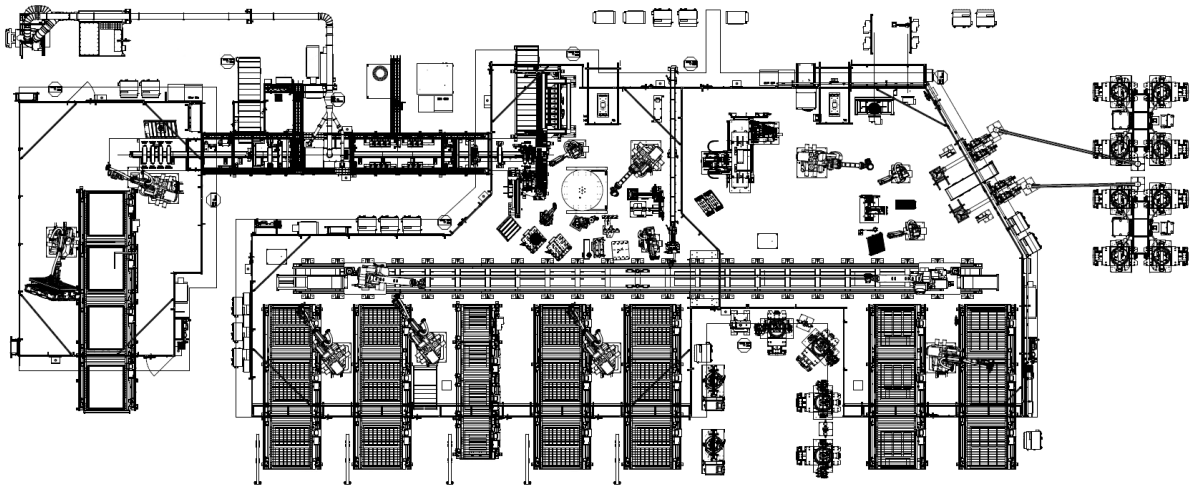

BET/BEV3 Stacker Line
Operation and Maintenance Manual

Designed and Built By

ATS™
INDUSTRIAL AUTOMATION

ATS Ohio Job 2350
March 2023

ATS Ohio, Inc.
7115 Green Meadows Drive
Lewis Center, Ohio 43035
Tel: 614-888-2344
Fax: 614-888-3875
After Hours Emergency: 519-653-3060

This document was created by the Technical Documentation Department of ATS Ohio.

CONTENTS

PREFACE

MANUAL REVISION HISTORY

Revisions made to this manual are listed below. Revision history information includes:

- Revision Level – When a manual is first published, it is considered a release and is identified as revision 0. All subsequent revisions to the manual are identified with a letter designation (A, B, C, etc.).
- Date – When the revision (or release) is effective.
- Description – Provides a brief explanation of why the revision was made. For example, if a machine was modified to test a new model and changes made to the machine affected pages in the manual.
- Affected Pages – Lists pages (including section number) affected by the revision.

Rev.	Date	Description	Affected Pages
0	03/2023	Document release	All

ABOUT YOUR DOCUMENTATION

Your documentation package includes this Operation and Maintenance Manual and an OEM Literature package. The following sections describe the contents of each of the documentation media.

Content

The following chapters compose the Operation and Maintenance Manual:

- ***Chapter 1 – Master Task List***. This chapter details the operation, electrical and mechanical maintenance, and repair tasks that must be performed.
- ***Chapter 2 – Safety***. This chapter details battery safety and describes the system safety-related equipment.
- ***Chapter 3 – System Description***. This chapter details the system equipment and utilities.
- ***Chapter 4 – System Operations***. This chapter details the operator interface equipment, describes the HMI screens, and describes the common operating procedures.
- ***Chapter 5 –Maintenance***. This chapter describes the maintenance tasks.
- ***Chapter 6 – Troubleshooting***. This chapter describes the system troubleshooting procedures.
- ***Chapter 7 – Assembly and Disassembly***. This chapter describes the methods for taking apart and putting together end of arm tooling and other mechanisms.
- ***Chapter 8 – Installation***. This chapter describes the methods for installing the equipment in a facility.
- ***Chapter 9 – Process Parameters***. This chapter describes the setpoints and critical parameter settings for the equipment.

Significance

This Operation and Maintenance Manual was written for the personnel responsible for the Stacker System. It is important to read, understand, and pay attention to every aspect of it.

The complete Operation and Maintenance Manual should be kept near the system for future reference.

The Operation and Maintenance Manual describes special details of the system necessary for trouble-free operation. Knowledge of these operating instructions will help avoid system faults.

Should you experience problems still, please contact our customer service department, someone will be happy to help you. Please refer to the contact information on the cover of this manual.

Graphics

All drawings, illustrations and photographs are provided to expand and enhance the text explanations. These graphics are representations only. They may not be drawn to scale. For accurate drawings, refer to the ATS mechanical and electrical drawings supplied to your company.

Style Conventions

This Operation and Maintenance Manual uses the following styles to indicate different kinds of information:

- **Bold Blue Times New Roman Text** indicates a chapter or section heading (in all chapters except for the Preface, the chapters and sections are numbered sequentially).
- SMALL CAPITAL TEXT indicates a physical button on the cell.
- **BOLD SMALL CAPITAL TEXT** indicates a button on an HMI screen.
- `Courier New Text` indicates on-screen software messages.
- A **Bold Blue Arial Letter** (such as **C**) refers to a pointer in the previous or identified figure.
- Bullets indicate listed items where order is of no significance.
- Numbered items indicate a step-by-step procedure or ordered list.

Special Notations

Throughout the Operation and Maintenance Manual, special symbols and notations alert the reader to safety concerns, which, if procedures are not properly performed, could cause death, serious injury or equipment damage. They may also indicate important or supplemental information, and where to find it. Boxed notations always appear immediately before or after the information or step to which they pertain.

WARNING!

Warning messages identify actions or conditions that could result in personal injury, health hazard, or loss of life.

CAUTION!

Caution messages identify conditions or practices that could result in machine operating faults or damage to equipment.

NOTE

Notes are generally used to highlight a suggestion or stress important information; they may also bring attention to a unique operating condition or provide a clarifying statement.

REFERENCE

References are used to call attention to a piece of literature provided by a third-party OEM equipment supplier.

Due to variations found in the operating conditions of certain applications and their working environments, the special notations in this manual cannot identify all potential problems or hazards. Caution and discretion must always be used while operating machinery, especially when using electrical power. Equipment should be operated and maintained only by qualified and trained personnel.

OEM Literature Package

The OEM Literature Package includes copies of the third-party equipment manuals, cut sheets, and associated product information. The hard copies are sorted alphabetically in an accordion-style folder. This package contains information as received by the product vendor. In the event any product information is missing or is out-of-date, please contact the product manufacturer directly.

1. MASTER TASK LIST

Number	Task Description	Manual Reference Location
CHAPTER 2 - SAFETY		
1.	Battery Safety	2.1 Battery Safety Overview
2.	Health and Safety	2.2 Health and Safety Statement
3.	General Safety	2.3 General Safety Guidelines
4.	Personal Safety	2.4 Personal Safety
5.	Work Area Safety	2.5 Work Area Safety
6.	Energy Control and Power Lockout	2.6 ECPL Placards and Tags
7.	Tool Safety	2.7 Tool Usage
8.	Machine Safety	2.8 Machine Safety
9.	Safety Device Locations	2.9 Safety Device Summary
10.	Energy Control Devices	2.10 Energy Control Device Descriptions
11.	SDS References	2.11 SDS References
12.	System Safety Labels	2.12 Visual Aids
CHAPTER 3 – SYSTEM DESCRIPTION		
13.	Stacker Line Summary	3.1 Stacker Line Summary
14.	Stacker Line Utilities	3.2 Stacker Line Utilities
15.	Battery Pack Assembly System Layout	3.3 Battery Pack Assembly System Layout
16.	Stacker Layout	3.4 Stacker Layout
17.	Battery Cell Load Equipment	3.5 Battery Cell Load Equipment
18.	Cell Processing Equipment	3.6 Cell Processing Equipment
19.	Cell Stacking Equipment	3.7 Cell Stacking Equipment
20.	Module Assembly Equipment	3.8 Module Assembly Equipment
CHAPTER 4 – SYSTEM OPERATION		
21.	Operator Interface Devices	4.1 Operator Interface Devices
22.	HMI Screens	4.2 HMI Screens
23.	Inspecting the Line	4.3.1 Inspecting the Line
24.	Starting an Automatic Cycle	4.3.2 Starting an Automatic Cycle
25.	Stopping a Cycle	4.3.3 Stopping a Cycle
26.	Shutting Down	4.3.4 Shutting Down
27.	Recovering from an Emergency Stop	4.3.5 Recovering from an Emergency Stop
28.	Recovering from a Fault	4.3.6 Recovering from a Fault

29.	Opening and Closing an Entrance Gate	4.3.7 Opening and Closing an Entrance Gate
30.	Loading Components	4.3.8 Loading (or Unloading) Components
31.	Removing Rejects	4.3.9 Removing Rejects
32.	Reintroducing Parts	4.3.10 Reintroducing Parts
33.	Modes of Operation	4.4 Modes of Operation
34.	System Backup	4.5 System Backup
CHAPTER 5 – MAINTENANCE		
35.	General Service Guidelines	5.1 General Service Guidelines
36.	Hazardous Energy Guidelines	5.2 Hazardous Energy Guidelines
37.	Lockout/Tagout Instructions	5.3 Lockout/Tagout
38.	Preventive Maintenance Tasks	5.4 Preventive Maintenance
39.	Lubrication Points	5.5 Lubrication Points
40.	Maintenance Task Instruction Sheets	5.6 Maintenance Task Instruction Sheets
41.	Third-Party Equipment Manuals	5.7 Third-Party Equipment Manuals
CHAPTER 6 – TROUBLESHOOTING		
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43.	Moving Device Faults	6.1.2 Moving Device Faults
44.	Sensor Faults	6.1.3 Sensor Faults
45.	Pneumatic Faults	6.1.4 Pneumatic Faults
46.	Air Cylinder Faults	6.1.5 Air Cylinder Faults
47.	Solenoid Faults	6.1.6 Solenoid Faults
48.	Gripper Faults	6.1.7 Gripper Faults
49.	Air Pressure Faults	6.1.8 Air Pressure Faults
50.	Conveyor Faults	6.1.9 Conveyor Faults
51.	Servo Motor Faults	6.1.10 Servo Motor Faults
52.	Vision Faults	6.1.11 Vision Faults
53.	Processor Faults	6.1.12 Processor Faults
54.	Common Fault Troubleshooting	6.2 Common Fault Troubleshooting
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55.	EB010R01 Cell Handling Robot End of Arm Tooling	7.1 EB010R01 Cell Handling Robot End of Arm Tooling
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57.	EB040 SuperTrak Pallet Fixture	7.3 EB040 SuperTrak Pallet Fixture
58.	EB320R01 Cell Stacking Robot End of Arm Tooling	7.4 EB320R01 Cell Stacking Robot End of Arm Tooling

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2. SAFETY

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2.1. BATTERY SAFETY OVERVIEW

WARNING!

Refer to the SDS for the Lithium-Ion Polymer Battery. Be aware of all hazards, air measures, fire hazards, leakage, handling and storage, toxicological data, environmental effects, and transportation requirements. Severe injury or potential harmful exposure is possible if these warnings are not followed.

WARNING!

Do not touch any battery from this line with two hands. Battery voltage may be lethal. Always assume a battery is charged. Follow all warnings and related safety procedures as described by your company. Severe injury or death may occur if this warning is not followed.

System personnel must comply with the following safety rules:

- Only have one hand touching the battery at any time.
- Never reach across the battery for any reason.
- Always wear appropriate personal protective equipment.
- Remove or properly cover all personal metal objects (watches, rings, earrings, necklaces, badges, and belt buckles).
- Never touch anyone working on a battery.
- Never distract anyone working on a battery.
- Keep all battery terminals covered except when needed for operations.

2.2. HEALTH AND SAFETY STATEMENT

Operate all assemblies, electrical components, and parts of this cell with care. Routinely inspect and maintain the cell as described in section 5.4 “Preventive Maintenance”.

Automation Tooling Systems (ATS) makes every effort to design and integrate automation systems that operate in a safe and predictable manner.

Each system employs safety devices that reduce the risk of personal injury. These devices include, but are not limited to, guarding around moving devices, emergency stop controls, and status indicators. It is the customer’s responsibility to ensure that personnel using the system are properly trained in the system’s operating, safety, and emergency procedures, industry safety standards (OSHA/OHSA) and to ensure that these procedures and practices are adhered to.

Any system modifications (including software and hardware) not authorized by Automation Tooling Systems may affect the safe operation of the system and result in personal injury.

Failure to meet these responsibilities or any unauthorized attempt to modify the system will void ATS-provided warranties.

2.3. GENERAL SAFETY GUIDELINES

The general safety guidelines, outlined below, are an overview of the safety topics covered in this section. While these guidelines provide information that will help prevent personnel injury and damage to equipment, read the entire section for a thorough understanding of safety practices and specific devices related to this equipment.

- Read this entire manual and become thoroughly familiar with the cell operation before working on any part of the cell
- Adopt good work habits regarding safety when working on or around the cell
- Avoid working on the cell when poor physical or mental health may affect job-related judgment
- Always dress properly for the job and use appropriate sight and hearing protection
- Always maintain a clean and safe work area
- Read and obey all signs posted on and around the cell
- Know the location of all Energy Control and Power Lockout (ECPL) placards and properly follow all posted procedures
- Use tools properly and safely whenever working on the cell
- Follow all Electrical and Mechanical System safety precautions outlined in this manual and dictated by plant safety specifications.
- Follow all System Operating Safety precautions outlined in this manual.
- Become thoroughly familiar with the location and function of all safety devices on the system including EMERGENCY STOP pushbuttons and lockout valves.

2.4. PERSONAL SAFETY

2.4.1. Overview

Accidents do not occur as the result of a single cause, but may occur because of an interaction between working conditions, human error, and other events. Given the complexity of machine technology, some accidents will inevitably occur. However, an error in judgment will always be the weakest link in the chain of events leading to an accident. Even under the best circumstances, judgment is affected by:

- Knowledge (and lack of knowledge) of the cell and peripheral equipment
- Personal work habits on the job
- Physical and mental fitness on the job

2.4.2. Knowledge First

It is vitally important for anyone working on the cell to become thoroughly familiar with its operation before working with it. Knowledge of the cell will help to avoid accidents. Read and understand all safety instructions before setting up, operating, maintaining, or servicing the cell. Know the location and function of all safety devices provided with the cell and check regularly to ensure their proper operation.

2.4.3. Work Habits

Personal safety combines knowledge, positive attitudes, and good work habits into a proactive awareness of potential hazards. Safe actions occur when an awareness of the importance of safety is combined with an understanding of tasks and becomes part of daily work habits on the job.

You have a responsibility to conduct your daily work actions safely. Adopt a professional attitude toward safety and develop personal safety skills you can depend on – for life!

2.4.4. Fitness for Duty

"Fitness for duty" is the state of being physically and mentally fit to perform job-related duties. It is important to reduce or eliminate anything that impairs job-related judgment.

Alertness is essential for sound judgment, and nothing affects alertness more adversely than fatigue. Several causes are:

- Lack of sleep – The most common cause of fatigue; continued loss of sleep causes increased nervousness and decreased reaction time. The ability to react quickly to a situation is affected
- Poor eyesight – Tired eyes lead to drowsiness, decrease your depth perception, and reduce field of vision
- Emotional stress – A buildup of emotional stress causes tension, irritability, and mental distraction
- Anger – If not managed appropriately, it causes drowsiness, impairs concentration and job performance
- Physical problems – Even minor ailments (headache, indigestion, sore throat) and other conditions-such as consuming a heavy meal can impair judgment, cause sluggishness, or make you drowsy
- Drug and alcohol use – The resulting drowsiness, nausea, or dizziness dulls reflexes and turns you into an "accident waiting to happen"

2.4.5. Dressing for Safety

Unless plant safety specifications indicate otherwise, always observe the following guidelines:

- Do not wear loose or baggy clothes. They should fit close to the body, *but not so tight as to hinder free movement*.
- Do not wear ties or scarves around the system at any time.
- Do not wear jewelry such as rings, bracelets, and necklaces around the system at any time. Medical alert jewelry should be worn with caution.
- Do not wear gloves unless handling hot, rough, or sharp surfaces.
- Wear shoes approved by plant safety specifications.
- Wear the correct protective clothing, especially when a job calls for it.
- Tie back long hair or restrain it with a cap or net.
- Wear a hard hat or other appropriate protection when a job requires it or where a risk of falling objects may exist.

