

Background and Motivation

- Micro Motion** ships high precision products requiring reliable protection
- Validation:** Drop testing mimics real world impacts
- Limitation:** Outsourcing slows turnaround and flexibility
- Efficiency:** In-house testing is faster and cheaper
- Sustainability:** Enables testing of more eco-friendly packaging

Machine Requirements

- ✓ 3'x5'x10' footprint
- ✓ 120V outlet supply
- ✓ Packages up to 90lbs
- ✓ Supports all packages on all face, corner, and edge orientations
- ✓ 15 second drop cycle
- ✓ 12"- 48" drop height
- ✓ 120psi compressed air inlet

Testing for Qualifications

- Goal:** Determine drop mechanism motion and verify machine operation
- Verified package support with gooseneck assembly
- Able to support 90lbs package
- Tested 10 box orientations
- 13 second drop cycle
- Verified electronic safety features

Future improvements

- Structure:** Optimize members for actual forces, potentially switch to aluminum extrusion
- Electrical:** Add height readout on controller, PCB with SMT
- Drop Mechanism:** Add pneumatic system for damping. Enlarge tracks to improve reliability

Height Adjustment

12" - 48" Drop Range

Height Lock: Friction clamp and internal hoist brake, lock carriage before drop

Structure Integration: Linear rails ensure smooth adjustment and alignment

Electronically controlled Chain Hoist adjusts drop height

TIG Welded Frame: 30 individual members, 400+ pounds of steel

Custom Controller and PCB: Controller with custom silicone buttons dictates fool-proof user inputs

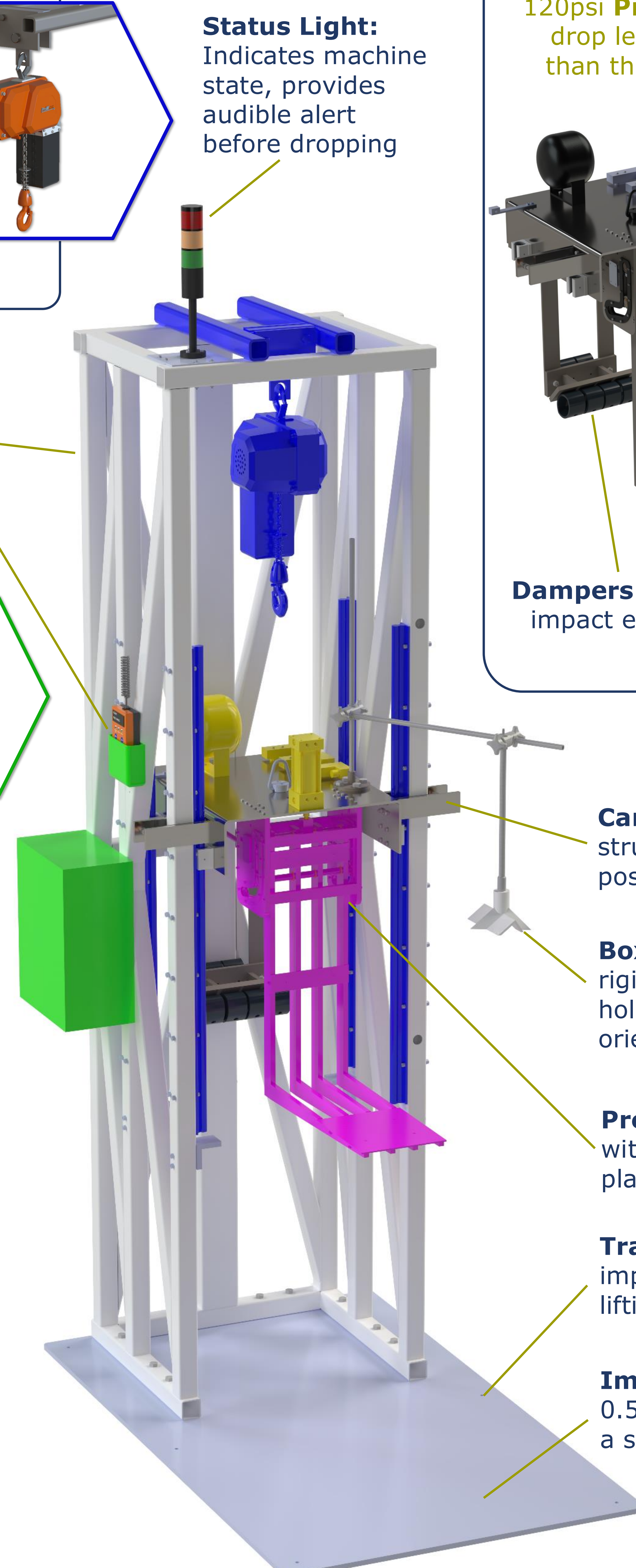
Electronics and UI

Electronics control height adjustment and drop sequence

Custom Power PCB

- Power
- LCD
- Valves
- Limit Switches
- Status Light
- Microcontroller
- Remote Power
- Hoist Remote
- Linear Encoder

