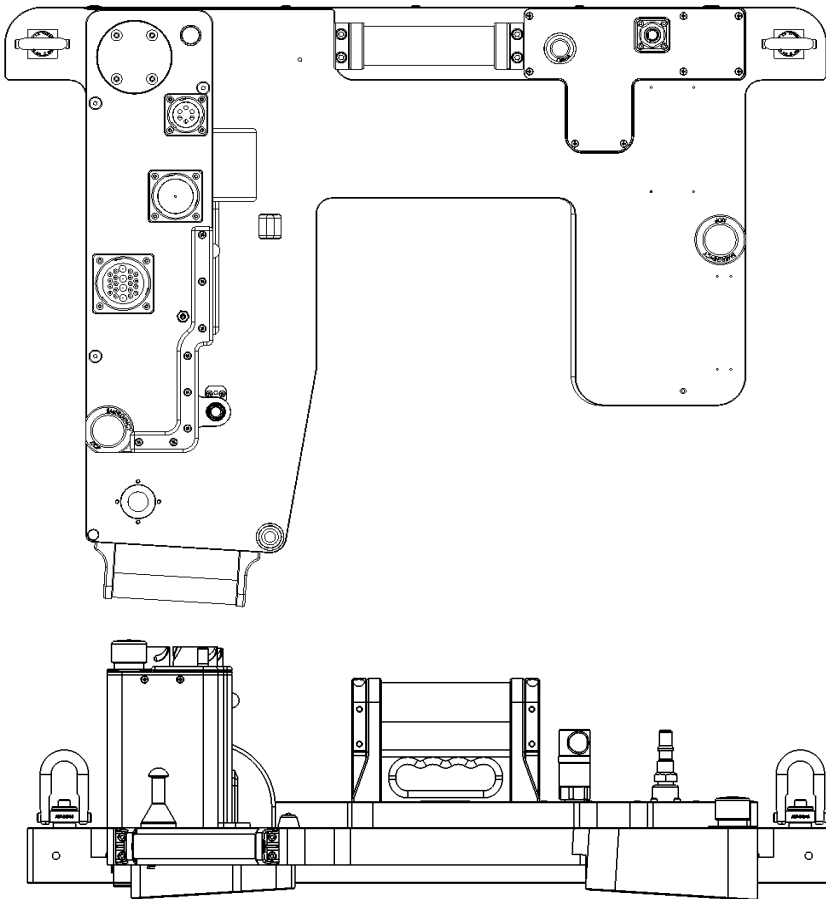
| Dimensions (480mm Stroke) | |
|---------------------------|---|
| Weight | 15 kg |
| Size (mm) | 380 X, 926 Y, 226 Z |
| Major Elements | |
| Camera for Indexing | Cognex |
| Y-Axis Drive System | Precision Ball Screw w/ Industrial Brushless DC Servo Motor |
| End Effector Interface | Locking Tapered Dovetail |



Light Flextrack (LFT) System 2.7.3

Active X Module

The Active X Module is the primary building block of the LFT 2.7 robot and houses the X-Axis precision drive train. It is the central connection point for the robot and contains an NISOM system controller



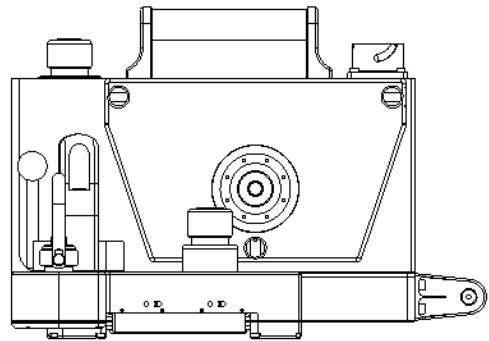
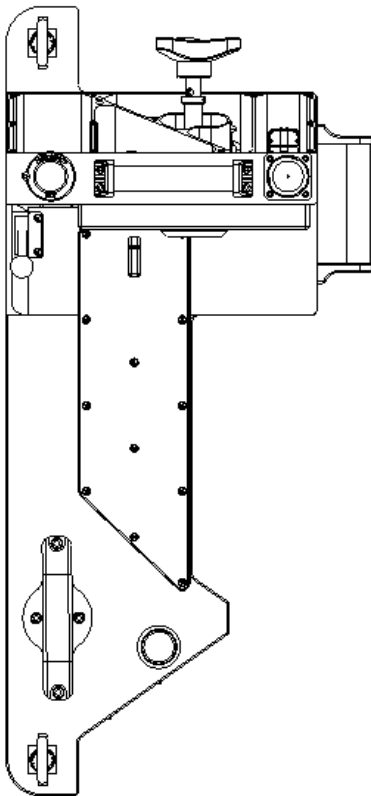
| Dimensions | |
|-------------------------|--|
| Weight | 14 kg |
| Size (mm) | 699 X, 524 Y, 226 Z |
| Major Elements | |
| Controller | NI SOM |
| X-Axis Drive System | Motor with Harmonic Drive Reduction |
| V-Groove Preload | Pneumatic |
| Sensors | |
| Obstruction Detection | Proximity sensors sighted along rails |
| Installation to Rail | V-groove lock sensor indicates correct installation |
| Installation to Y-Spine | Proximity sensor indicates correct installation torque |
| Rail Home Position | Optical sensor detects home position on rail |



Light Flextrack (LFT) System 2.7.3

Passive X Module

The Passive X Module supports the Y-Module and allows for a Y-Axis stroke of up to 900mm. Its primary function is to support Z-Axis loads when the drilling end effector clamps to the work surface.



| Dimensions | |
|------------|---------------------|
| Weight | 8 kg |
| Size (mm) | 699 X, 324 Y, 226 Z |

| Major Elements | |
|-------------------|-------------------|
| V-Groove Clamping | Twist Lock Handle |