2.4.6. Eye Protection

To reduce the risk of eye injury, wear the proper eye protection. Choose eye protection equipment that will best protect your eyes against an injury that may result from the type of work being performed. Unless plant safety specifications indicate otherwise, safety glasses with side shields will be sufficient for normal system operation. Always keep eyewear clean.

2.4.7. Hearing Protection

To reduce the risk of long-term hearing damage, use hearing protection appropriate for the job. Choose hearing protection equipment (foam ear plugs, padded headset) that protects against noise levels produced by the cell and surrounding equipment. However, do not select hearing protection that will totally muffle all noise. During cell operation, it is important to hear any unusual noises that may indicate a problem. Check with your plant safety specifications to determine the best hearing protection for the job and the area where the job is performed.

2.4.8. Head Protection

To reduce the risk of damage to your head, wear a bump cap when working under equipment, within an automated cell, and when appropriate for the job. Check with your plant safety specifications to determine the best bump cap for the job and the area where the job is performed.

2.4.9. Foot Protection

To reduce the risk of damage to your feet, wear safety-rated steel toed shoes appropriate for the job. Check with your plant safety specifications to determine the best shoes for the job and the area where the job is performed.

2.5. WORK AREA SAFETY

2.5.1. Cleanliness

Keep work areas clean and free of hazardous obstructions. Be aware of protruding machine components. Keep floors clean and dry. Clean up chemical (cleaning solvent, beverage) and process fluid (hydraulic oil) spills immediately. Follow plant-approved procedures to clean up all spills.

2.5.2. Warning Signs

Warning signs are posted to alert workers of hazardous conditions. Observe all warning signs when working on/around the cell. Warning signs should always be clearly visible. Do not cover, paint over, alter or deface signs, or remove them from the cell. Replace signs that become unreadable.

2.5.3. Traffic Areas

Aisles, pathways, and catwalks must be kept clear of obstructions to allow free movement in all directions. Do not block their access with items such as boxes, tool chests or ladders. This is especially true in case of an emergency, where rescue personnel must have quick access to an injured worker.

2.5.4. Unsafe Conditions

Immediately report any unsafe working conditions to your supervisor or safety department. Faulty safety devices, damaged hoses, and loose or broken parts all pose a safety hazard. Report all fluid leaks (oil) and unusual odors (excessive vapors, overheated metal).

2.5.5. Cell Guarding

The guarding used in the BET/BEV3 Stacker Line forms a protective housing around automated equipment that allows for safe operation. The guarding is comprised of a metal framework fitted with fixed guarding panels, light curtains, and safety-interlocked guarding doors. The guarding should never be removed or modified except by qualified technicians familiar with the cell.

2.5.6. Conveyor Safety

Operators and maintenance personnel must be aware of all safety hazards before operating or maintaining any of the line conveyor equipment.

REFERENCE 	***For more information about the conveyor equipment, refer to the equipment supplier documentation (Omni Chain Driven Live Roller Conveyor Straight and Curve Technical Handbook pg. 3-10).***

2.5.7. Working at Heights Safety

Working at heights means that Personnel are working in a place that requires necessary precautions to prevent them from falling at a distance and injuring themselves. Working at heights precautions are outlined below:
Ensure all Personnel are trained for working at heights.

- Perform as much work as possible at ground level before working at heights.
- Inspect work area for hazards, possible falling objects, and that the work area is suitable for working at heights.
- Ensure Personnel can move safely to and from the work area while they are working at height.
- Ensure equipment used for working at heights (harnesses, elevated platforms, ladders, etc.) are suitable for the task.
- All equipment used for working at heights should be inspected before each use.
- Ensure emergency procedures are in place before beginning work.
- Ensure to use appropriate anchor points for fall arresting equipment.
- Do not overload equipment with personnel, tools, and materials.
- Do not reach too far, twist, or extend from equipment.

NOTE

Consult your GM Working at Heights training and manuals for a proper understanding of Working at Heights.

2.6. ECPL PLACARDS AND TAGS

Energy Control and Power Lockout (ECPL) placards identify the primary, associated, and stored energy or power sources of the cell. The ECPL placard(s) are usually located on the main electrical enclosure. Color-coded lockout tags corresponding to the source icons (such as E-1, A-1) on the placard help locate the same sources on the cell. These tags are mounted near, or hanging directly on, the energy and power source locations.

2.7. TOOL USAGE

Tool usage safety guidelines, as they apply to the cell, are as follows:

- Do not leave any tools (hand or electric) on or around the cell. Any machine vibration may cause tools to fall into moving automation and cause extensive damage.
- When repairing or adjusting any part of the cell, use the proper tool for the job. The incorrect size or type of tool may damage the cell components.

2.8. MACHINE SAFETY

2.8.1. Electrical Safety

Electrical safety precautions are outlined below:

- Cell troubleshooting or maintenance should be performed only by qualified technicians familiar with the cell, using an up-to-date set of cell schematics.
- Before performing maintenance or service on any part of the Electrical System, perform all applicable ECPL procedures. Before proceeding, verify that power is removed from all circuits.

WARNING! ***Before working on electrical or mechanical problems with the cell (whenever possible), place the MAIN DISCONNECT SWITCH in the OFF position and lockout the switch. Severe injury or death may occur if this warning is not followed.***

- If it is necessary to perform troubleshooting with the power on, know where power is present and proceed with extreme caution. Whenever possible, use electrically insulated tools.
- When servicing electrical enclosures, follow all PPE (personal protective equipment) requirements per posted arc flash warnings in accordance with plant safety specifications.
- Always use an appropriate fuse puller. Never attempt to replace a specified fuse with a higher-rated fuse (such as replacing a 5-amp fuse with a 10-amp fuse).

2.8.2. Pneumatic Safety

Pneumatic safety precautions are outlined below:

- Cell troubleshooting or maintenance should be performed only by qualified technicians familiar with the cell, using an up-to-date set of cell schematics.
- Before performing maintenance or service on the Pneumatic System, shut off the air supply at the main shutoff valve and bleed air from pneumatic lines. Perform all applicable ECPL procedures.
- Purge from pneumatic lines any trapped air that was not relieved by performing the ECPL procedure(s); for example, air trapped by a pilot- operated check valve.
- Use extreme caution around automation (such as clamps, slides, or lifts) that may move when air is relieved from the cell. Before relieving air from lines, secure all such automation.
- Avoid manually actuating solenoid valves, especially if others are working in the area.

WARNING! ***The inherent danger of electrical energy is well known. Similarly, compressed air energy is powerful and may also be very dangerous. Before attempting to remove a component from an air line, always disconnect the supply air and thoroughly exhaust the line or system. Failure to heed the following precautions could result in serious, even fatal, personal injury.***

2.8.3. Mechanical Safety

Mechanical safety precautions are outlined below:

- Mechanical maintenance, adjustments or repairs should be performed only by qualified technicians familiar with the cell.
- Before performing any maintenance or repairs on an upper platen, ensure safety pins are properly placed. Refer to the ECPL placard if such conditions exist.
- If mechanical service does not require cell power, perform the appropriate ECPL procedures to disconnect or dissipate energy sources.
- Keep all moving parts of machinery and surrounding areas free of rags, dirt, and excessive oil or metal debris.
- Before operating any moving machinery, all protective guards must be in place and secured.

2.8.4. Laser Safety

2.8.4.1. Laser Safety Compliance

ATS Ohio certifies that the Class 4 lasers utilized in this machine (when operated as instructed in this User Manual) complies with all applicable laser safety regulations as administered by the Center for Devices and Radiological Health (CDRH). A Laser Product Report was submitted for the purposes of reporting and recordkeeping as required by the CDRH (see 21 CFR 1000-1040.11 and related sections in 21 CFR 1000-1010).

2.8.4.2. General Laser Safety Warnings

In addition to the warnings found in this manual, read through the warnings and safety precautions sections in the Trumpf manuals provided for the laser. Operators and maintenance personnel must be aware of all safety hazards before operating or maintaining the laser or any equipment in or near the laser. Use the following warnings as a general guide for laser safety:

- Misuse of the controls or adjustments, or performance of procedures other than those specified in this manual and the Trumpf manuals may result in hazardous radiation exposure and electrical risks.
- The laser emits invisible infrared laser radiation. Since direct or diffuse laser radiation can inflict severe corneal injuries, always wear eye protection when in the same area as an exposed laser beam. Eyewear protects against scattered energy and is not intended to protect against direct viewing of the beam or reflections from metallic surfaces.
- Direct viewing of a laser beam can cause irreversible damage to eyesight. Laser radiation is invisible but if a person stands close enough to the visibility threshold, the eye receives it almost completely. Direct viewing of the laser beam should absolutely be avoided. A collimator focuses the laser energy right at the exit of the nozzle.
- If the skin is exposed to direct focused radiation, it could burn.
- DO NOT place materials inside the machine other than those specifically designed for the machine. Any material placed inside the laser radius other than that specifically designed may result in damage, radiation, or fire.
- DO NOT open the laser power supply unit for any reason. Dangerous voltage is present even when the power supply is disconnected from the main supply.
- The laser system is sealed in certain points. These seals MUST NOT be broken or removed for any reason.
- Refer to and follow the laser safety precautions in ANSI Z136.1-199, American National Standard for Safe User of Lasers. Procedures listed under the Standard include appointment of a Laser Safety Officer, operation of the product in an area of limited access by trained personnel, servicing of equipment only by trained and authorized personnel, and posting of signs warning of the potential hazards.

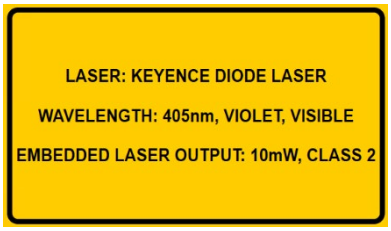
2.8.4.3. Laser Warning Signs

Laser warning signs alert operators to the hazards present in the system. This section provides illustrations and information about the laser labels around the system.

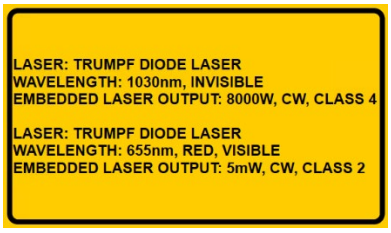
REFERENCE	***For information about the labels on the actual laser, refer to the literature supplied by Trumpf (Trumpf – Operator's Manual TruDisk 1000-8002 Chapter 1 pg. 19-28).***

This symbol is located on the laser to warn of laser radiation hazards.

This sign is located on each guard door and opening to warn of laser radiation hazards.

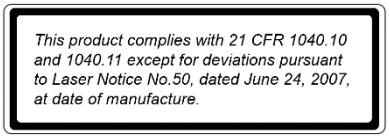


This sign is located on each guard door and opening to warn of laser radiation hazards.



This sign is located on each guard door and opening to warn of laser radiation hazards.

This sign is located on the main PDP enclosure to identify the product and CDRH accession number.

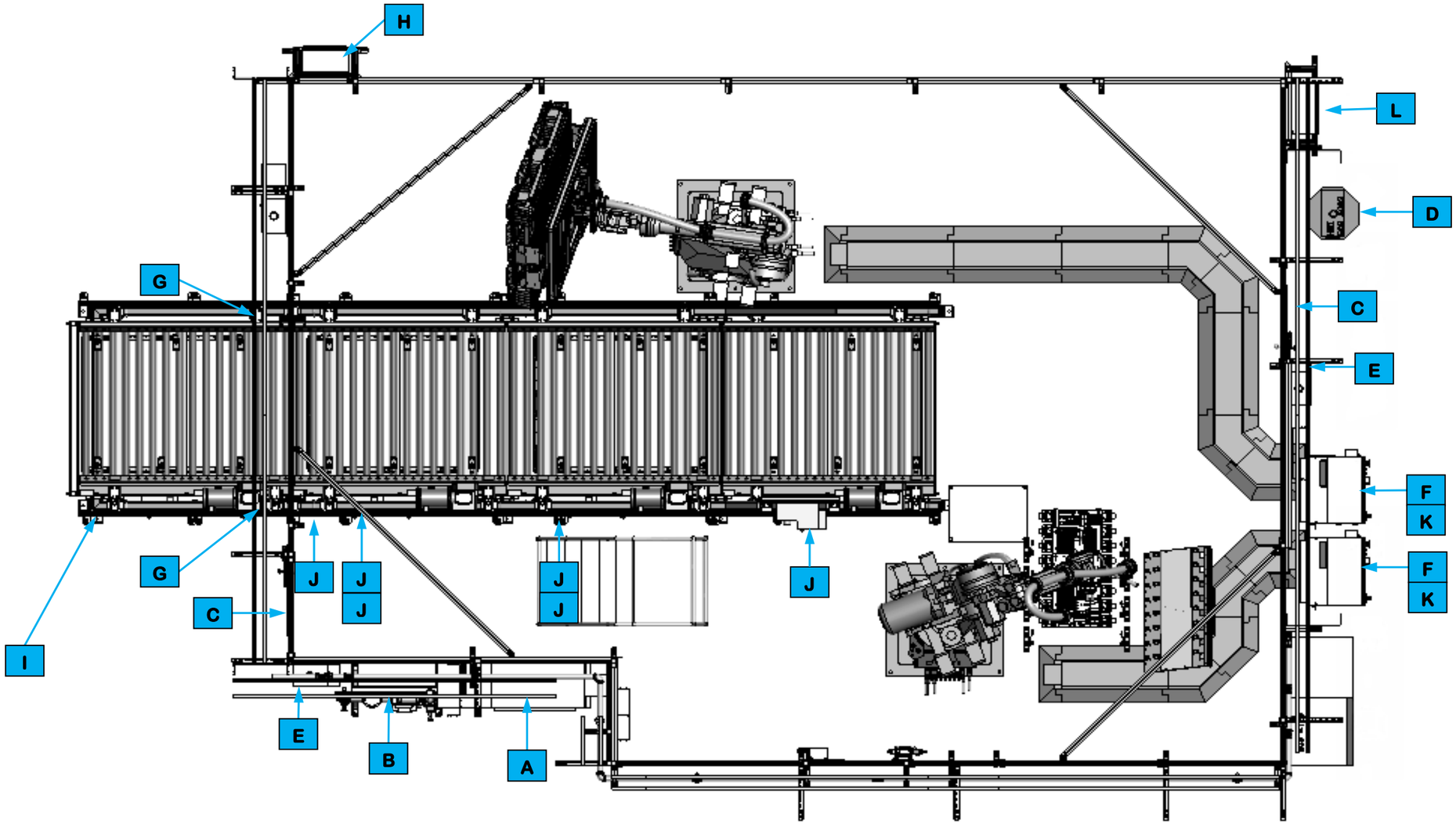


This sign is located on the main PDP enclosure to indicate compliance with CDRH regulations.

2.9. SAFETY DEVICE SUMMARY

The figures that follow identify the locations of the various safety devices used in each of the work cells. Section 2.10 describes each of these safety devices. Refer to the cell Energy Control Lockout Placards for specific information about the energy control devices.