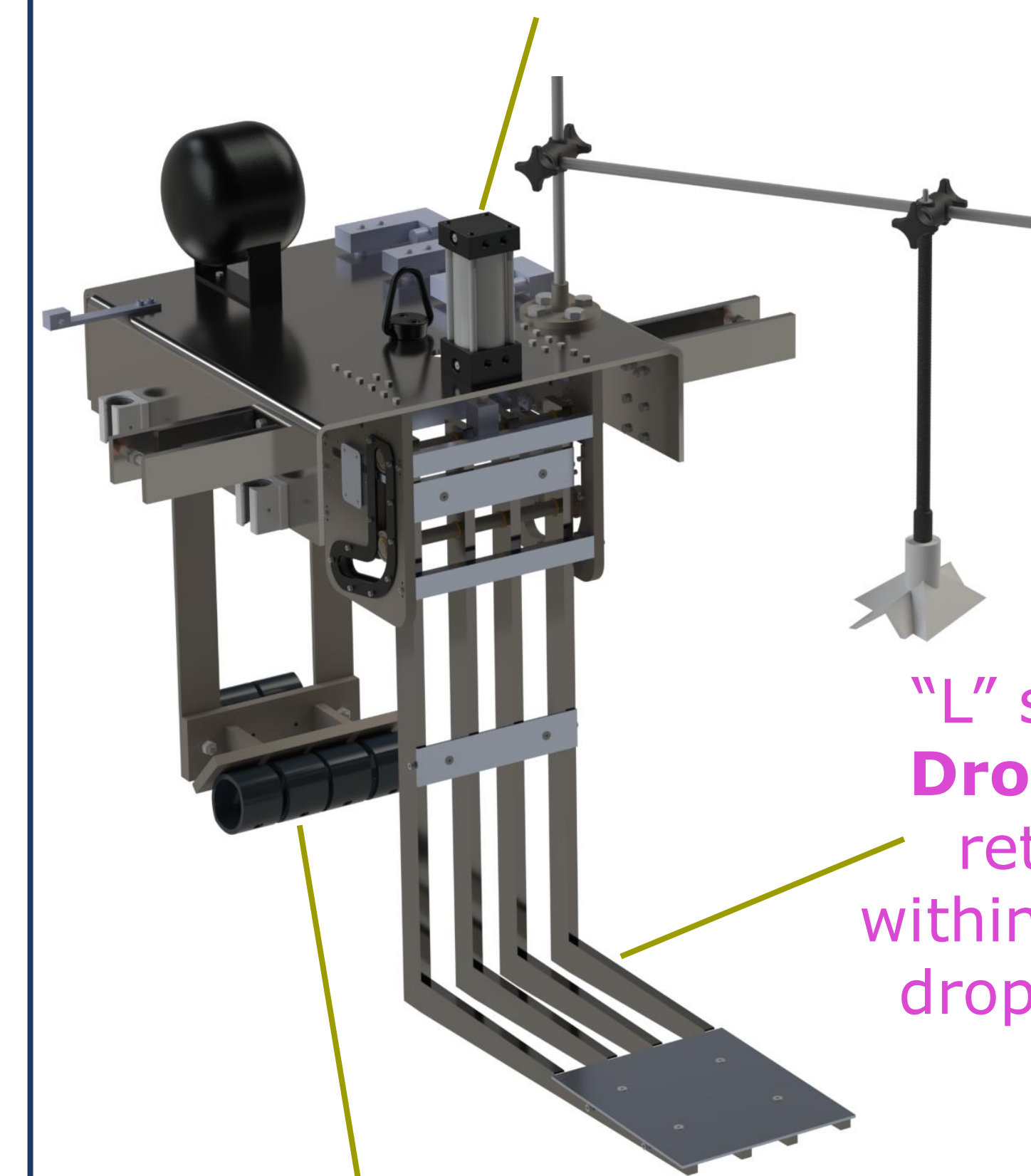
- User Interface:** Operated by custom controller. Status light and LCD indicate machine state to user
- Safety-Based Operation:** Firmware uses arming sequence to prevent damage and ensure safety
- Safety Circuit:** Hardwired safe states are triggered by internal logic & manual E-stop



Status Light: Indicates machine state, provides audible alert before dropping

Drop Mechanism

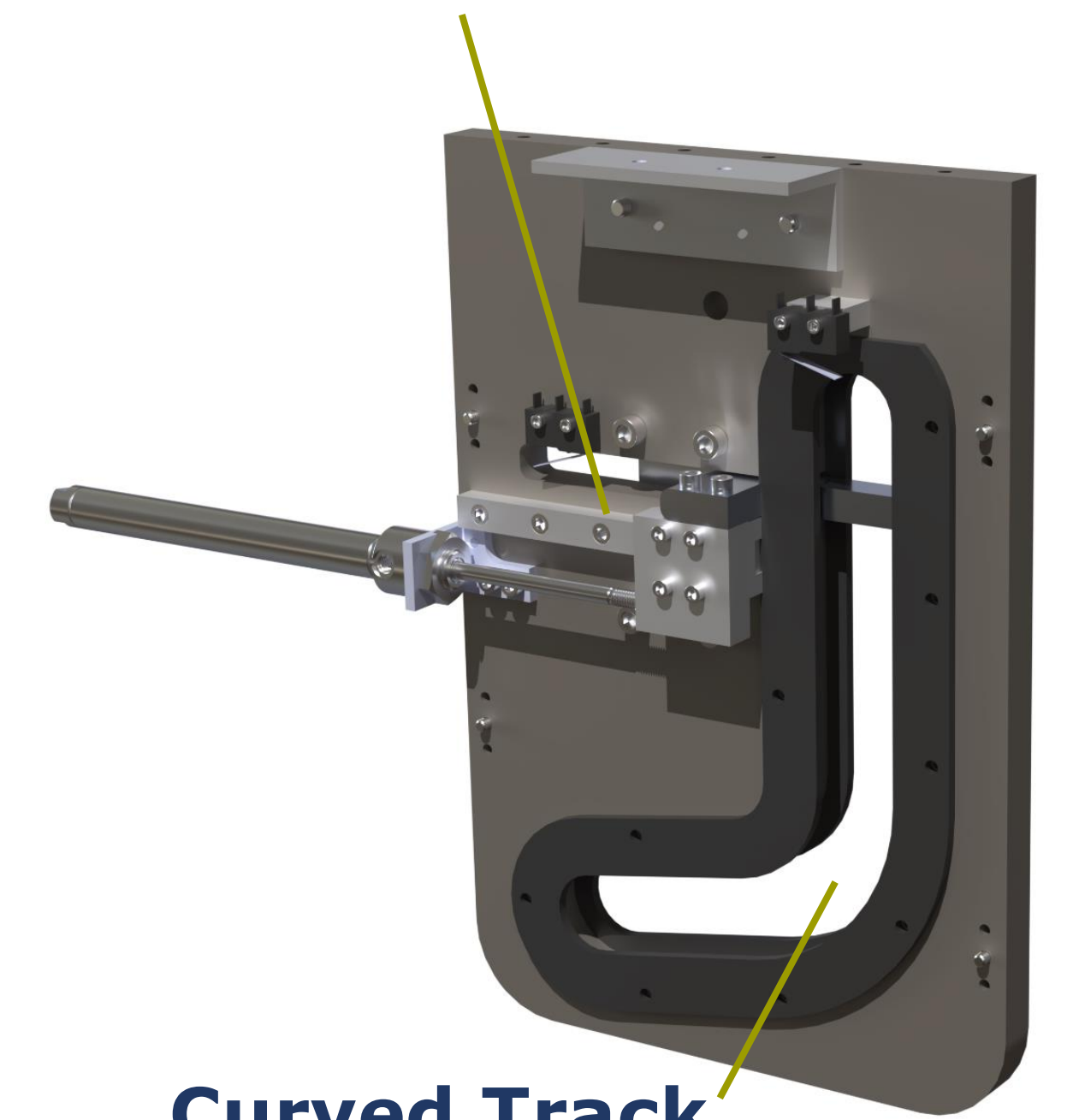
120psi **Pneumatics** push drop leaf down faster than the package falls