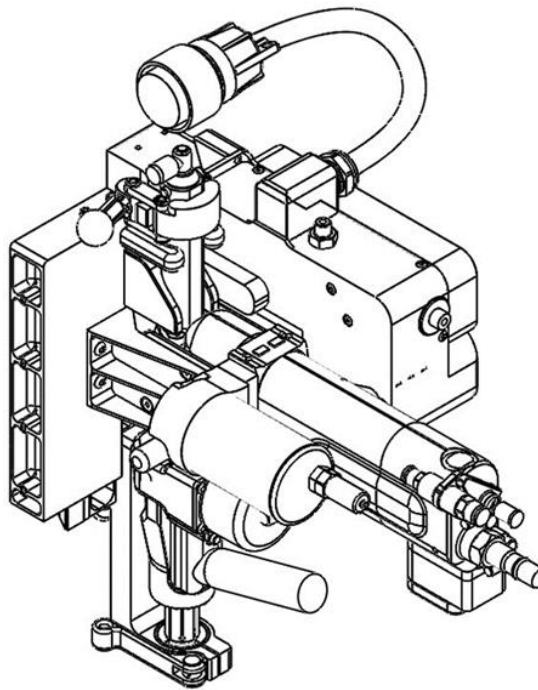
| Sensors | |
|-------------------------|--|
| Obstruction Detection | Proximity sensors sighted along rails |
| Installation to Y-Spine | Proximity sensor indicates correct installation torque |



Light Flextrack (LFT) System 2.7.3

Pneumatic Drilling End Effector for Positive Feed Motors

The Drilling End Effector is part of the LFT 2.7.3 modular robot. The compact design contains a pneumatic spindle along with a vision system and magnetic through skin sensor (TSS), and innovative design allows the the LFT 2.7.3 robot to precisely orient itself on an aircraft surface and drill high quality holes.



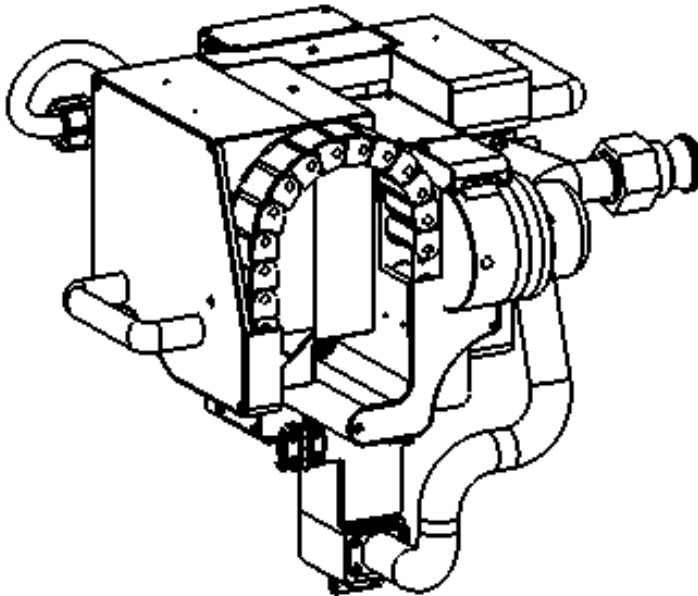
| Dimensions | |
|------------------------|---|
| Weight | 4 kg |
| Size (mm) | 351 X, 200 Y, 343 Z |
| Fly Height (mm) | 10 Typical |
| Major Elements | |
| ADU Clamp Axis | Pneumatic |
| Module Mounting System | Precision Dovetail |
| ADU Actuation System | Pneumatic |
| Sensors | |
| ADU Detection | Proximity sensor built into latch detects installation of ADU |



Light Flextrack (LFT) System 2.7.3

Electric Drilling End Effector

The Electric Drilling End Effector is part of the LFT 2.7.3 modular robot. Our spindle provides control over many drilling functions including drilling feeds and speeds, drilling by layer, programable through bit coolant, broken drill bit detection, HSK-32 tool holder with RFID, and many other key features and functions.



| Dimensions | |
|-----------------|---------------------|
| Weight | 15 kg |
| Size (mm) | 290 X, 410 Y, 360 Z |
| Fly Height (mm) | 10 Typical |

| Major Elements | |
|------------------------------|--|
| Spindle Motor (RPM) | Programable DC Servo Motor (up to 12000 rpm w/ 1:2 pulley) |
| Module Mounting System | Precision Dovetail |
| ADU Actuation System | Programable Pneumatic |
| Coolant Option | Programable Through Bit or Side Mist |
| Tool Holder | Tribos HSK-32 with RFID |
| Countersink Accuracy | $\pm 0.05\text{mm}$ (.002in) |
| Built in Through Skin Sensor | For Blind Hole Magnetic Sensing |



Light Flextrack (LFT) System 2.7.3

Dimensions

| | |
|---------------|---|
| LFT-2.7-T650A | 700mm X, 995mm Y, 360mm Z 59 kg max |
| LFT-2.7-T900A | 700mm X, 1340mm Y, 360mm Z 60 kg max |

Working Envelope

| | |
|--------------------------------|------------------------------------|
| Orbital Direction (Along Rail) | Determined by Number of Rails Used |
| Longitudinal Direction | 650mm or 900mm (shown below) |
| End Effector Fly Height | 10mm typical |
| Skin Curvature | 1200mm to 4000mm radius |
| Orientation | Robot will work in any orientation |

Positional Accuracy

| | |
|--------------------------------|---|
| Hole Normality | $\pm 0.5^\circ$ |
| Positional Accuracy (Y-Window) | $\pm 0.5\text{mm}$ (650mm), ± 0.65 (900mm): From Reference Features |