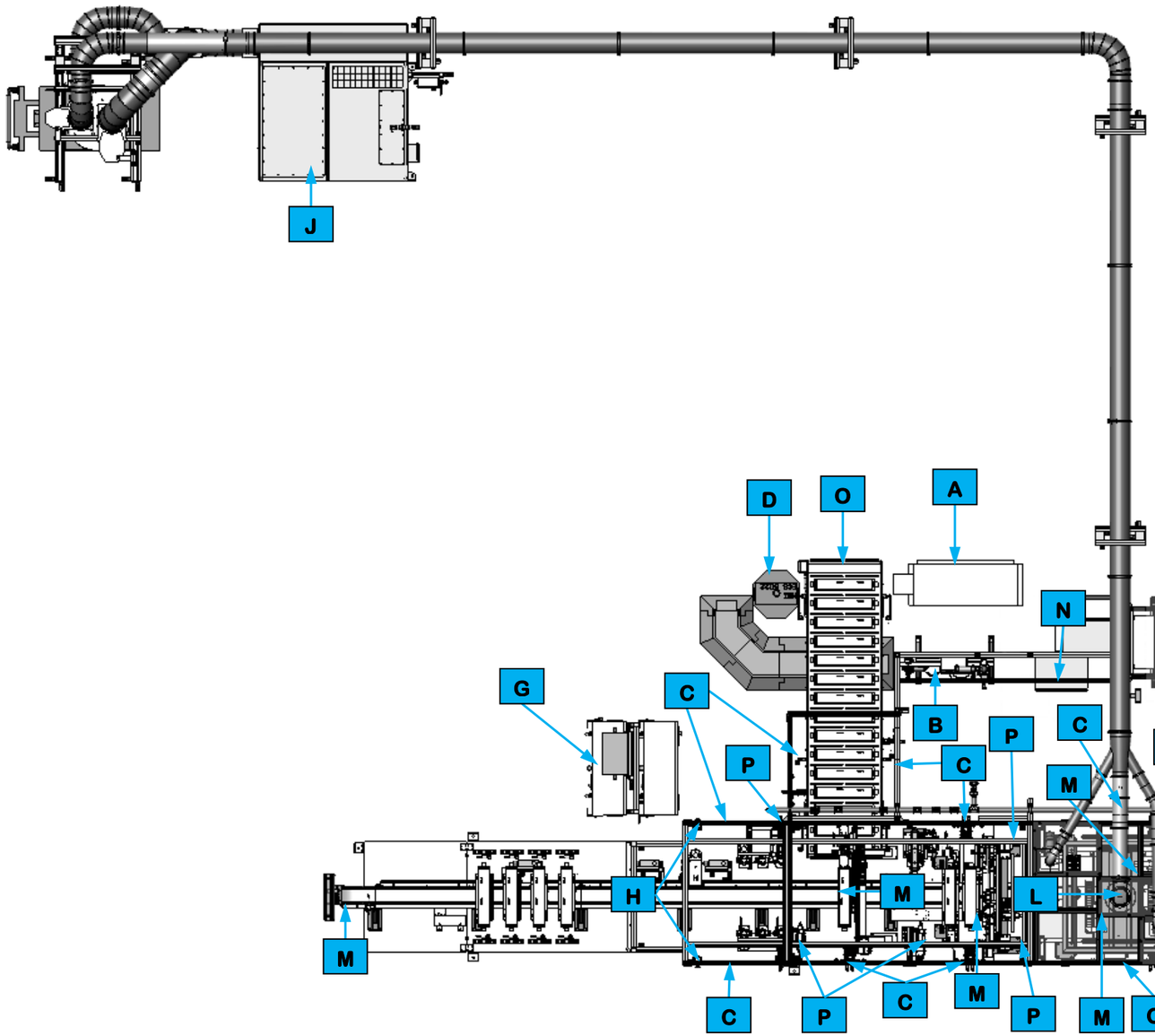
2.9.1. Cell Load Safety Devices



Safety Device Callouts in Figure 2-1	
A	Cell PDP
B	Cell Air Shutoff
C	Entrance Gate
D	HMI Panel
E	Entrance Gate Box
F	Robot Controller
G	Light Curtain
H	Conveyor Panel
I	Safety Device Junction Box
J	Armorstart Motor Starter
K	Station Air Shutoff
L	PLC Panel

Figure 2-1. Cell Load safety device locations.

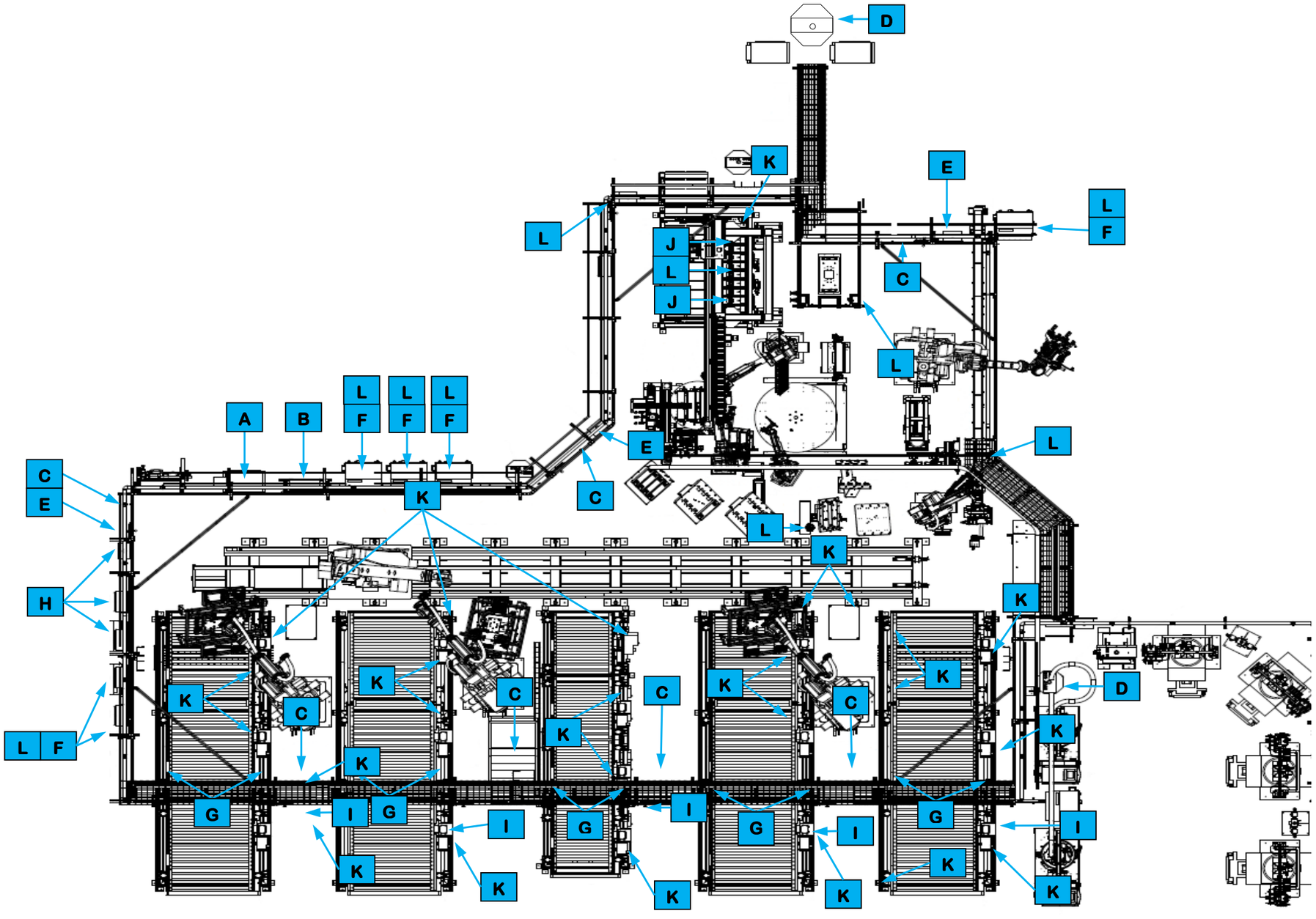
2.9.2. Cell Processing Safety Devices



Safety Device Callouts in Figure 2-2			
A	Cell PDP	I	Laser Controller
B	Cell Air Shutoff	J	Torit Air Handler
C	Entrance Gate	K	Riedel Chiller
D	HMI Panel	L	Flame Detector
E	PHMI Panel	M	Gravity Pin
F	Entrance Gate Box	N	Servo Control Panel
G	SuperTrak Enclosure	O	Armorstart Motor Starter
H	E-Stop Enclosure	P	Station Air Shutoff

Figure 2-2. Cell Processing safety device locations.

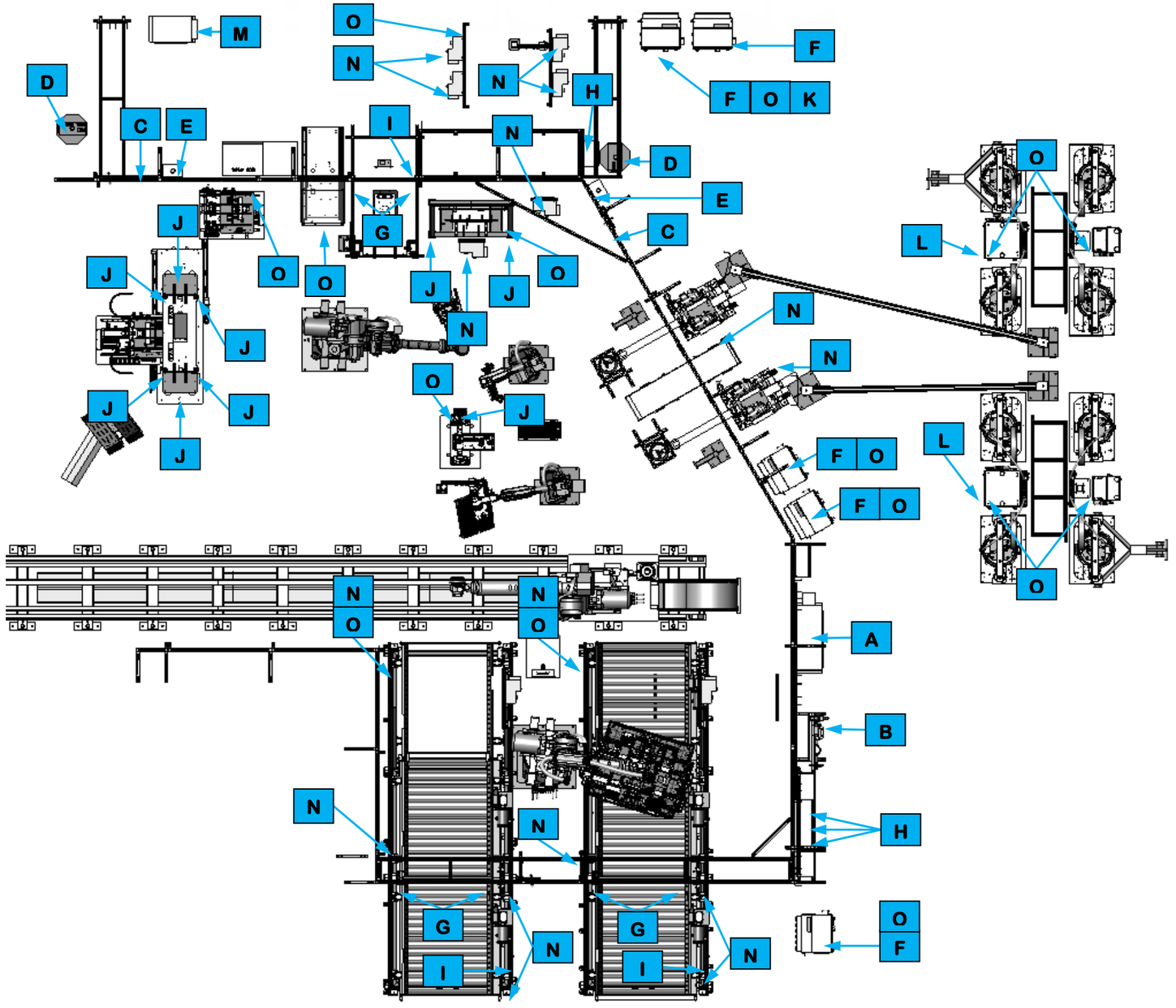
2.9.3. Cell Stacking Safety Devices



Safety Device Callouts in Figure 2-3	
A	Cell PDP
B	Cell Air Shutoff
C	Entrance Gate
D	HMI Panel
E	Entrance Gate Box
F	Robot Controller
G	Light Curtain
H	Conveyor Panel
I	Safety Device Junction Box
J	Lock Pin
K	Armorstart Motor Starter
L	Station Air Shutoff

Figure 2-3. Cell Stacking safety device locations.

2.9.4. Module Assembly Safety Devices



Safety Device Callouts in Figure 2-4	
A	Cell PDP
B	Cell Air Shutoff
C	Entrance Gate
D	HMI Panel
E	Entrance Gate Box
F	Robot Controller
G	Light Curtain
H	Conveyor Panel
I	Safety Device Junction Box
J	Gravity / Lock Pin
K	Atlas-Copco “A-B” Controller
L	Atlas-Copco “B” Controller
M	Servo Control Panel
N	Armorstart Motor Starter
O	Station Air Shutoff

Figure 2-4. Module Assembly safety device locations

2.10. ENERGY CONTROL DEVICE DESCRIPTIONS

There are many different types of energy control devices used throughout the system. Some of the devices include lockable disconnects and are part of the Energy Control and Power Lockout (ECPL) program. Lockable devices are shown on the ECPL placards affixed to each of the main PDP enclosures. The section that follows describes the various energy control devices, their locations (also reference ***Figure 2-1***, ***Figure 2-2***, ***Figure 2-3***, and ***Figure 2-4*** on the previous pages), and their uses.

2.10.1. Cell Power Distribution Panel

Each cell has a single Power Distribution Panel (PDP) that is used to distribute control power to the related equipment and to communicate with the cell processor. The PDP features indicators that illuminate to identify when control power is on. A fused disconnect (Lockout Point E-1) is located on the outside of the PDP and is used to enable or disable control power for the cell. Inside the PDP is an additional disconnect (Lockout Point E-2) that provides auxiliary power control. Refer to the GM standards and to the ATS electrical drawings for more information about the PDP equipment and functionality. Refer to the ECPL placards on each PDP for information about locking out the cell energy sources.

2.10.2. Cell Main Pneumatic Disconnect

Each cell requires compressed air and has its own air processing equipment that processes air supplied from the plant and distributes the processed air to the cell equipment. The air processing equipment has a shutoff valve (Lockout Point A-1) that removes the flow of processed air from the plant through the cell equipment. Turning the valve to the off position disconnects air pressure to the cell valve packs and vents the pressure through a muffler. A lockout hole in the handle of the valve allows a lock to be installed for energy control purposes. Refer to the ECPL placards on each PDP for information about locking out the cell energy sources.

2.10.3. Entrance Gate Door

Most of the cell devices are surrounded by guarding that prevents unauthorized (and unsafe) access to the equipment while it is in operation. Guard doors are incorporated in various locations around the guarding to provide access to the equipment when necessary.

Each guard door is equipped with an interlock switch and slide bar. The slide bar helps hold the door closed. The interlock switch detects when the slide bar is removed and signals the system processor. The processor then removes control power and air from the appropriate equipment. The guard doors are part of the cell safety circuit, along with EMERGENCY STOP buttons and other safety devices.

WARNING!

The interlock circuit is used as a safety precaution to prevent personnel from injury due to sudden mechanism movement. Never attempt to defeat or bypass an interlock switch, an interlock device, or any part of the interlock circuit. Failure to observe this warning may result in serious injury or death.

REFERENCE

For more information about the interlock switch, refer to the equipment supplier documentation (Fortress – amGardpro Guard Switch Operating Instructions pg. 1-4, Fortress – Stainless amGardpro Slidebar Operating Instructions pg. 1-3).

2.10.4. HMI/PHMI Panels

Each cell has one or more HMI panels (or Portable HMI panels) that personnel use to interface with the cell. Each HMI panel features an EMERGENCY STOP button that can be used to immediately stop all cell equipment. The EMERGENCY STOP button immediately removes control power from the cell. The EMERGENCY STOP button requires the button to be pulled back out after it has been pressed in. After pressing an EMERGENCY STOP button, follow the recovery procedure outlined in Chapter 4.

WARNING!

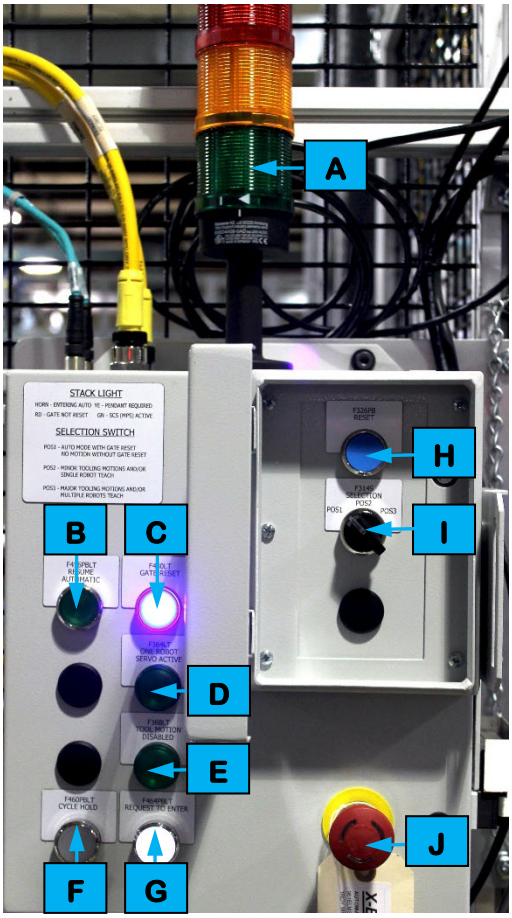
Press an EMERGENCY STOP ***button to immediately stop movement of all mechanisms. Ensure that all movement has stopped before entering the cell. Follow procedures taught in your GM-UAW Lockout class. Severe injury or death may occur if this warning is not followed.***

2.10.5. Entrance Gate Box

Each cell has an entrance gate box (see ***Figure 2-2***) at each guard door. Each gate box provides numerous controls, used as follows.