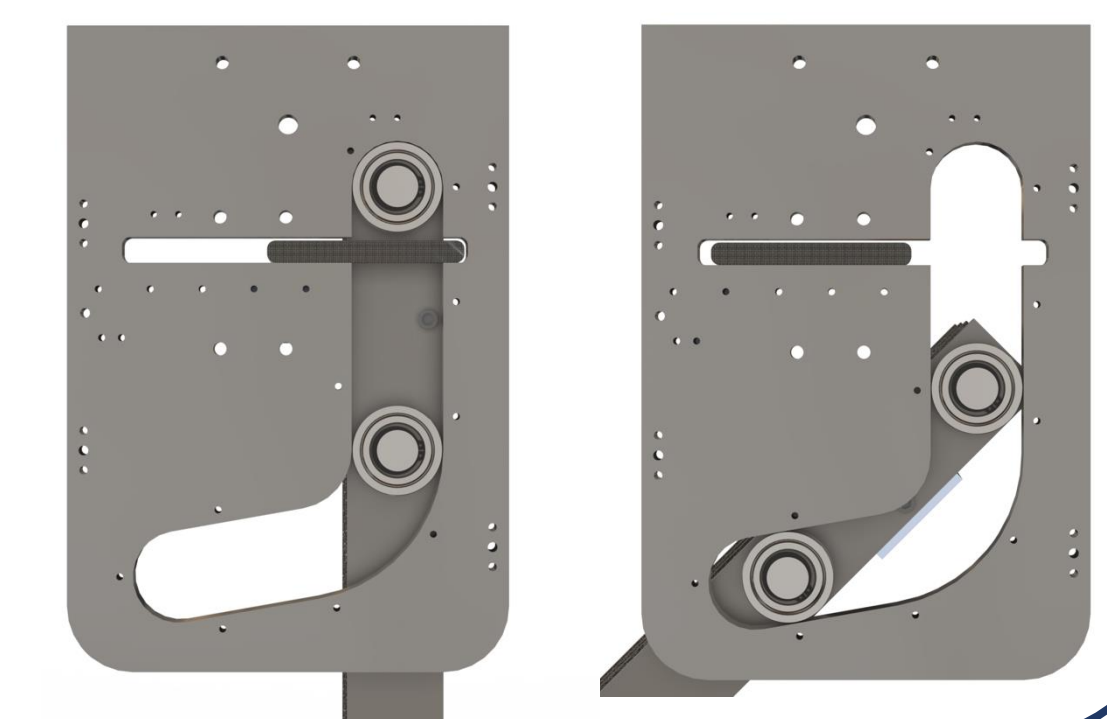
Dampers absorb impact energy

"L" shaped **Drop Leaf** retracts within the 12" drop height

Leaf Lock keeps platform in loading position



Curved Track ensures smooth motion of drop leaf



Carriage Stabilizer: Clamps to structure to hold the carriage in position during drops