NOTE

Consult your GM-UAW Lockout training for a proper understanding of the MPS system. Chapter 4 details the procedure for using the Gate Box.



Device Callouts in Figure 2-5	
A	Stack Light indicators
B	RESUME AUTOMATIC button
C	Gate Reset indicator
D	One Robot Servo Active indicator
E	Tool Motion Disabled indicator
F	CYCLE HOLD button
G	REQUEST TO ENTER button
H	RESET button
I	SELECTION toggle switch
J	E-STOP button

Figure 2-5. An illustration of an entrance gate box.

Stack Light Indicators

On top of the entrance gate box is a stack light (see **A** in ***Figure 2-2***) with three colored indicator lights and a horn. The lights and horn are used to indicate the status of the gate reset relay and the MPS system. When activated, each indicator identifies the following condition:

- Red Indicator (Flashing) – gate is not reset
- Yellow Indicator (Solid) – hazardous motion has been enabled and pendant is required
- Green Indicator (Solid) – MPS system is active, all hazardous motion has been disabled
- Horn – entering automatic mode

RESUME AUTOMATIC button

The RESUME AUTOMATIC button (see **B** in ***Figure 2-2***) is used to restart the cell after the safety system is reset and all other control devices have been placed in the proper state for automatic operation. An indicator light inside the button can illuminate solid, flash off and on, or go dark to indicate the following:

- Steady On – all stations are in auto
- Normal Flash – all stations are ready for auto
- Rapid Flash – at least one station is not in auto or is not ready for auto
- Off – no stations are in auto or are not ready for auto

Gate Reset Indicator

The Gate Reset indicator (see **C** in ***Figure 2-2***) illuminates to indicate the gate is closed and reset.

One Robot Servo Active Indicator

The One Robot Servo Active indicator (see **D** in ***Figure 2-2***) illuminates to indicate the gate is not reset, one of the robot servo contactors has been successfully enabled, an any other robots are disabled by the Entrance Gate Box.

Tool Motion Disabled Indicator

The Tool Motion Disabled indicator (see **E** in ***Figure 2-2***) illuminates to indicate when the gate is not reset and the tool outputs are disabled by the entrance gate box.

CYCLE HOLD Button

The CYCLE HOLD button (see **F** in ***Figure 2-2***) stops the cell after the cycle has been completed. Inside the button is a white indicator that flashes when the button is pressed and turns solid when the cell has come to rest at the end of the cycle. The indicator will also flash if the Position Selector is not in “Pos1” after closing and resetting the Entrance Gate Box.

REQUEST TO ENTER Button

The REQUEST TO ENTER button (see **G** in ***Figure 2-2***) stops the cell after the cycle has been completed. Inside the button is a white indicator that flashes when the button is pressed and turns solid when the cell has come to rest at the end of the cycle. Once the cycle is complete and all devices have come to a stop and the button is solid, the gate can be opened. The indicator will also flash if the Position Selector is not in “Pos1” after closing and resetting the Entrance Gate Box.

RESET Button

The RESET button (see H in ***Figure 2-2***) re-energizes the gate reset function once the gate has been closed and the Fortress Interlocks slide switch has been re-inserted into the gate box.

SELECTION Toggle Switch

The three-position selector switch (see I in ***Figure 2-2***) allows maintenance personnel to selectively enable or disable hazardous and non-hazardous tooling motions within the cell for routine maintenance tasks. The selector switch provides the following levels of control:

- Pos1 – allows automatic operation if the gate is reset; disables all tooling motion with the gate open. The switch must be in this position for automatic mode.
- Pos2 – allows only non-hazardous (minor) tooling motion within the cell and/or single robot teach.
- Pos3 – allows all tooling motion within the cell, with hazardous (major) motion requiring the use of an enabling pendant. This position also allows all robot teach.

The selector switch does not affect non-motion output power, such as indicators, vacuum, and horns.

E-STOP Button

The EMERGENCY STOP button (see I in ***Figure 2-2***) immediately removes control power from the cell. The EMERGENCY STOP button requires the button to be pulled back out after it has been pressed in. After pressing an EMERGENCY STOP button, follow the recovery procedure outlined in Chapter 4.

2.10.6. Robot Electrical / Pneumatic Disconnect

Each robot in each cell has its own proprietary controller. Each controller features an electrical disconnect and a pneumatic disconnect (for robot end of arm tooling that utilizes vacuum equipment). Power is distributed from the cell Power Distribution Panel (Lockout Point E-1) to the robot controller. The robot controller distributes power to the robot. During normal cycling, the robot controller is automatically directed by the cell processor. By removing automatic control from the cell processor, interface buttons and other controls provide manual control of the robot. To remove power from the entire robot (480V), turn the electrical disconnect switch and pneumatic shutoff valve to off and install locks. Refer to the ECPL placard at the cell for more information.

REFERENCE 	***For more information about the robot equipment, refer to the equipment supplier documentation from Fanuc (Fanuc – Robot M-10iA Mechanical Unit Operator's Manual pg. 14-37, Fanuc – Robot M-20iA Mechanical Unit Operator's Manual pg. 13-40, Fanuc – Robot R-2000iC Mechanical Unit Operator's Manual pg. 26-65).***

2.10.7. Light Curtain / Sensing Field

Three sensing devices are located on both the input and output sides of the line dunnage conveyors at the point of passage between the guarded and unguarded areas of the work cell. The sensing devices are in series to aid in the detection and distinction of the object traversing the sensing fields. Each series includes a retro-reflective sensing field, a light curtain sensing field, and another retro-reflective sensing field. The processor monitors the status of the sensing fields and the time delay between the activation of each sensing field to determine if a person or a container is traversing the field. When a container traverses, the fields are broken in a very specific time sequence. When the processor detects the inputs within

the specified time frame, the safety circuit is overridden momentarily to allow the equipment to pause processing while the container traverses in or out. Any variation in the timing triggers the processor to disable the safety circuit and disconnect control power.

REFERENCE

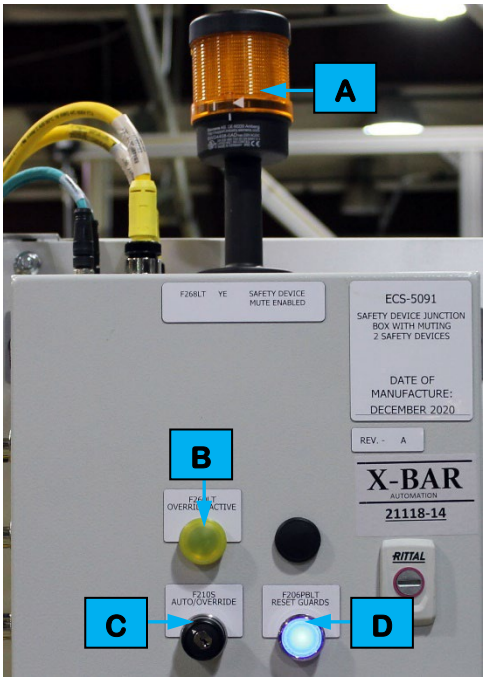
For more information about the light curtain, refer to the equipment supplier documentation (Sick deTec4 Prime Safety Light Curtain Operating Instructions pg. 13-20).

2.10.8. Conveyor Contactor Panel

The line conveyors are configured in distinct groupings. Each grouping has a dedicated contactor panel that provides complete energy control and monitoring of all the conveyor devices within the defined group. The outside of the panel enclosure features indicators that illuminate to identify when control power is on. A fused disconnect is located on the outside of the enclosure and is used to enable or disable control power for the associated conveyor equipment. Refer to the GM standards and to the ATS electrical drawings for more information about the contactor panel equipment and functionality. Refer to the ECPL placards on each PDP for information about locking out the cell energy sources.

2.10.9. Safety Device Junction Box (ECS-5091)

The ECS-5091 safety device junction box (see ***Figure 2-6***) provides connectivity and interface from the MCP to a cell by picking up wiring for light curtains, auxiliary power for valve manifolds, and receptacles for DeviceNet. The junction box features the following controls and indicators.



Device Callouts in Figure 2-6	
A	Mute Enabled indicator light
B	Override Active indicator light
C	AUTO/OVERRIDE switch
D	RESET GUARDS button

Figure 2-6. An illustration of an example ECS-5091 safety device junction box

Status Light

An amber colored status light (see **A** in ***Figure 2-6***) sits on the top of the junction box and is used to identify when the cell safety circuit is muted.

Override Active Indicator

An override active indicator light (see **B** in ***Figure 2-6***) illuminates whenever the AUTO/OVERRIDE key is set to OVERRIDE.

AUTO/OVERRIDE Key

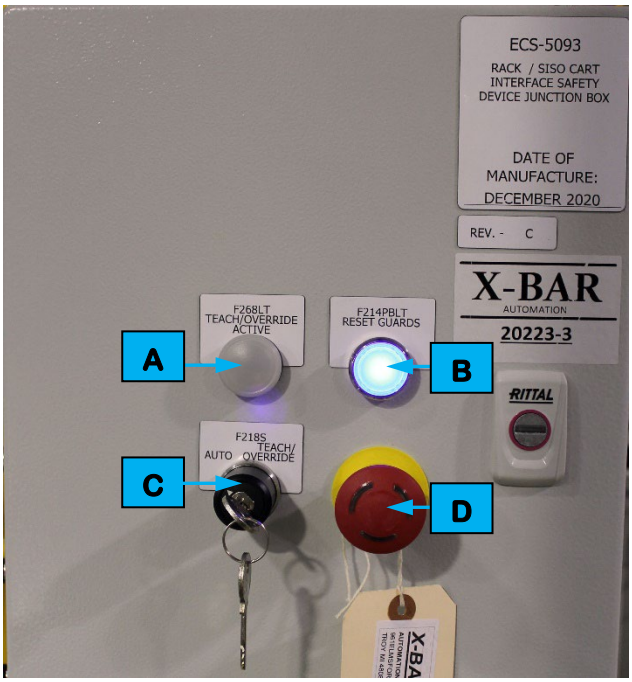
The AUTO/OVERRIDE key (see **C** in ***Figure 2-6***) is used to toggle the operating mode of the light curtains and other safety devices. The override function can only be used for 120-seconds at a time. The switch must be held in the OVERRIDE position.

RESET GUARDS Button

The RESET GUARDS button (see **D** in ***Figure 2-6***) is used to reset the guard safety circuit.

2.10.10. Safety Device Junction Box (ECS-5093)

The ECS-5093 safety device junction box (see ***Figure 2-7***) provides connectivity and interface from the MCP to a cell by picking up wiring for light curtains, auxiliary power for valve manifolds, and receptacles for DeviceNet. The junction box features the following controls and indicators.



Device Callouts in Figure 2-7	
A	Teach/Override Active indicator
B	RESET GUARDS button
C	AUTO/TEACH/OVERRIDE switch
D	E-STOP button

Figure 2-7. An illustration of an example ECS-5093 safety device junction box.

Teach/Override Active Indicator

The teach/override active indicator light (see **A** in ***Figure 2-7***) illuminates whenever the AUTO/TEACH/OVERRIDE key is set to TEACH/OVERRIDE.

RESET GUARDS Button

The RESET GUARDS button (see **B** in ***Figure 2-7***) is used to reset the guard safety circuit.

AUTO/TEACH/OVERRIDE Key

The AUTO/TEACH/OVERRIDE key (see **C** in ***Figure 2-7***) is used to toggle the operating mode of the light curtains and other safety devices. The override function can only be used for 120-seconds at a time. The switch must be held in the TEACH/OVERRIDE position.

EMERGENCY STOP Button

The EMERGENCY STOP button (see **D** in ***Figure 2-7***) immediately removes control power from the cell. The EMERGENCY STOP button requires the button to be pulled back out after it has been pressed in. After pressing an EMERGENCY STOP button, follow the recovery procedure outlined in Chapter 4.

2.10.11. SuperTrak Electrical Disconnect

The SuperTrak™ conveyor system, utilized in Cell Processing, has its own electrical controls enclosure with its own independent disconnect switch. This controls enclosure is located adjacent to the loading area of the conveyor system at Cell Load. Refer to the ECPL placard on the Cell Processing PDP for information about locking out the SuperTrak™ equipment.

2.10.12. Laser Controller

Cell EB040 utilizes a laser controller to generate the energy required to cut the metal battery module tabs. The laser generator has its own proprietary enclosure (with controls and indicators) that supplies laser energy, through a laser fiber, to the laser heads. The energy is focused by the laser head into a beam that is projected at a cutting location at a specific focal distance.

REFERENCE	***For more information about the laser controller, refer to the equipment supplier documentation (Trumpf Operator's Manual TruDisk 1000-8002 pg. 25).***

2.10.13. Torit Air Handler

Cell EB040 utilizes an air handler to remove fumes and debris from the laser cutting processes. The air handler has its own proprietary enclosure with controls and indicators.

REFERENCE	***For more information about the air handler, refer to the equipment supplier documentation (Donaldson Torit – Downflo LS Installation, Operation and Maintenance Manual pg. 3-8).***

2.10.14. Riedel Chiller

Cell EB040 utilizes a chiller to pump coolant through the laser heads to keep the tooling cool. The chiller has its own proprietary enclosure with controls and indicators.

REFERENCE	***For more information about the chiller, refer to the equipment supplier documentation (Dimplex – Riedel Chiller Operating Instructions pg. 17-20).***

2.10.15. Flame Detector

Cell EB040 utilizes a flame detector, located on the roof of the laser chamber, that is attached to a sprinkler system. The flame detector automatically activates the sprinkler system in the event a fire is detected.

REFERENCE 	***For more information about the flame detector, refer to the equipment supplier documentation (Flamex Minimax Operating Instructions Flame Detector UniVario FMX5000 IR pg. 13-33).***

2.10.16. Gravity / Lock Pin

Some of the vertically actuated tooling in the line features a gravity pin that can be inserted to prevent the tooling from falling during maintenance activities. A holder with sensing houses the gravity pin. The gravity pin can be engaged to secure the tooling in the raised position. Refer to the ECPL placards on each PDP for information about the use and locations of the gravity pins.

2.10.17. Servo Contactor Panel

Designated cells have a dedicated contactor panel that provides complete energy control and monitoring of all the servo motors within the cell. The outside of the panel enclosure features indicators that illuminate to identify when control power is on. A fused disconnect is located on the outside of the enclosure and is used to enable or disable control power for the associated servo drives. Refer to the GM standards and to the ATS electrical drawings for more information about the contactor panel equipment and functionality. Refer to the ECPL placards on each PDP for information about locking out the cell energy sources.

2.10.18. Atlas-Copco Controllers

The EB400 TIM Dispense equipment utilizes proprietary Atlas-Copco controllers to direct the operation of the dispense equipment. There are “A/B” controllers mounted above the associated robot controllers, “A” controllers, and “B” controllers. Each controller features control buttons and indicators as well as an electrical disconnect switch. Refer to the ECPL placards on the EB400 PDP for information about locking out the controllers.

REFERENCE 	***The TIM Dispense equipment was consigned by GM to ATS for integration. For more information about the dispense equipment, refer to the Atlas-Copco product manuals provided to GM.***

2.10.19. Remote Cycle Start

A remote cycle start box is located at several of the reject stations around the line: EB320T01, EB450T01, and EB490. The remote cycle start box features a CYCLE START button that an operator can press to release the rejects from the station.

2.10.20. Armorstart Motor Starter

Each conveyor in each cell has a separate motor starter that is used to enable or disable power to the individual conveyor motor. The motor starter is a proprietary device with a rotary disconnect. A lockout hole in the handle allows a lock to be installed for energy control purposes. Refer to the ECPL placards on each PDP for information about locking out a conveyor motor.

REFERENCE

For more information about the motor starter, refer to the equipment supplier documentation (Allen-Bradley ArmorStart Distributed Motor Controller User Manual pg. 15-28).

2.10.21. Station / Device Air Shutoff

Specific devices, and groups of devices, have independent air shutoff valves that can be used to disconnect the air supply from only the associated equipment. Turning the valve to the off position disconnects air pressure to the devices and vents the pressure through a muffler. A lockout hole in the handle of the valve allows a lock to be installed for energy control purposes. Refer to the ECPL placards on each PDP for information about locking out the cell energy sources.

2.10.22. Conveyor Pull Cord

Each of the dunnage conveyors at EB020, EB300, and EB400 have a conveyor pull cord that is used to indicate the loading or unloading of dunnage at a conveyor. Pull cords are utilized when loading and unloading is done manually. Stack lights are used in conjunction with the pull cords to indicate status.

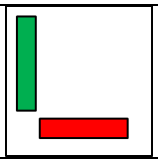
2.11. SDS REFERENCES

There are several different chemical products used in the operation and maintenance of the Stacker Line equipment. Refer to the following Safety Data Sheets for safe handling of these chemicals.

Product	Manufacturer	SDS File Name
Lubricant	Chevron	Chevron - Delo Silver SAE SDS
Lubricant	Chevron	Chevron - Rykotac EP Grease SDS
Lubricant	Drislide	Drislide - LG-01-02 Grease SDS
Lubricant	ExxonMobil	ExxonMobil - Mobilube HD Plus 80W-90 SDS
Lubricant	Harmonic Drive Systems	Harmonic Drive Systems - Harmonic Grease 4B No 2 SDS
Lubricant	ITW Pro Brands	ITW Pro Brands - LPS Force 842 SDS
Lubricant	Kluber	Kluber - Isoflex NCA 15 SDS
Lubricant	Kluber	Kluber - Klubersynth UH1 6-460 SDS
Lubricant	Kyodo Yushi	Kyodo Yushi - Vigogrease REO SDS
Lubricant	Lubriplate	Lubriplate - SYNAC 32 SDS
Lubricant	Lucas	Lucas - White Lithium Grease NLG1 #2 SDS
Lubricant	Nippon Oil	Nippon Oil - BONNOC AX 68 SDS
Lubricant	Shell	Shell - Alvania Grease S 2 SDS
Lubricant	THK	THK - AFA Grease SDS
Lubricant	THK	THK - AFB-LF Grease SDS

2.12. VISUAL AIDS

There are visual aids that have been added to select pieces of equipment that are in addition to safety and maintenance labels already attached by third party manufacturers. Refer to the following table for information about these additional visual aids.

Visual Aid	Visual Aid Description	Visual Aid Location(s)
	Displays a warning about possible pinch points for mechanical equipment along with arrows that indicate the moving part's direction of travel	Can be found on each conveyor lift gate
SET TO 65 PSI	Displays various pressures that equipment is normally set for	Can be found at all pressure regulators
NORMALLY OPEN	Displays a valve's normal position (Open or Closed)	Can be found at all manually controlled air valves
	Displays an air valve handle in open and closed positions with green being open and red being closed	Can be found at all manually controlled air valves
COMPRESSED AIR	Displays the contents and direction of air flow in air lines	Can be found on all air lines

3. SYSTEM DESCRIPTION

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3.1. STACKER LINE SUMMARY

The Stacker Line is part of a larger BET/BEV3 Battery Pack Assembly System. Each Stacker Line is identical and is used to build three module types –TRP3.1, MCP 2P12S and MCP 3P8S. The Stacker Line equipment prepares the cells and assembles all components (Cells, Binder Clips, Thermal Barriers, Side Plates, Cooling Plates, and ICB/Top Plates) into a Module Sub-Assembly. This Module Sub-Assembly is then transferred to the Module Final Assembly Line (MFA) for final processing.

3.2. STACKER UTILITIES

The Stacker System has the following utility requirements:

		Cell Load (EB020)	Cell Processing (EB040)	Cell Stacker (EB300)	Module Assembly (EB400)
Compressed Air Supply	Air Pressure (PSI)	65	75	65	65
	Max. CFM	55	60	75	105
	Supply Pipe Size	1.5″	1.5″	1.5″	1.5″
Electrical Supply	Equipment Volts	480	480	480	480
	Equipment Phase	3	3	3	3
	Main Disconnect Amps	100	100	200	200

3.3. BET/BEV3 BATTERY PACK ASSEMBLY SYSTEM LAYOUT - DETROIT

The BET/BEV3 Battery Pack Assembly System for Detroit includes a Pack Main Line, two Module Final Assembly Lines, and four HV Stacker Lines, and two SP Stacker lines. ***Figure 3-1*** illustrates this system layout. For information about the Pack Main Line, refer to the ATS *Pack Main Line Operation and Maintenance Manual*. For information about the Module Final Assembly Line, refer to the ATS *Module Final Assembly Line Operation and Maintenance Manual*.

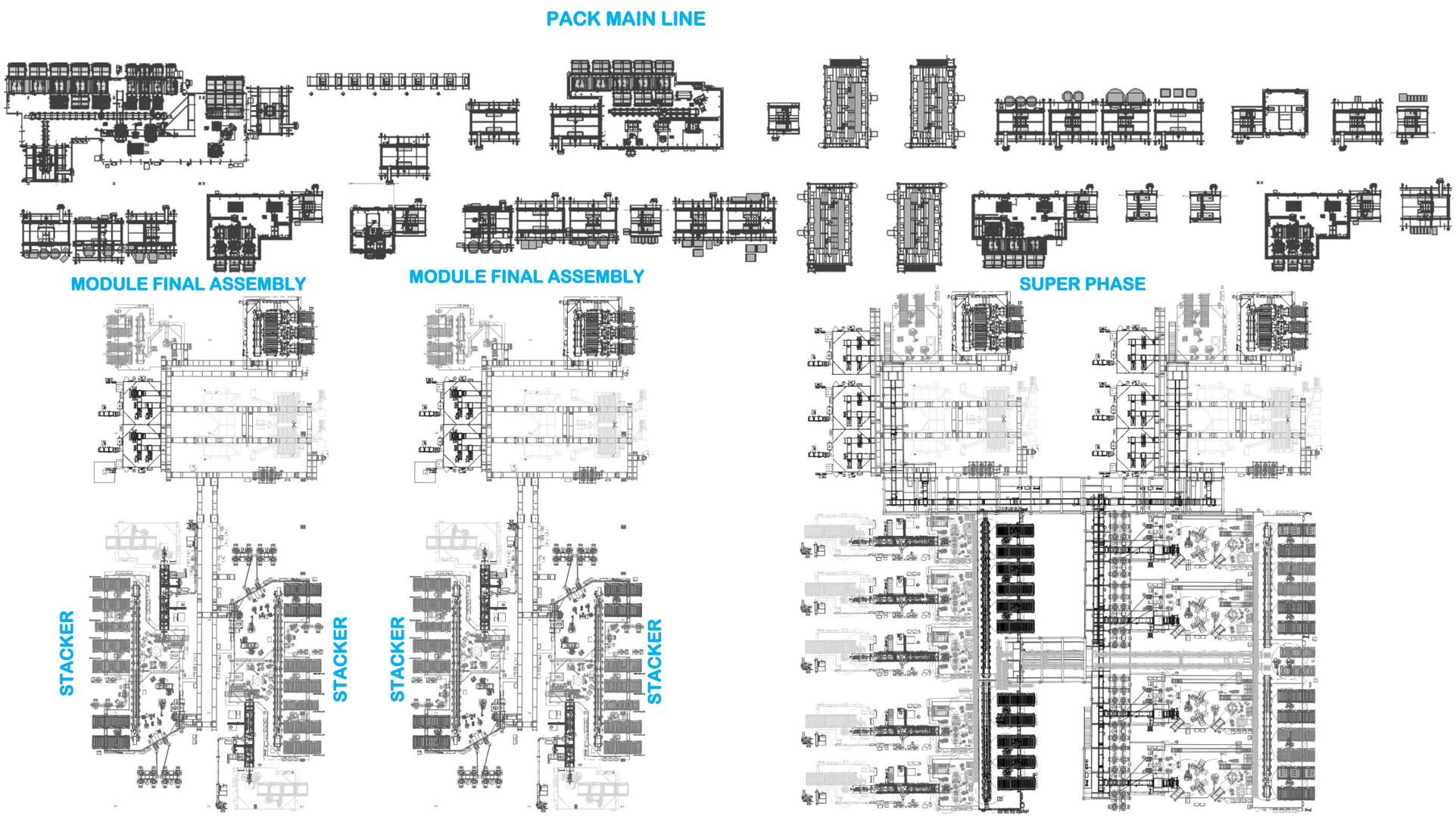


Figure 3-1. BET/BEV3 System Detroit layout

3.4. BEV3 BATTERY PACK ASSEMBLY SYSTEM LAYOUT – SPRING HILL

The BEV3 Battery Pack Assembly System for Spring Hill includes a Pack Main Line, two Module Final Assembly Lines, and one SP Stacker Line. ***Figure 3-2*** illustrates this system layout. For information about the Pack Main Line, refer to the ATS *Pack Main Line Operation and Maintenance Manual*. For information about the Module Final Assembly Line, refer to the ATS *Module Final Assembly Line Operation and Maintenance Manual*.

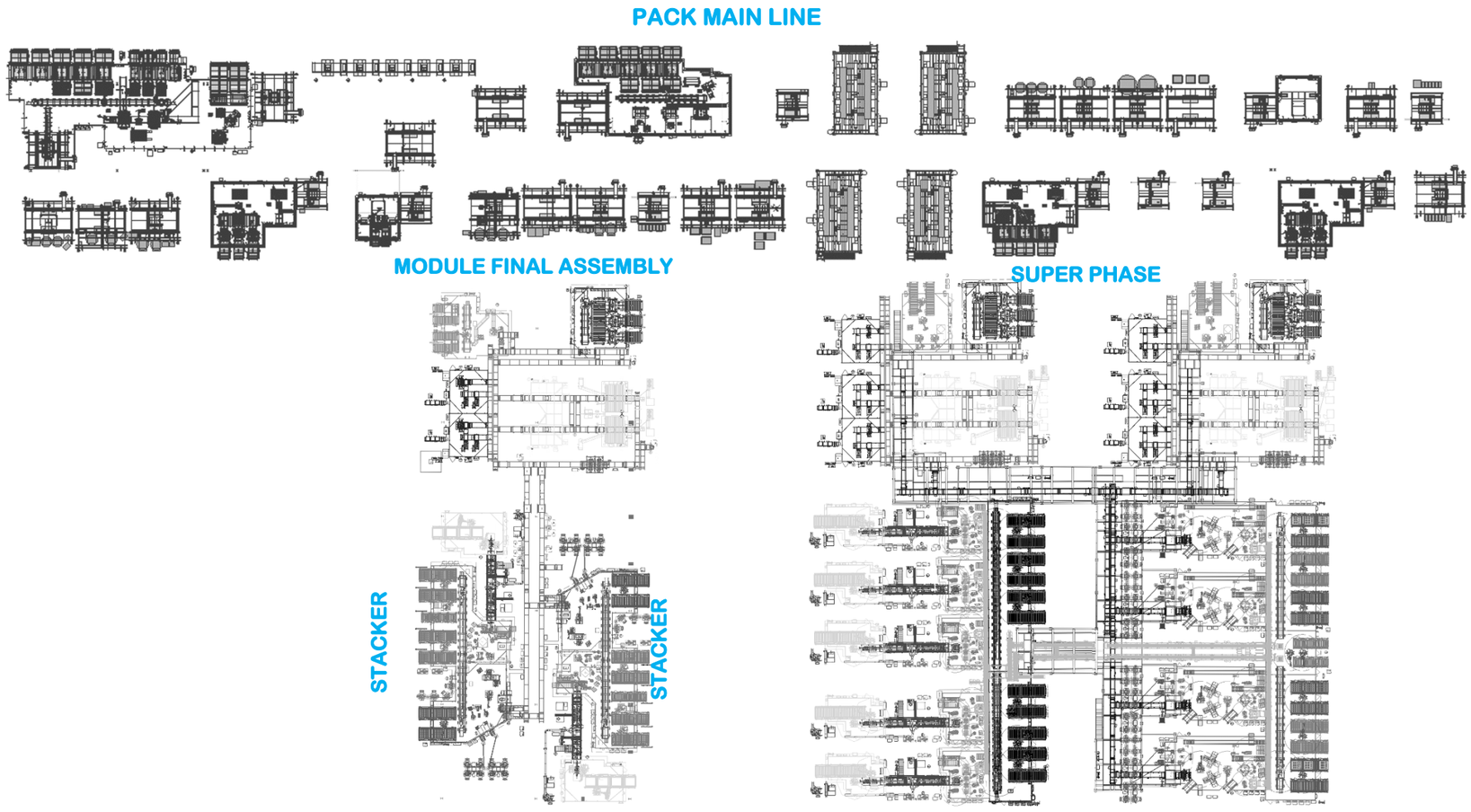


Figure 3-2. BEV3 System Spring Hill layout

3.5. STACKER LAYOUT

Each Stacker consists of four cells: Cell Load, Cell Processing, Cell Stacker, and Module Assembly. ***Figure 3-3*** illustrates the layout of this equipment.