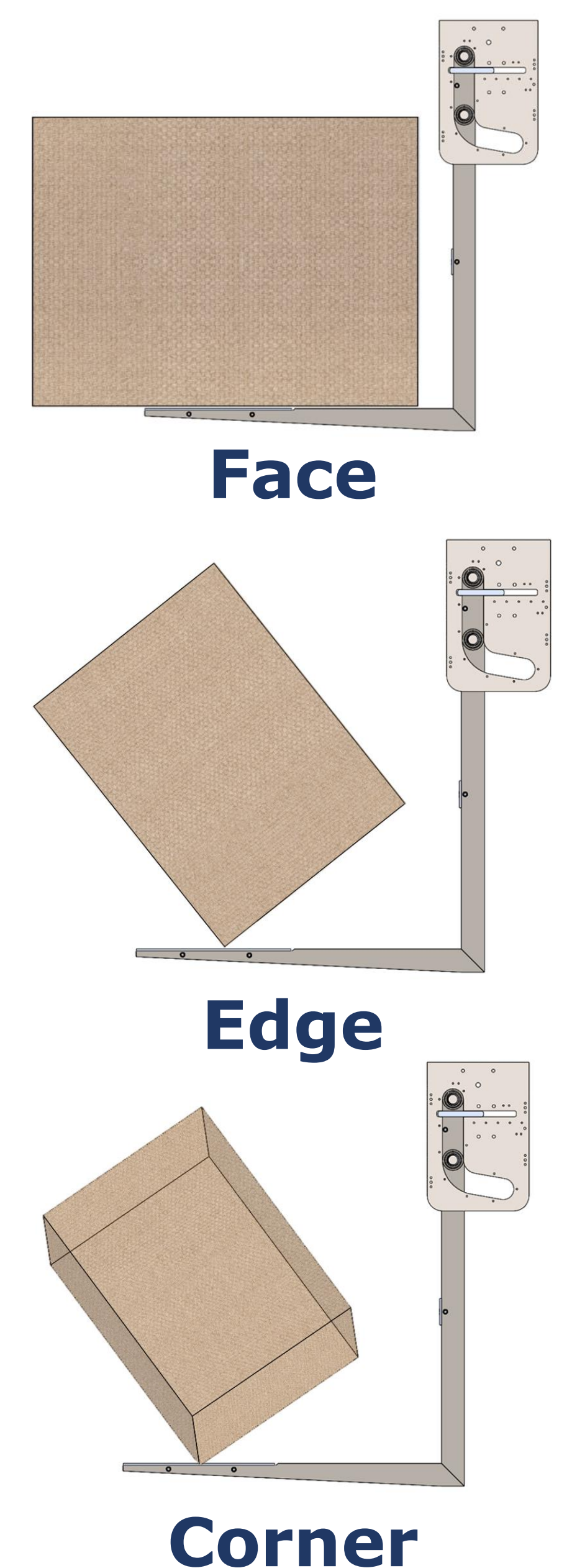
Box Orientation Fixture: Uses rigid links with a custom claw to hold boxes in the required orientations

Precision Alignment: Pins with tight tolerances hold drop platform flat within one degree

Transportation: Detachable impact surface and 6 removable lifting eyes aid transportation

Impact Surface: 3'x5' plate of 0.5" water jet cut steel provides a stable and flat base

Required Drop Orientations



Background and Motivation

- Precision:** High value products need strong protection
- Validation:** Drop testing mimics real world impacts
- Limitations:** Outsourcing slows turnaround and flexibility
- Efficiency:** In-house testing is faster and cheaper
- Sustainability:** Enables more eco-friendly packaging

Machine Requirements

- ✓ Includes safety features
- ✓ 120V outlet supply
- ✓ Packages up to 90lbs
- ✓ Supports all packages on faces, corners, and edges
- ✓ 15 second drop cycle
- ✓ 3'x5'x10' footprint
- ✓ 12"-48" drop height

Manufacturing

- Quantity:** 110 machined components, 300+ hours of machining
- TIG Welded Frame:** 30 individual members, 400+ pounds of steel
- Impact Surface:** 3'x5' plate of 0.5" water jet cut steel provides a stable and flat base for packages to land on
- Precision Alignment:** Tight tolerances and alignment pins hold drop platform flat within one degree
- Transportation:** Impact surface is removable for transportation, removable lifting eyes allow transportation with forklift or crane

Height Adjustment

12" - 48" Drop Range

Height Lock: Friction clamp and internal hoist brake, lock carriage before drop

Structure Integration: Linear rails ensure smooth adjustment and alignment

Electronically controlled Chain hoist adjusts height

Electronics and UI

User Interface: Custom controller, status light, and LCD indicate machine state to user

State-Based Sequence: Firmware uses arming sequence to prevent damage and ensure safety

Safety Circuit: Hardwired safe states are triggered by internal logic & manual E-stop

Future Improvements: Height readout on controller and PCB with SMT

Primary PCB

- Valves
- Power
- LCD
- Limit Switches
- Status Light
- Microcontroller
- Remote Power
- Hoist Remote
- Linear Encoder

Electronics control height adjustment and drop sequence

Required Drop Orientations

Face

Edge

Corner

Drop Mechanism

120psi Pneumatics push drop leaf down faster than the package falls

Leaf Lock keeps platform in loading position

"L" shaped Drop leaf allows retraction within the 12" drop height

Curved track ensures smooth motion of drop leaf

Damper system absorbs impact energy

Testing

Pneumatic Testing

- Drop leaf dynamics and impact with damping mechanism

Height Adjustment Tests

- Tested carriage motion with linear rails
- Accuracy of height readout

Remote Testing

- Drop sequence verification
- Remote button logic tests including edge cases

Package Drop Testing

- Verifying package support with gooseneck assembly
- Tested for package interference when dropping
- Able to support 90lb package
- Tested 10 box orientations

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- ✓ 12"-48" drop height

Testing for Qualifications

- Goal:**
- package support with gooseneck assembly
 - Tested for package interference when dropping
 - Able to support 90lb package
 - Tested 10 box orientations