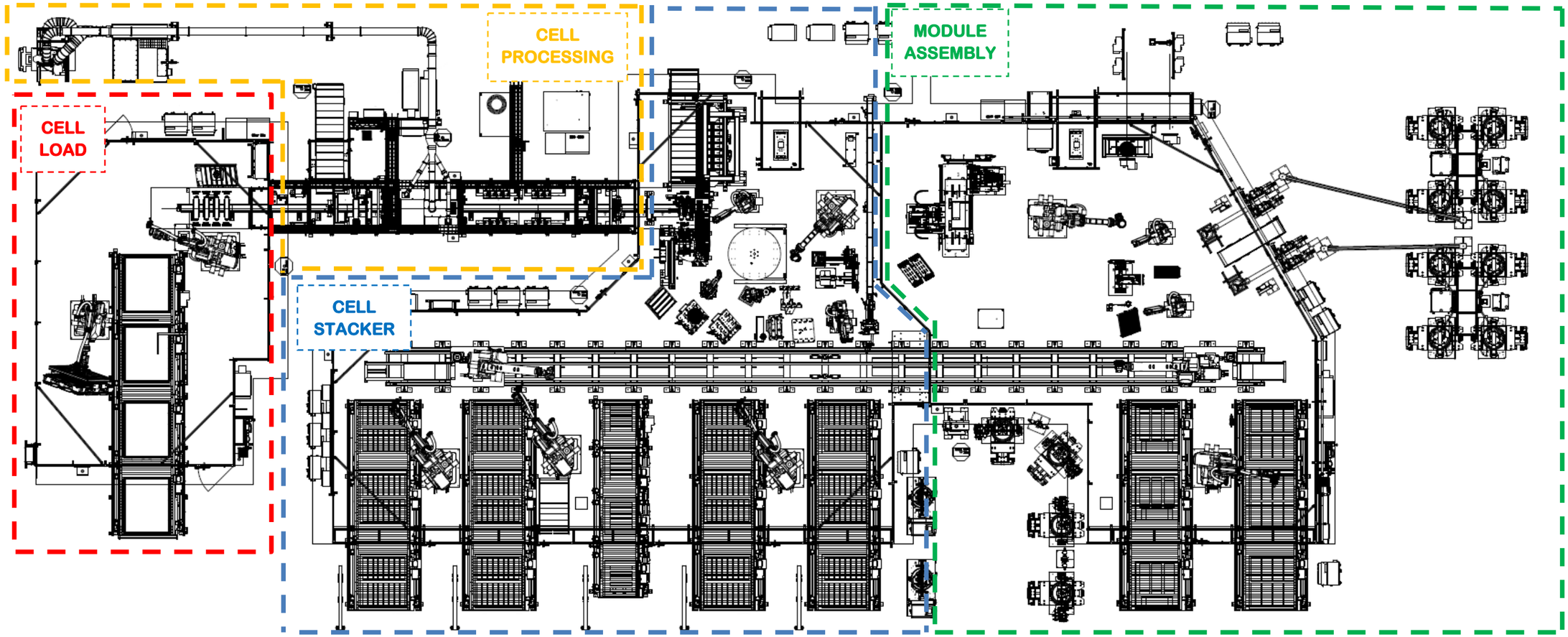
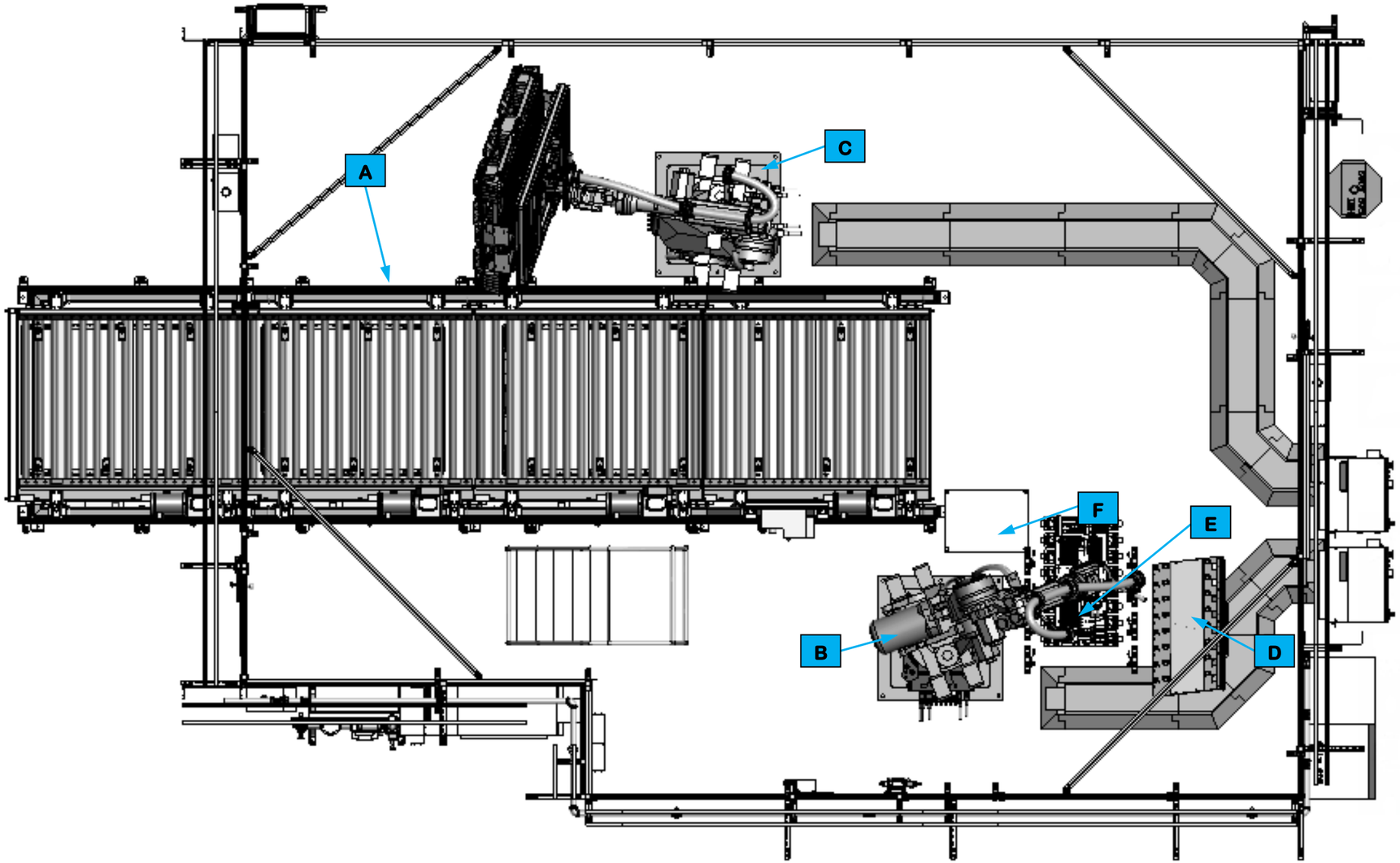


Figure 3-3. Stacker layout

3.6. BATTERY CELL LOAD EQUIPMENT

The Battery Cell Load equipment (see ***Figure 3-4***) unloads cells from returnable dunnage and loads the cells to pallets on a conveyor.



Equipment Callouts in Figure 3-4		
A	EB010T01	Conveyor Equipment
B	EB010R01	Cell Handling Robot
C	EB020R01	Tray Handling Robot
D	EB020	Cell Positioning Table
E	EB030	Drop to Conveyor
F	N/A	Robot and Vision Calibration Stand

Figure 3-4. Battery Cell Load equipment layout

3.6.1. Sequence of Operation

The Battery Cell Load equipment completes the following operations during a normal cycle.

1. A Cell Handling Robot (EB010R01) manipulates End of Arm Tooling (EOAT) to pick eight cells from a tray on Conveyor Equipment and to place the cells to a Cell Positioning Table (EB020).
2. Gravity aligns the cells in a repeatable orientation on the Cell Positioning Table.
3. The Cell Handling Robot manipulates the EOAT to pick the cells from the Cell Positioning Table and the robot then moves over a SuperTrak conveyor (EB030).
4. The SuperTrak conveyor (part of the next work cell) stops four pallets at a load position.
5. The Cell Handling Robot lowers the EOAT to release four cells to the pallets, one cell per pallet.
6. The Cell Handling Robot raises the EOAT clear, the SuperTrak conveyor releases the pallets downstream, and the SuperTrak conveyor then stops another four pallets at the load position.
7. The Cell Handling Robot lowers the EOAT to release the remaining four cells to the pallets, one cell per pallet.
8. The Cell Handling Robot raises the EOAT clear and the SuperTrak conveyor releases the pallets downstream.

The Battery Cell Load equipment completes the following operations when handling trays and dunnage stacks.

1. When a new dunnage stack is present on the Conveyor Equipment (EB010T01) input level at the unload position, a Tray Handling Robot (EB020R01) manipulates End of Arm Tooling (EOAT) to pick the empty top tray from the dunnage stack and to place the empty tray to an empty dunnage container on the output level of the Conveyor Equipment.
2. The Cell Handling Robot (EB010R01) manipulates EOAT to pick cells from the dunnage tray and to place the cells as described in the normal cycle sequence of operation. The Cell Handling Robot continues picking and placing cells until the tray is empty.
3. When the tray is empty, the Tray Handling Robot manipulates the EOAT to pick the empty tray and place the empty tray to the dunnage container on the output side of the Conveyor Equipment.
4. The Cell Handling Robot and Tray Handling Robot continue unloading cells and empty trays from the dunnage stack until the last tray has been removed from the input level of the Conveyor Equipment and has been placed to the output level of the Conveyor Equipment.
5. When the output dunnage is full of empty trays, the Conveyor Equipment releases the output dunnage to an operator for unloading. Once the output dunnage is clear, the Tray Handling Robot picks the pallet base from the input level to the output level to begin a new empty stack. The Conveyor Equipment then transfers a new dunnage stack to the input side unload position where the process starts again.

For more detailed sequences, refer to the ATS timing charts provided to your company.

3.6.2. EB010T01 Conveyor Equipment

The Conveyor Equipment (see callout **A** in ***Figure 3-4***) transfers tray containers full of cells into the work cell and transfers empty tray containers out of the work cell.

REFERENCE	***For more information about the conveyor equipment, refer to the equipment supplier documentation (Omni Chain Driven Live Roller Conveyor Straight and Curve Technical Handbook pg. 17-20).***

The Conveyor Equipment utilizes third-party Omni conveyance devices. Powered roller conveyor sections are used to pull containers into the work cell and to push empty containers out of the work cell. Each powered roller conveyor section has

its own motor and motor starter. At the work position, the Tray Handling Robot is used to transfer a single container from the input level to the output level.

Three sensing devices are located on both the input and output levels of the conveyor at the point of passage between the guarded and unguarded areas of the work cell. The sensing devices are in series to aid in the detection and distinction of the object traversing the sensing fields. Each series includes a retro-reflective sensing field, a light curtain sensing field, and another retro-reflective sensing field. The processor monitors the status of the sensing fields and the time delay between the activation of each sensing field to determine if a person or a container is traversing the field. When a container traverses, the fields are broken in a very specific time sequence. When the processor detects the inputs within the specified time frame, the safety circuit is overridden momentarily to allow the equipment to pause processing while the container traverses in or out. Any variation in the timing triggers the processor to disable the safety circuit and disconnect control power.

3.6.3. EB010R01 Cell Handling Robot and EOAT

The Cell Handling Robot and End of Arm Tooling (EOAT) (see callout **B** in ***Figure 3-4***) is used to pick eight cells out of a tray, transfer the cells to a Cell Positioning Table, and then pick and place the cells to pallets on a SuperTrak conveyor (four cells at a time, one cell per pallet).

REFERENCE ***For more information about the robot equipment, refer to the equipment supplier documentation (Fanuc Robot R-2000 iC Mechanical Unit Operator's Manual pg. 26-65).***

The Fanuc R-2000 iC/210F robot is a third-party component integrated with the other cell mechanisms. The robot manipulates several axes to properly position EOAT. Vision equipment (also third-party Fanuc equipment) identifies the cell positions relative to the tray in which the cells are located. The robot utilizes coordinates from the vision equipment to properly position the EOAT for picking the cells.

The EOAT consists of a gripper frame that holds two linear lights, the Fanuc camera, eight vacuum generators, and 32 vacuum pads. Two opposing sides of the gripper frame feature linear lights that are used to illuminate the pick area for the Fanuc camera. The vacuum pads are configured into eight groups of four, with each group consisting of two vacuum pads on one side and two vacuum pads on the opposite side. Each group is configured to pick a single cell and has its own dedicated vacuum generator. When the EOAT is lowered onto a group of cells, the vacuum generators turn on to enable vacuum through the vacuum pads to suction the cells against the pads. The vacuum generators remain turned on until the EOAT is lowered at a release point.

3.6.4. EB020R01 Tray Handling Robot and EOAT

The Tray Handling Robot and End of Arm Tooling (EOAT) (see callout **C** in ***Figure 3-4***) is used to pick a single empty tray out of a container on the input conveyor and to place the tray to a container on the output conveyor.

REFERENCE ***For more information about the robot equipment, refer to the equipment supplier documentation (Fanuc Robot R-2000 iC Mechanical Unit Operator's Manual pg. 26-65).***

The Fanuc R-2000 iC/210F robot is a third-party component integrated with the other cell mechanisms. The robot manipulates several axes to properly position EOAT. Vision equipment (also third-party Fanuc equipment) assists the robot in properly picking and placing trays by inspecting an empty dunnage container to calculate the tray placement

coordinates and by inspecting an empty tray on a dunnage stack to calculate the tray pick coordinates (the camera also uses an algorithm to determine the tray height based on the distance between the tray fiducial positions).

The EOAT consists of a gripper frame that holds two linear lights, the Fanuc camera, two vacuum generators with eight vacuum pads, and four air cylinders. Two opposing sides of the gripper frame feature linear lights that are used to illuminate the pick area for the Fanuc camera. The vacuum pads are configured into two groups of four, with each group consisting of two vacuum pads on one side and two vacuum pads on the opposite side. Each group has its own dedicated vacuum generator. When the EOAT is lowered onto a tray, the vacuum generators turn on to enable vacuum through the vacuum pads to suction the tray against the pads. The vacuum generators remain turned on until the EOAT is lowered at a release point. The air cylinders are used to pick and place the pallet base from the input conveyor to the output conveyor. The air cylinders actuate some lift tooling which engages the fork truck pockets of the pallet base to securely support it for lifting. A thru-beam sensor on this tooling is used to detect the presence of the pallet base.

3.6.5. EB020 Cell Positioning Table

The Cell Positioning Table (see callout **D** in ***Figure 3-4***) provides a tilted nest that locates cells in a repeatable position to ensure they are properly aligned before being placed to the next operation. When the Cell Handling Robot End of Arm Tooling (EOAT) releases the cells to the table, the cells fall into the bottom edge of the nest and one of the nest sides. The EOAT then acquires the cells again in their repeatable position. Sensors in the table detect when a cell is present or absent.

If necessary, an operator can reintroduce one or more cells by loading them to the Cell Positioning Table by hand. For more information about this process, refer to ***Chapter 4 section 4.3.10.1 Cell Load (EB020) Part Reintroduction***.

3.6.6. EB030 Drop to Conveyor

The Drop to Conveyor equipment (see callout **E** in ***Figure 3-4***) consists of four Pepperl & Fuchs through-beam sensors located at the load position of the SuperTrak conveyor, one sensor per pallet position. The sensors check that a cell is present or absent in the pallet as required for the cycle.

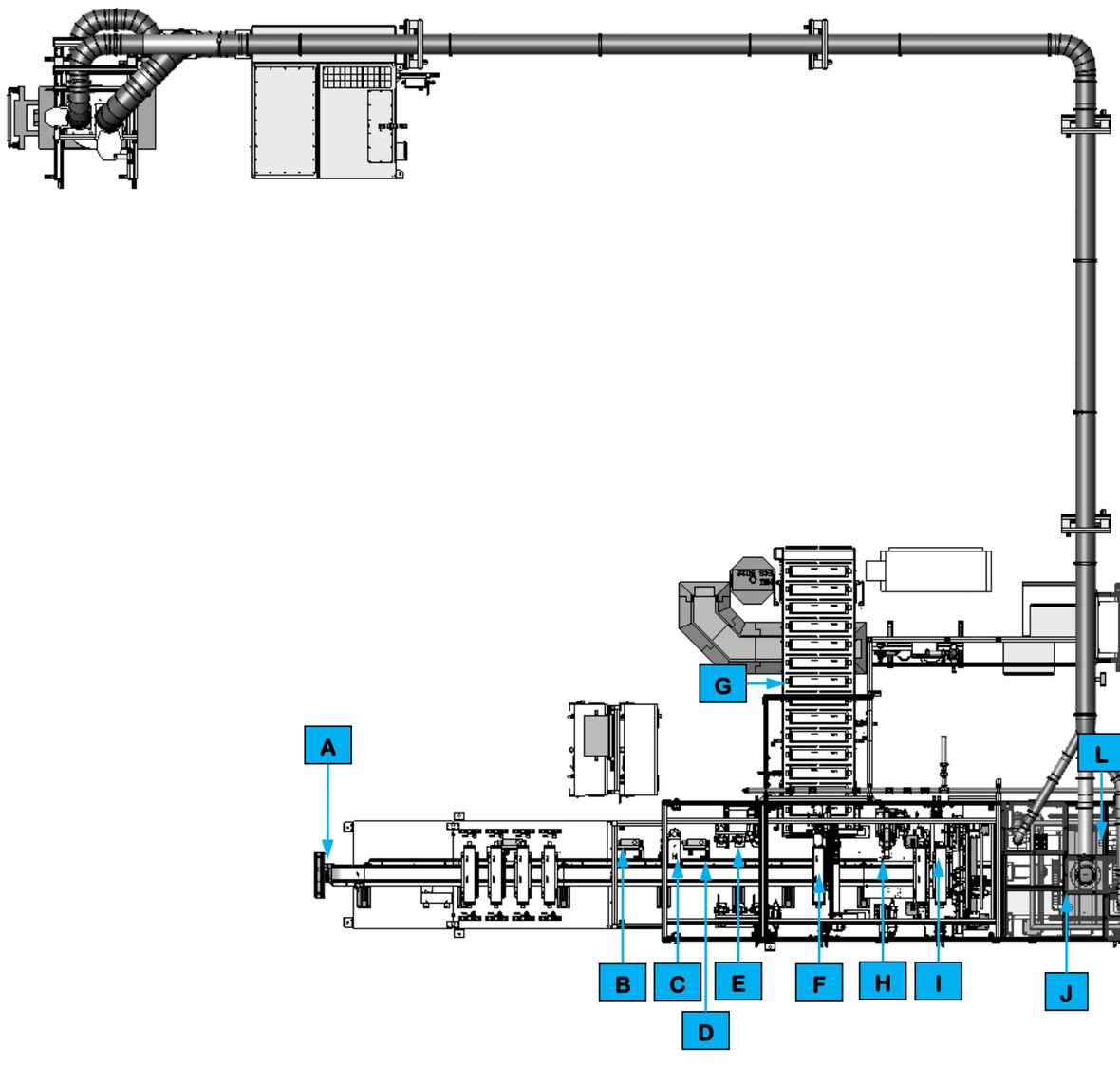
3.6.7. Robot and Vision Calibration Stand

The Robot and Vision Calibration Stand (see callout **F** in ***Figure 3-4***) provides a calibration grid that is used as a reference when calibrating the robot and robot vision equipment. Calibration of the robot and robot vision equipment is documented in the associated Fanuc documentation.

REFERENCE	***For information about the robot and vision equipment calibration, refer to the equipment supplier documentation (Fanuc iRVision 2D Camera Application Operator's Manual, Grid Pattern Calibration With A Fixed Camera, Page 160).***

3.7. CELL PROCESSING EQUIPMENT

Cell Processing (see ***Figure 3-5***) reads the barcode of each cell, conducts electrical open circuit voltage testing on each cell, removes rejected cells, knurls the aluminum tab of each cell, biases each cell to one side or the other, flips designated cells, laser trims the copper and aluminum cell tabs, verifies that the cell tabs have been properly trimmed (and that no ″hanging chads″ are present), forms the cell tabs to specific shapes, flips and/or rotates designated cells, and positions the cells to be unloaded to the next process.



Equipment Callouts in Figure 3-5						
A	N/A	SuperTrak Conveyor		J	EB130	Laser Trim 1
B	EB040	Barcode Reader		K	EB135	Laser Trim 2
C	EB050	Open Circuit Voltage (OCV) 1		L	EB137	Trim Verification
D	EB060	Open Circuit Voltage (OCV) 2		M	EB140-EB190	Tab Forming
E	EB070	Open Circuit Voltage (OCV) 3		N	EB200-EB250	Tab Forming
F	EB080	Reject Pick-and-Place		O	EB280	Post-Bend Cell Flip
G	EB080T01	Reject Conveyor		P	EB290	Cell Rotate
H	EB090	Tab Knurling				
I	EB100	Cell Bias				

Figure 3-5. Cell Processing equipment layout.

3.7.1. Sequence of Operation

Cell Processing completes the following operations during a cycle.

1. A SuperTrak conveyor systems stops four empty pallets at the start of the conveyor.
2. A Cell Handling Robot (EB020) places a cell into each of the four pallets.
3. The conveyor releases the pallets downstream.
4. At EB040, a single pallet is stopped, and the barcode is read from the cell in the pallet. The conveyor then releases the pallet downstream.
5. At EB050/EB060/EB070, three pallets are stopped where tooling engages the pallets and open circuit voltage tests are conducted on the cells. The tooling disengages and the conveyor releases the pallets downstream.
6. If a pallet has a cell that has been rejected, the pallet is stopped at EB080. Pallets with good cells continue along the conveyor to EB090. When a pallet with a reject is stopped at EB080, mechanisms pick the cell from the pallet, move the cell over a reject conveyor, rotate the cell, and place the cell into the reject conveyor. The reject conveyor (EB080T01) then transports the rejected cell to an operator.
7. At EB090, a single pallet is stopped. Tooling lowers, knurls the cell aluminum tab, and the tooling raises clear. The conveyor then releases the pallet downstream.
8. At EB100, a single pallet is stopped. Tooling biases the cell to one side or the other depending on the build recipe. Pallet clamps are actuated to lock the cell into a fixed position in the pallet. The conveyor then releases the pallet downstream.
9. At EB110, a single pallet is stopped only when the build recipe requires a flipped cell, all other pallets pass through the station. Once a pallet is stopped, tooling grips the cell, the pallet clamps are actuated to unlock the cell, and the cell is picked, flipped 180°, and is set back into the pallet. The pallet clamps are actuated to lock the cell into the pallet and the tooling releases the cell. The conveyor then releases the pallet downstream.
10. At EB130, a single pallet enters a laser chamber where first the copper tab of the cell is trimmed by a laser head and then the aluminum tab of the cell is trimmed by a second laser head (EB135). Fumes and debris are removed from the laser chamber to an external source. The pallet never stops for operations; the travel is slowed but the pallet moves continuously through the station.
11. At EB137, a single pallet is slowed as it passes through the station sensors that determine the cell tab length and check if any ″hanging chads″ are present, indicating that the tab was not completely cut during the previous process.
12. At EB140-EB230, a single pallet is stopped at only one of the Tab Forming stations and bypasses all other Tab Forming stations. Once the pallet is stopped, tooling grips the tabs of the cell in the pallet. Upper die tooling lowers to form the initial tab bends, and lower die tooling raises to finish the tab bends. Once all the tooling retracts clear the pallet is released downstream.
13. At EB280, a single pallet is stopped only when the build recipe requires a flipped cell, all other pallets pass through the station. Once a pallet is stopped, tooling grips the cell, the pallet clamps are actuated to unlock the cell, and the cell is picked, flipped 180°, and is set back into the pallet. The pallet clamps are actuated to lock the cell into the pallet and the tooling releases the cell. The conveyor then releases the pallet downstream.
14. At EB290, a single pallet is stopped only when the build recipe requires a rotated cell, all other pallets pass through the station. Once a pallet is stopped, tooling grips the cell, the pallet clamps are actuated to unlock the cell, and the cell is raised, rotated 180°, and is set back into the pallet. The pallet clamps are actuated to lock the cell into the pallet and the tooling releases the cell. The conveyor then releases the pallet downstream.

For more detailed sequences, refer to the ATS timing charts provided to your company.

3.7.2. SuperTrak™ Conveyor

The ATS SuperTrak™ conveyor system (see callout **A** in *Figure 3-5*) is a flexible high-speed pallet transport system. With this system, the direction, acceleration, speed, and position of each individual pallet is totally programmable. Integrated collision avoidance eliminates pallet-to-pallet contact and provides auto-queuing. Integrated collision avoidance eliminates pallet-to-pallet contact and provides auto-queuing. Each pallet is designed with tooling that clamps a battery cell in place.

At each end of the SuperTrak, a gravity pin can be inserted to tooling to prevent pallets from rolling off the end of the conveyor turn. A holder with sensing houses the gravity pin. An operator removes the pin from the holder and inserts the pin into a block. The end of the pin protrudes from the block a distance that prevents a pallet from rolling backward (at the start of the conveyor, or forward at end of the conveyor).

Four pallets are stopped at the first work position on the conveyor where all four pallets are loaded with battery cells. The pallets are then released downstream individually where they are worked on one at a time. At the opposite end of the conveyor, four pallets are stopped where they are unloaded, and the battery cells are transferred to the next process.

REFERENCE

For more information about the SuperTrak™ equipment, refer to the equipment supplier documentation (ATS Operation and Maintenance Manual SuperTrak™ GEN3 Modular Conveyor pg. 19-43).

3.7.3. EB040 Barcode Reader

When a pallet with a battery cell is stopped at the station (see callout **B** in *Figure 3-5*), a Matrox GTX camera reads the barcode off the battery cell for tracking purposes. The pallet is then released downstream.

REFERENCE

For more information about the camera, refer to the equipment supplier documentation (Matrox Iris GTX Install and Technical Manual pg. 22-50).

3.7.4. EB050/EB060/EB070 OCV

The conveyor system stops three pallets at the station (see callouts **C**, **D**, and **E** in *Figure 3-5*) where three identical tools perform identical operations on the three battery cells in the pallets. At each station, a pair of SMC parallel grippers (on opposing sides of the pallet) close contact tooling onto the battery cell tabs. A Keithley DMM6500 digital multimeter (three in total, one for each cell) conducts an Open Circuit Voltage (OCV) test on the battery cell through the contact tooling. The test results are recorded, the grippers open, and the conveyor system releases the pallets downstream.

REFERENCE

For more information about the multimeter, refer to the equipment supplier documentation (Keithley Model 2700 Multimeter/Switch System User's Manual Chapter 1 pg. 5).

3.7.5. EB080 Reject Pick-and-Place

A pallet is only stopped at the station (see callout **F** in *Figure 3-5*) if a barcode read failed or if an OCV test failed. Pallets with good parts continue to the next station without stopping. When a pallet with a reject is stopped at the station, a Reject Pick-and-Place lowers to the pallet, picks the battery cell, raises from the pallet, extends over a Reject Conveyor (see callout **G** in *Figure 3-5*), lowers to the Reject Conveyor, and the Reject Pick-and-Place releases the battery cell to the Reject Conveyor. The Reject Pick-and-Place then returns over the SuperTrak conveyor, the SuperTrak conveyor releases

the empty pallet downstream, and the Reject Conveyor enables momentarily to index the rejected battery cell clear of the Pick-and-Place.

The Reject Pick-and-Place utilizes a vertical pneumatic cylinder to raise and lower, a horizontal pneumatic cylinder to move between pick and place locations, an end effector with four vacuum cups, and a pneumatic rotary table to change the battery cell orientation. During a cycle, the vertical cylinder lowers the end effector to the battery cell in the pallet. The end effector vacuum cups are supplied with vacuum pressure to grip the battery cell. The vertical cylinder then raises the battery cell, the horizontal cylinder extends the tooling over the Reject Conveyor, the rotary table rotates 90°, the vertical cylinder lowers the tooling, and the vacuum cup pressure is released to drop the battery cell onto the Reject Conveyor. The vertical cylinder raises, the rotary table rotates 90° back to the original orientation, and the horizontal cylinder retracts the tooling back over the SuperTrak conveyor.

The vertical tooling of the Reject Pick-and-Place features a gravity pin that can be inserted to prevent the tooling from falling during maintenance activities. A holder with sensing houses the gravity pin. An operator removes the pin from the holder and inserts the pin into a through-hole in the tooling plates, securing the vertical tooling in the raised position.

3.7.6. EB080T01 Reject Conveyor

The Reject Conveyor (see callout **G** in ***Figure 3-5***) utilizes a Dorner 3200 series conveyor to transport rejected battery cells out to an operator. The flat belt conveyor features flights spaced at intervals that allow a single cell to be placed between each flight. The flights are detected by a through-beam sensor. Each index of the conveyor belt repositions one pitch, advancing the battery cells one slot forward. A button at the operator end of the conveyor allows the operator to drive the conveyor independently to remove battery cells as needed.

REFERENCE	***For more information about the conveyor, refer to the equipment supplier documentation (Dorner 3200 Series Flat Belt LPZ Conveyors Installation, Maintenance & Parts Manual pg. 3).***

3.7.7. EB090 Tab Knurling

The conveyor system stops a pallet at the station (see callout **H** in ***Figure 3-5***) so that the aluminum tab of the battery cell can be knurled. The tab slides between a set of guides and dies. Once positioned, a 5-ton pneumatic BTM press extends a ram and an upper die to press down on the aluminum tab that is backed by a lower die. The dies impart knurls to the tab. At the bottom of the press stroke, a Schneider Electric microswitch verifies that a complete knurl was formed. Once the press has reached the end of its stroke and the switch verification has taken place, the press raises to the home position. The conveyor system then releases the pallet downstream.

The press tooling features a gravity pin that can be inserted to prevent the tooling from falling during maintenance activities. A holder with sensing houses the gravity pin. The gravity pin can be engaged to secure the press in the raised position.

REFERENCE	***For more information about the press, refer to the equipment supplier documentation (BTM Set-Up and Maintenance Guide pg. 31).***

3.7.8. EB100 Cell Biasing

The conveyor system stops a pallet at the station (see callout **I** in ***Figure 3-5***) so that the cell can be pushed (biased) to the right or left side in a known, fixed position as needed for the build recipe. The station has two identical bias tools (on opposite sides of the pallet) and a pallet clamp actuator. If a cell needs to be biased to the right, then the left bias tool uses a SMC slide table to extend machined push tooling that over-pushes the cell past the bias position (or if the cell needs to be biased left then the right tool extends). Once the cell has been over-pushed, the left bias tool retracts. The right bias tool then extends a mid-stop (Festo intermediate position module) and a SMC slide table extends push tooling to push the cell to the correct location. A Keyence measurement sensor verifies that the cell is biased correctly. Once correctly biased, a pair of SMC compact slides actuate pusher tooling to close the pallet clamp actuator, locking the cell to the pallet. The conveyor system then releases the pallet downstream.

3.7.9. EB130/EB135 Laser Trim

The conveyor system passes pallets continuously through the station (see callouts **K** and **L** in ***Figure 3-5***) without stopping, though the pallet travel speed is reduced. Each pallet enters a semi-light-tight laser chamber where two laser cutting heads are positioned, slightly offset. The two cutting heads share a single laser beam. The beam is emitted from a laser generator and is transmitted first to the copper laser cutting head (EB130) and then to the aluminum laser cutting head (EB135). Each cutting head is mounted to servo-driven Y- and Z-axis linear actuators. The Y-axis controls the length of the cut while the Z-axis controls the laser head focal length. At the copper laser cutter, the cell tab passes between guide plates and the tab is supported by a blade. The laser beam is fired just prior to the leading edge of the tab entering the cutting area and the laser beam remains on until just after the trailing end of the tab exits the cutting area. The blade supporting the tab is retracted by a SMC slide table. When the blade is retracted, the scrap material cut from the tab drops into a collector. The collector is plumbed through ducting to an evacuation system. The evacuation system draws smoke and debris through ducting (both above and below the cutting heads). As soon as the laser beam turns off at the copper laser cutter, the beam is transferred to and turned on at the aluminum laser cutter. The aluminum tab of the cell is then cut in a similar manner as the copper tab with identical tooling. The laser beam is turned off completely after the aluminum tab has been cut. The conveyor system then releases the pallet downstream.

WARNING!

DO NOT operate the laser with the chamber open. DO NOT stare directly at the laser beam. The safety circuit prevents the laser from firing while the chamber door is open. DO NOT attempt to circumvent or disable the interlock circuit.

Avoid all exposure to visible and invisible laser radiation. Failure to comply may result in hazardous laser radiation exposure and/or blindness. Review the General Laser Safety Warnings in Chapter 2 of this manual as well as those found in the Trumpf documentation.

The Trumpf laser generator has two fiber cables that provide a beam-sharing connection to the two laser cutting heads. The laser cutting heads are attached to servo-driven Y- and Z-axis linear actuators inside of a semi-light-tight chamber. The laser generator and associated equipment is located around the outer perimeter of the chamber. The laser generator supplies the energy for the laser heads to cycle. A Riedel chiller pumps coolant through the laser heads to keep the tooling cool. A Donaldson Torit evacuation system removes debris and fumes from the laser chamber. The evacuation system includes a duct spark cooler to mitigate sparks in the collection system by creating turbulence in the air flow stream. Four Axis Communication CCTV cameras are located inside of the chamber with a monitor outside of the chamber to display the camera images.

REFERENCE	***For more information about the laser equipment, refer to the equipment supplier documentation (Trumpf – Operator's Manual TruDisk 1000-8002 Chapter 3, Donaldson Torit Downflo LS Installation, Operation and Maintenance Manual pg. 3-8, Dimplex – Riedel Chiller Operating Instructions pg. 17-20, Axis Communications – Axis M5525-E PTZ Network Camera User Manual pg. 3-6***

The Z-axis linear actuators each feature a gravity pin that can be inserted to prevent the tooling from falling during maintenance activities. A holder with sensing houses the gravity pin. The gravity pin can be engaged to secure the tooling in the raised position.

3.7.10. EB137 Trim Verification

The conveyor system slows the travel speed of a pallet but does not stop it as it passes through the station (see callout **M** in ***Figure 3-5***), crossing between several Keyence laser micrometers emit beams that are broken by the cell tab. The processor performs calculations based on the percentage of the beams that are broken to determine the length of the cell tab. These calculations are used to check if any ″hanging chads″ are present, indicating that the tab was not completely cut during the previous process.

REFERENCE	***For more information about the laser micrometers, refer to the equipment supplier documentation (Keyence IG Series User's Manual Chapter 1).***

3.7.11. EB140 – EB230 Tab Forming

The conveyor system stops a single pallet at one of seven sets of Tab Forming stations (see callouts **N** and **O** in ***Figure 3-5***) depending on the build recipe. The work area has space for up to five more sets of Tab Forming stations to be installed in the future. Each Tab Forming station set is nearly identical and operates identically, the only difference is the shape that the die sets form.

Each Tab Forming station is comprised of two identical mechanisms that are mirror images. The inside (conveyor-facing) of each mechanism features a pair of vertical SMC compact air cylinders (an upper and a lower) that are used to control the clamping action of the station. The outside (guard-facing) of each mechanism features a pair of vertical SMC compact air cylinders (an upper and a lower) that are used to control the die sets and a horizontal SMC slide table that is used to control a tab forming backup blade.

Once a pallet is stopped at the designated Tab Forming station, the inside air cylinders (both upper and lower) extend clamp tooling to pinch the cell tabs and hold the tabs steady during the forming process. The outside upper air cylinders extend dies that bend the tabs the outside lower air cylinders then extend dies that finish bending the tabs (forming a tight ″S″ shape). The outside upper and lower air cylinders retract clear, the inside upper and lower air cylinders retract clear, and the conveyor system releases the pallet downstream.