Height Adjustment

12" - 48" Drop Range

Height Lock: Friction clamp and internal hoist brake, lock carriage before drop

Structure Integration: Linear rails ensure smooth adjustment and alignment

Electronically controlled Chain hoist adjusts height

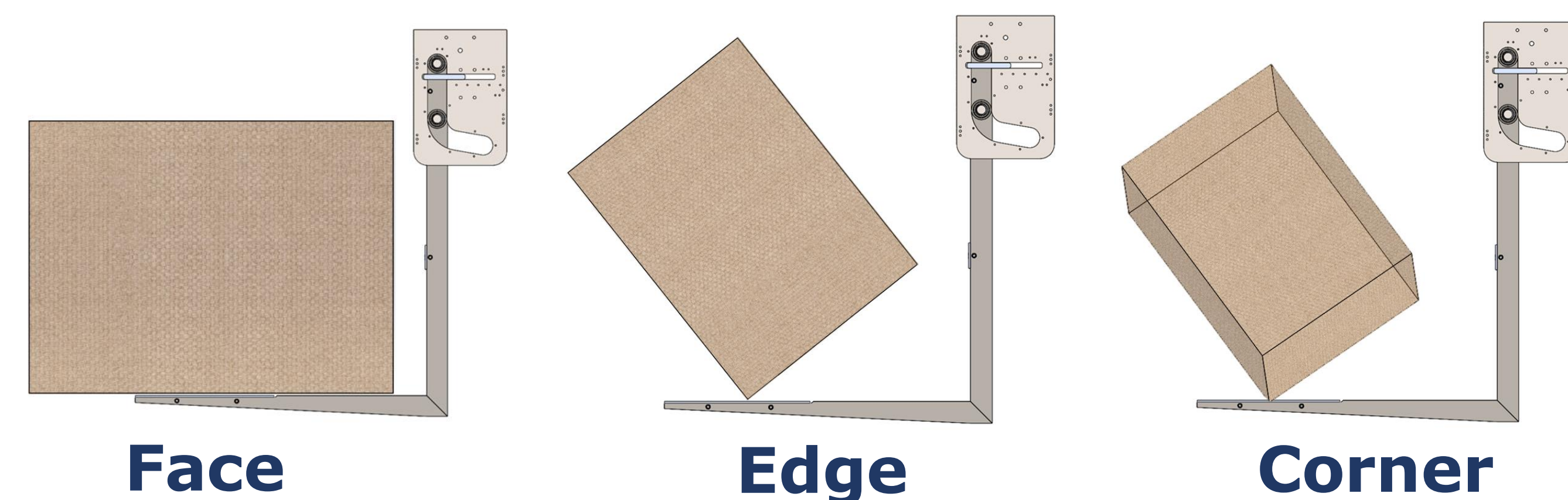
Status Light and Alarm: asdf jl;kfjff jfoqoruitasflf lmandf

TIG Welded Frame: 30 individual members, 400+ pounds of steel

Precision Alignment: Tight tolerances and alignment pins hold drop platform flat within one degree

Impact Surface: 3'x5' plate of 0.5" water jet cut steel provides a stable and flat base for packages to land on

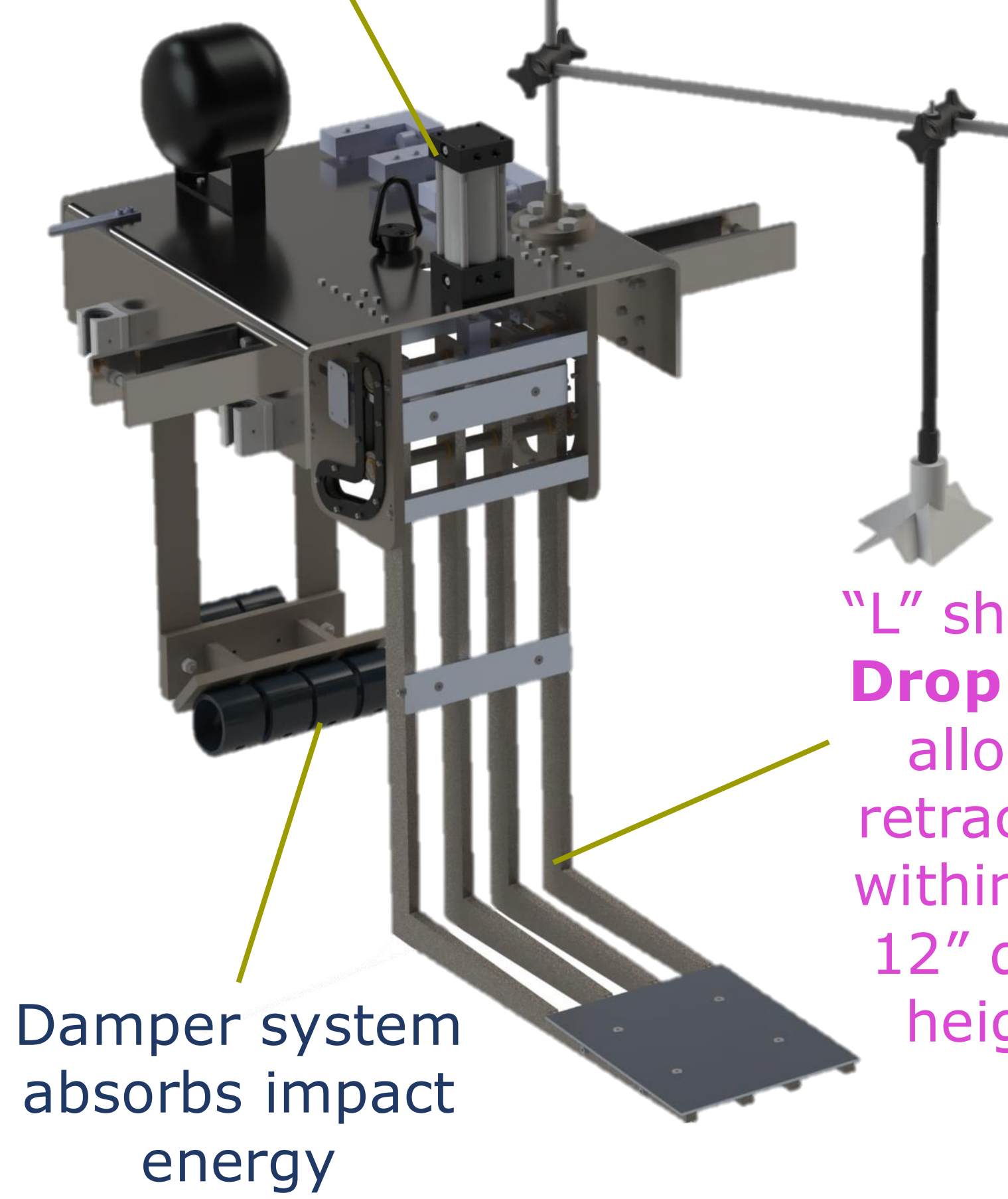
Required Drop Orientations



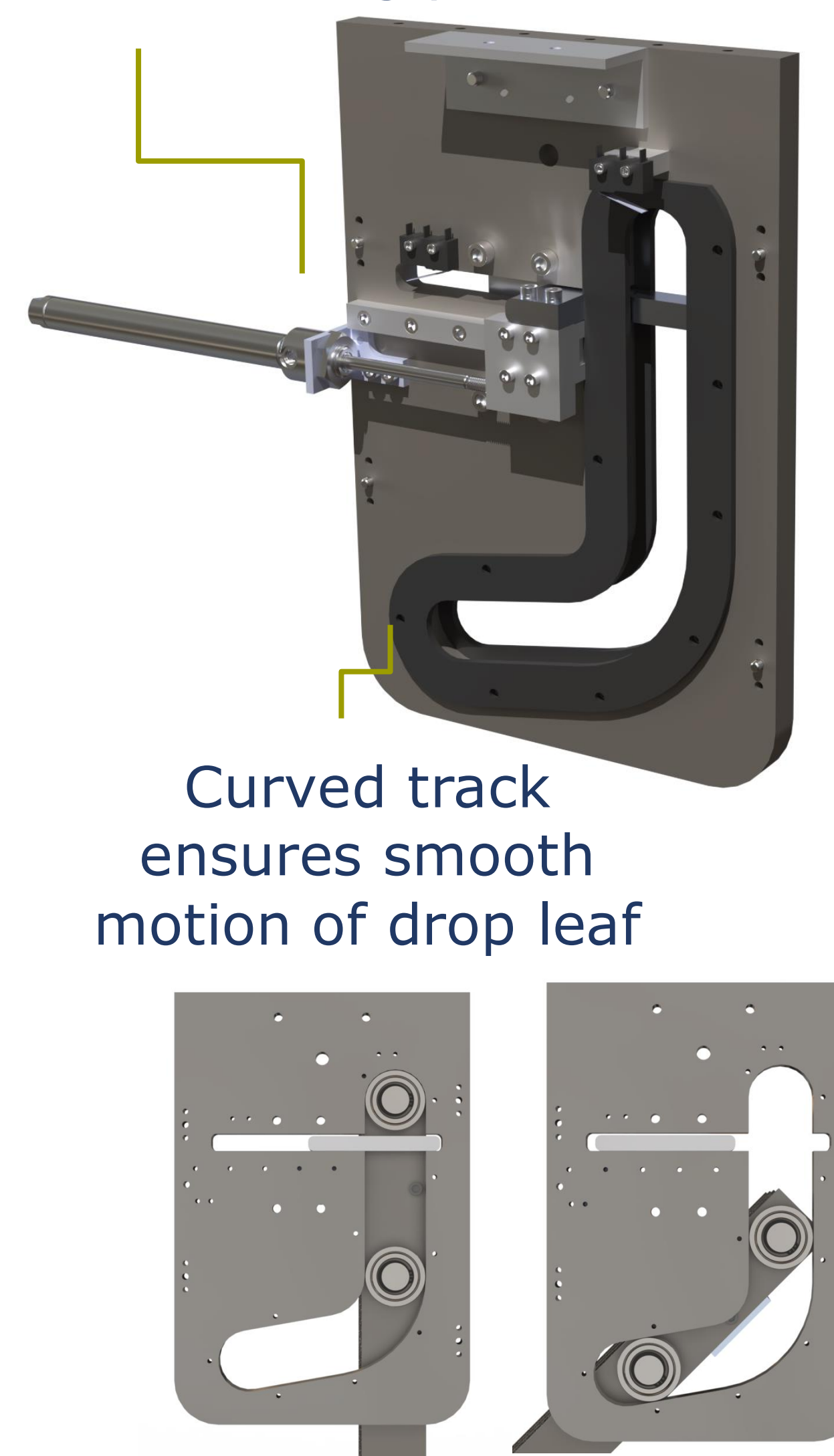
Drop Mechanism

120psi **Pneumatics** push drop leaf down faster than the package falls

Leaf Lock keeps platform in loading position

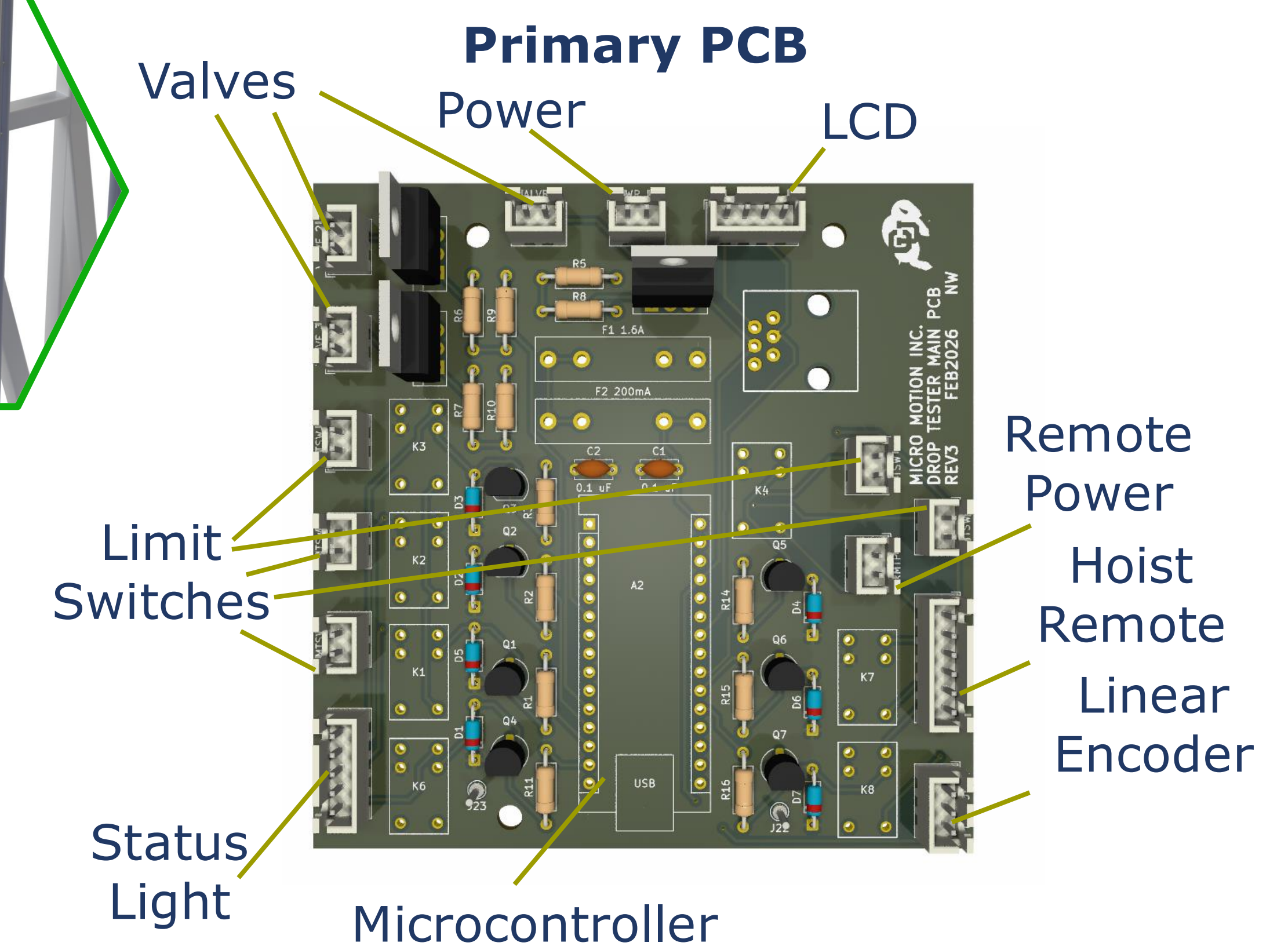


"L" shaped Drop leaf allows retraction within the 12" drop height



Electronics and UI

Electronics control height adjustment and drop sequence



User Interface: Custom controller, status light, and LCD indicate machine state to user

State-Based Sequence: Firmware uses arming sequence to prevent damage and ensure safety

Safety Circuit: Hardwired safe states are triggered by internal logic & manual E-stop

Future Improvements: Height readout on controller and PCB with SMT

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- ✓ 3'x5'x10' footprint
- ✓ 12"-48" drop height

Testing for Qualifications

- Goal: Determining drop mechanism movement and verifying machine operation**
- Verified package support with gooseneck assembly
- Able to support 90lb package
- Tested 10 box orientations
- Shimmed linear rails to mitigate binding
- Switched to less stiff dampers

Future improvements

- Structure:** Optimize frame structure, potentially switch to aluminum
- Validation:**
- Limitations:**
- Efficiency:**
- Sustainability:**
- Electrical:** Add height readout on controller and PCB with SMT
- *Add 3rd future improvement***

Height Adjustment

12" - 48" Drop Range

Height Lock: Friction clamp and internal hoist brake, lock carriage before drop

Structure Integration: Linear rails ensure smooth adjustment and alignment

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Status Light: Indicates machine state, provides audible alert before dropping

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Primary PCB - Custom

Power, LCD, Valves, Remote Power, Limit Switches, Hoist Remote, Status Light, Microcontroller, Linear Encoder

User Interface: Operated by custom controller. Status light, and LCD indicate machine state to user

Safety-Based Order: Firmware uses arming sequence to prevent damage and ensure safety

Safety Circuit: Hardwired safe states are triggered by internal logic & manual E-stop

Drop Mechanism

120psi **Pneumatics** push drop leaf down faster than the package falls

Leaf Lock keeps platform in loading position

Curved track ensures smooth motion of drop leaf

"L" shaped Drop Leaf retracts within 12" drop height

Dampers absorb impact energy

Precision Alignment: Tight tolerances and pins hold drop platform flat within one degree

Impact Surface: 3'x5' plate of 0.5" water jet cut steel provides a stable flat base

Required Drop Orientations

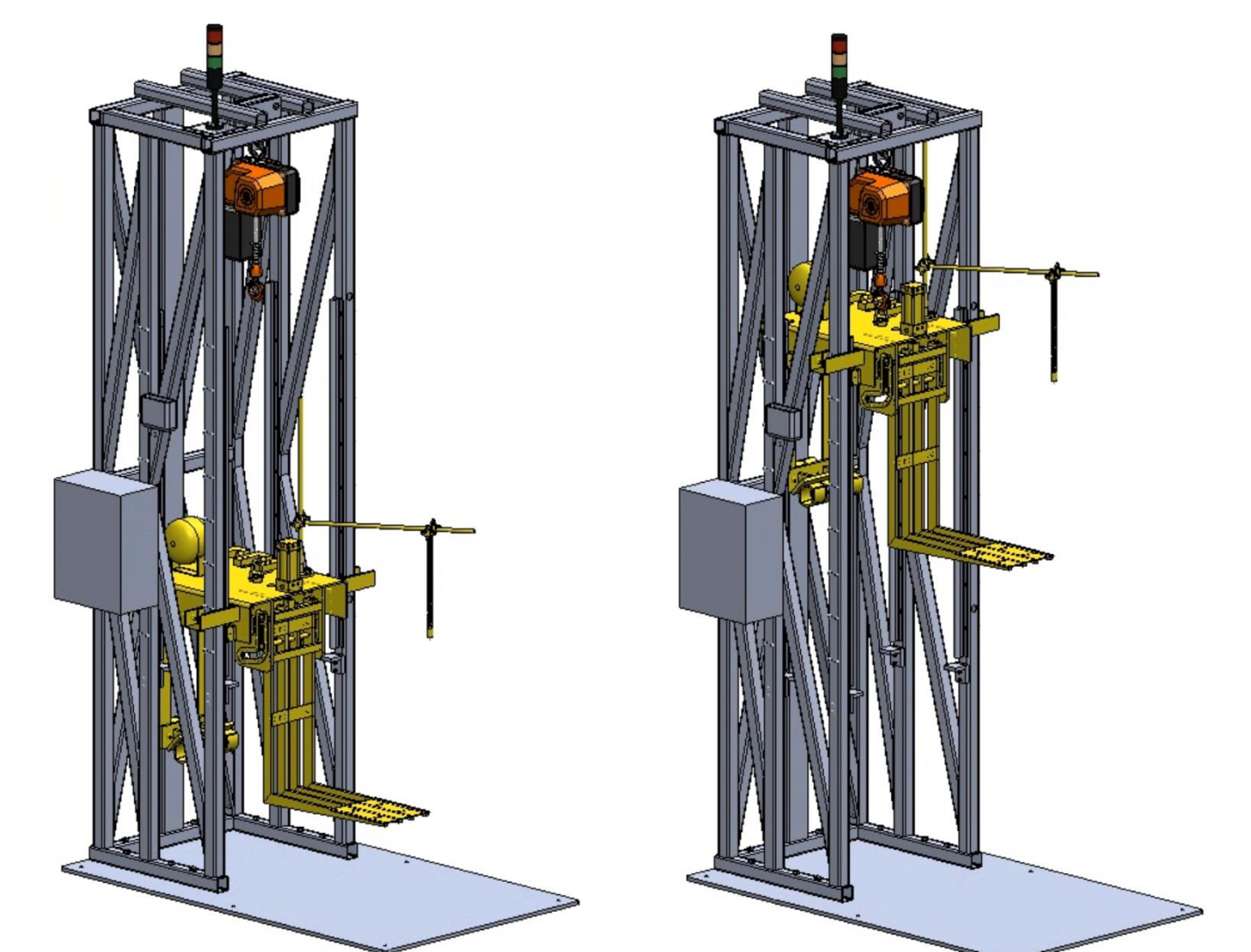
Face

Edge

Corner

Notes (feel free to add)

- Current image is a placeholder, will add a render of the same image later.
- Should add most important subassembly (drop leaf) top right of the image (above full assembly image).
- Waiting on Micro Motion to 1) Provide transparent image for their logo and 2) approve poster.
- Should we add a section for electronics?
- **Notes from Collin**
 - **Maybe a graphic showing how the drop leaf falls away**
 - **also graphic of how boxes sit on faces, edges, and corners**
 - **Show height adjustment range; 12" - 48"**
 - **Don't jump too into the details**
- **Daria Feedback**
 - Add context specifically to micro motion in the background section, maybe just an intro sentence, keep the bold bullets
 - **CONNECTION TO MICRO MOTION**
 - Safety requirement is very vague
 - Highlight safety stuff in a key features box for example
 - Manufacturing is taking up real estate
 - Add facts as pickoff points from the main image
 - Show iteration 1/first design, emphasize the redesign required
 - On a screen or something
 - Mention that testing is all about requirements during the presentation, not poster



Presentation Order and Discussion Points (feel free to add)

- Introductions - Everyone (30 sec) – 1:02
- Background and Motivation – Andrew & Anselme (0.5 min) – 0:28
 - Include the main goal of pulling a platform away from box faster than gravity to make a box hit the ground in its specific orientation
- Machine Requirements – Francine & Al (2 min) – 2:17
 - Don't need to go over every bullet point, just give the gist
 - Include the fact that it is a machine going into a warehouse to be a final product
- Drop Mechanism – Dylan & Andrew & Isaac (5 min) - 4:14
 - Dylan: benchmarking, design intent of overall system, 'drop leaf', pneumatics
 - Andrew – locking mechanism
 - Isaac – damping mechanism
- Height Adjustment – Riley & Remy & Anselme/Francine (4 min) – 3:54
 - Riley and Remy can split up the bullet points on the poster with what each person worked on
 - Should probably mention design iterations and how we landed on our big steel structure
 - Anselme/Francine – carriage stabilizer to help hold 90 lbs packages
- Electronics – Tegan & Nick (3 min) – 2:27
- Testing – Isaac & Francine (2 min) – 2:02
- Future improvements and wrap-up – Anselme (1.5 min) 1:15

- TOTAL = 18.5 MIN

- Anselme, Nick, Tegan, Remy, Riley POSTER Dylan, Andrew, Isaac, Francine, Al – Rearrange this with new poster