Each Tab Forming station is attached to two pairs of THK rails with mounting plates sandwiched between the rail pairs. This configuration allows personnel to release an indexing plunger and then telescope the station clear of the conveyor out to a position where maintenance can be performed on the equipment. Additionally, the upper tooling of each Tab Forming station features a gravity pin that can be inserted to prevent the tooling from falling during maintenance activities. A holder with sensing houses the gravity pin. The gravity pin can be engaged to secure the tooling in the raised position.

3.7.12. EB280 Post-Bend Cell Flip

The conveyor system stops a pallet at the station (see callout **P** in ***Figure 3-5***) only when the pallet is flagged by the build recipe. All other cells bypass this station and continue down the conveyor system. When a pallet is stopped at the station with a cell that needs to be flipped, a pair of SMC parallel grippers close on the cell ends. A pair of SMC compact slides then actuate pusher tooling to open the pallet clamp actuator, unlocking the cell from the pallet. Once the cell has been unlocked from the pallet, a SMC cylinder raises the station tooling and cell. A SMC rotary actuator then rotates two rotary shafts. Timing pulleys on the shaft ends rotate timing belts that connect with timing pulleys that connect to drive shafts attached to the parallel grippers. The grippers rotate simultaneously to flip the cell over 180°. The SMC cylinder then lowers the station tooling and cell, dropping the cell back onto the pallet. The SMC compact slides actuate the pusher tooling to close the pallet clamp actuator, locking the cell in the pallet. The parallel grippers then open and the conveyor system releases the pallet downstream.

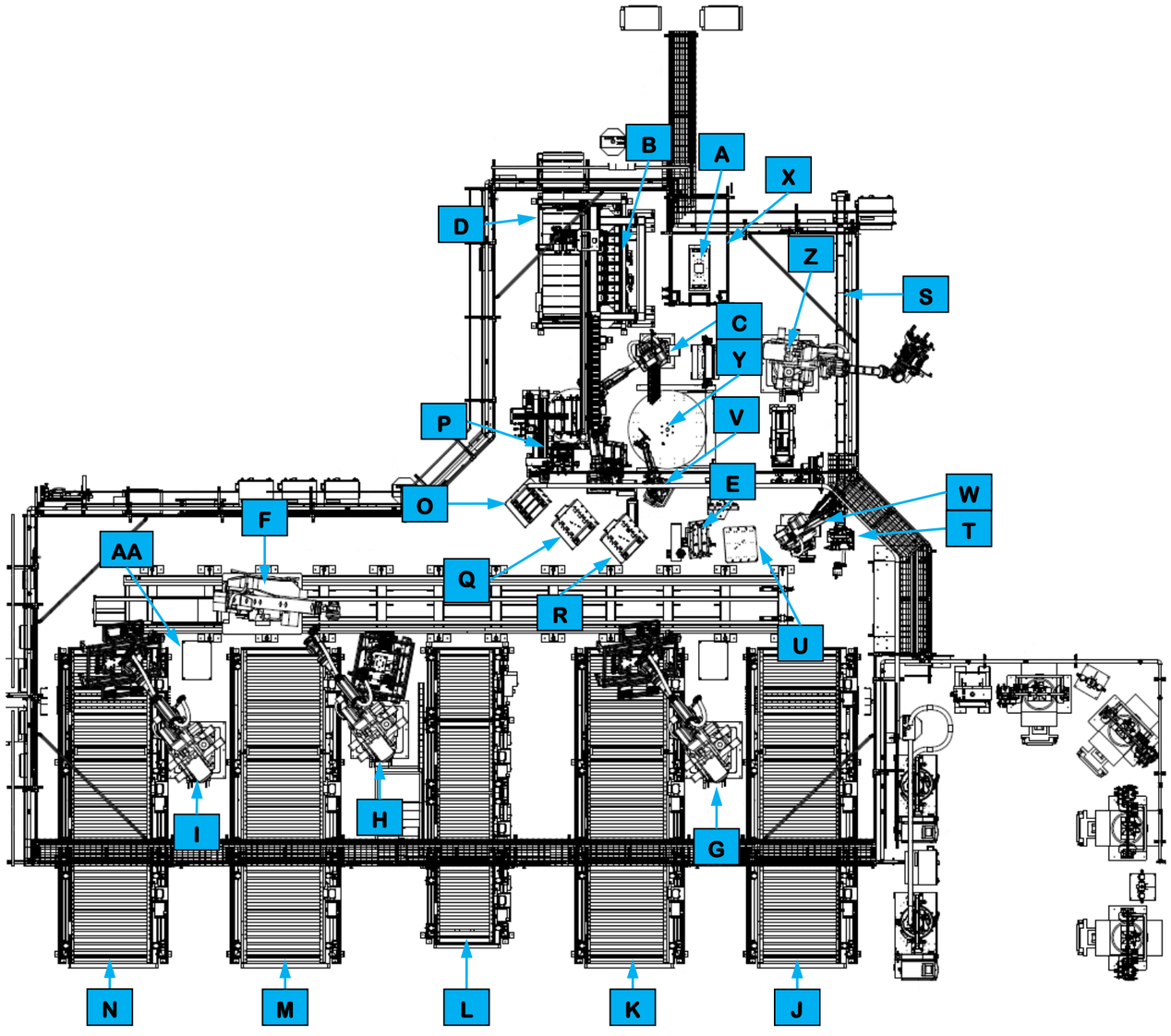
The upper tooling features a gravity pin that can be inserted to prevent the tooling from falling during maintenance activities. A holder with sensing houses the gravity pin. The gravity pin can be engaged to secure the tooling in the raised position.

3.7.13. EB290 Cell Rotate

The conveyor system stops a pallet at the station (see callout **Q** in ***Figure 3-5***) only when the pallet is flagged by the build recipe. All other cells bypass this station and continue down the conveyor system. When a pallet is stopped at the station with a cell that needs to be rotated, SMC compact slides actuate pusher tooling to open the pallet clamp actuator, unlocking the cell from the pallet. Once the cell has been unlocked from the pallet, a SMC slide table lowers six SMC vacuum pads to the top of the cell. A SMC vacuum generator supplies vacuum through the vacuum pads to grip the cell. With the cell gripped, the slide table raises the cell clear of the pallet. Once the cell is clear, an Allen-Bradley servo motor rotates the cell 180° and the slide table then lowers the cell onto the pallet. Vacuum is removed from the vacuum pads to release the cell. Once the cell is released, the compact slides actuate the pusher tooling to close the pallet clamp actuator. The conveyor system then releases the pallet downstream to be unloaded by EB300.

3.8. CELL STACKING EQUIPMENT

Cell Stacking (see ***Figure 3-6***) stacks cells, side plates, a mid-beam, and thermal barriers in a specific sequence according to a build recipe. The operations take place around a four-position dial, with adjacent equipment supplying parts as needed or removing rejected parts as necessary.



Equipment Callouts in Figure 3-6		
A	EB310	Cell Pick
B	EB320	Cell Swap Rack
C	EB320R01	Cell Stacking Robot
D	EB320T01	Reject Conveyor
E	EB330	Thermal Barrier Handoff
F	EB330R01	Dunnage Robot
G	EB330R02	Dunnage Robot
H	EB330R03	Dunnage Robot
I	EB330R04	Dunnage Robot
J	EB330T01	Side Plate Conveyors
K	EB330T02	Short L-Clip Conveyors
L	EB330T03	Thermal Barrier Conveyors
M	EB330T04	Long L-Clip 1 Conveyors
N	EB330T05	Long L-Clip 2 Conveyors
O	EB340	Short L-Clip Handoff
P	EB340R01	Thermal Barrier Robot
Q	EB345	Long L-Clip Handoff 1
R	EB346	Long L-Clip Handoff 2
S	EB348	Side Plate Reject Conveyor
T	EB349	Dispense and Inspect
U	EB350	Side Plate Handoff
V	EB350R01	Side Plate Robot
W	EB350R02	Side Plate Robot
X	EB356	Reject Soft Stack
Y	EB360	Stack Dial
Z	EB370R01	Press Load Robot
AA	N/A	Robot and Vision Calibration Stand

NOTE

The Side Plate, Short Binder Clip, Thermal Barrier, and Long Binder Clip Conveyor configurations vary among phases based on the plant column locations. The phase 1 configuration (B01) is shown in this illustration.

Figure 3-6. Cell Stacking equipment layout.

3.8.1. Sequence of Operation

Most of the operations at Cell Stacking occur around the two-position EB355 Mini Stack Build Dial and the four-position EB360 Stack Dial, with the remaining operations supplying parts to the equipment around the dial, removing rejected parts from the cell, or holding parts until they are needed.

1. At the dial position 1 (EB355T01), the following operations take place:

    a. EB355- Mini Stack Build Dial rotates a pair of Mini Stack nests with a Bottom Binder Clip in each nest into position.

    b. EB352- Cell to Cell Adhesive Dispense gantry dispenses a strip of adhesive on the top of each Bottom Binder Clip. The dispense pattern is vision inspected upon completion of the dispense to check that it meets specifications.

    c. EB315- Cell Unload Pick & Place places two cells (one per nest) onto the Lower Binder Clip in each nest.

    d. EB352- Cell to Cell Adhesive Dispense gantry dispenses a strip of adhesive on the top of each cell. The dispense pattern is vision inspected upon completion of the dispense to check that it meets specifications.

    e. Steps c. and d. repeat two more times to end up with three cells in each nest.

    f. EB340- Binder Clip Robot loads a pair (one per nest) of Mid Beams to the top of each cell stack.

    g. EB352- Cell to Cell Adhesive Dispense gantry dispenses a strip of adhesive on the top of each Mid Beam. The dispense pattern is vision inspected upon completion of the dispense to check that it meets specifications.

    h. Steps c., d., and e. are repeated. At the end of this point of the build process each nest contains a stack of the following (in order from bottom of nest to top): Lower Binder Clip, Cell, Cell, Cell, Mid Beam, Cell, Cell, Cell with adhesive bonding each layer.

    i. When an EB352 dispense patterns fails vision inspection in one or both Mini Stack Build nests the build process will stop in that nest and will get removed at dial position 2 (EB355T02).

2. At the dial position 2 (EB355T02), the following operations take place:

    a. EB355- Mini Stack Build Dial rotates a pair of Mini Stack nests with a partial built Mini Stack in each nest into position.

    b. EB340- Binder Clip Robot loads a pair (one per nest) of Top Binder Clips to the top of each cell stack to complete the Mini Stack build.

    c. EB320- Mini Stack Load Robot picks a Mini Stack from nest 1 on dial and transfers to the EB352 Z-Height Inspection station and then to EB360T02 Stacking Dial (position 2) to place to stacking nest.

        i. If the Mini Stack was failed at dial position 1 the robot will place the rejected Mini Stack to the EB356- Reject Soft Stack cart.

d. EB320- Mini Stack Load Robot picks a Mini Stack from nest 2 on dial and transfers to the EB352 Z-Height Inspection and then to EB360T02 Stacking Dial (position 2) to place to stacking nest.

    i. If the Mini Stack was failed at dial position 1 the robot will place the rejected Mini Stack to the EB356- Reject Soft Stack cart.

e. EB340- Binder Clip Robot loads a pair (one per nest) of Bottom Binder Clips to the empty nest on the Mini Stack Build dial.

1. At the dial position 1 (EB360T01), the following operations take place:
    a. EB360 Stack Dial rotates an empty stacking nest to the dial position.
    b. EB350R01 Side Plate/Thermal Barrier Load Robot picks a side plate from EB350 Side Plate Exchange Table and places the side plate to the empty stacking nest.
    c. EB360 Stack Dial rotates after the operations around the dial are complete.
2. At the dial position 2 (EB360T02), the following operations take place:
    a. EB360 Stack Dial rotates a stacking nest with a side plate to dial position 2.
    b. EB320R01 Mini Stack Load Robot picks a single Mini Stack from the Mini Stack Build nest.
        i. If the Mini Stack is a reject, EB320R01 Cell Stacking Robot places the rejected Mini Stack to EB356 Reject Cart.
        ii. Mini Stack Robot stops and waits until replacement Mini Stack is built and presented on Mini Stack Build dial
    c. EB320R01 Mini Stack Robot places the Mini Stacks to the stacking nest after taking them to the EB352 Z-height Inspection station for testing.
    d. EB320R01 Mini Stack Robot continues picking and placing Mini Stacks to the stacking nest as called for by the recipe.
    e. When the recipe calls for a thermal barrier, EB350R01 Side Plate/Thermal Barrier Robot picks a thermal barrier from EB330 Thermal Barrier Handoff and positions the thermal barrier beneath a Bar Code Read and Reject mechanism. When the thermal barrier bar code is read properly, EB350R01 Thermal Barrier Robot places the thermal barrier to the stacking nest.
        i. If the thermal barrier bar code is not read properly, EB350R01 Side Plate/Thermal Barrier Robot places the rejected thermal barrier into a Reject Bin. EB340R01 Thermal Barrier Robot then picks another thermal barrier and presents it to the Bar Code Read mechanism.
    f. EB320R01 Mini Stack Robot and EB350R01 Side Plate/Thermal Barrier Robot continue loading parts to the stacking nest until all parts are stacked per the recipe.
    g. EB360 Stack Dial rotates after the operations around the dial are complete.
3. At the dial position 3 (EB360T03), the following operations take place:
    a. EB360 Stack Dial rotates a stacking nest with a side plate, Mini Stack, and thermal barriers to dial position 3.
    b. This dial position remains idle.
    c. EB360 Stack Dial rotates after the operations around the dial are complete.
4. At the dial position 4 (EB360T04), the following operations take place:
    a. EB360 Stack Dial rotates a stacking nest with a side plate, Mini Stack, and thermal barriers to dial position 4.
    b. EB350R01 Side Plate/Thermal Barrier Load Robot picks a side plate from EB350 Side Plate Exchange Table and places the side plate on to the top of the parts stacked in the stacking nest.

c. EB370R01 Press Load Robot picks the soft stack from the EB360 Stack Dial and places the soft stack to the Module Assembly EB460 Assembly Press.
    i. If any of the process failed on the EB360 Stacking Dial the failed soft stack will be placed to the EB356- Reject Soft Stack cart for manual removal from the system.

5. EB330R01 Dunnage Robot picks thermal barriers, side plates, Top and Bottom Binder Clips and mid-beams from dunnage conveyors (EB330T01, EB330T02, EB330T03, EB330T04, EB330T05) and places the parts to Handoff tables (EB330, EB340, EB345, EB346, EB347) as needed.

For more detailed sequences, refer to the ATS timing charts provided to your company.

3.8.1. EB300 Tab Scan

The conveyor system stops a pallet at the station (see callout **??** in ***Figure 3-5***) to be inspected. A pair of 3D scanners (one at each end of the cell) are located directly above each cell tab. The scanners will measure the profile of both cell tabs to determine the finished length of each tab relative the cell pouch datum. Cells that fail this inspection will be rejected and removed from the conveyor by EB315 Cell Unload Pick and Place.

3.8.2. EB305 Cell Biasing

The conveyor system stops a pallet at the station (see callout **??** in ***Figure 3-5***) so that the cell can be pushed (biased) to the right or left side in a known, fixed position as needed for the build recipe. The station has two identical bias tools (on opposite sides of the pallet) and a pallet clamp actuator. If a cell needs to be biased to the right, then the left bias tool uses a SMC slide table to extend machined push tooling that over-pushes the cell past the bias position (or if the cell needs to be biased left then the right tool extends). Once the cell has been over-pushed, the left bias tool retracts. The right bias tool then extends a mid-stop (Festo intermediate position module) and a SMC slide table extends push tooling to push the cell to the correct location. A Keyence measurement sensor verifies that the cell is biased correctly. Once correctly biased, a pair of SMC compact slides actuate pusher tooling to close the pallet clamp actuator, locking the cell to the pallet. The conveyor system then releases the pallet downstream.

3.8.3. EB310 Cell Pick

The Cell Pick equipment (see callout **A** in ***Figure 3-6***) consists of two Cell Bias tools (identical to EB305) and two Pepperl & Fuchs through-beam sensors located at the unload position of the SuperTrak conveyor, one sensor per pallet position. The sensors check that a cell is present or absent in the pallet as required for the cycle. SMC compact slides actuate pusher tooling to open the pallet clamp actuator, releasing the cells from the pallets. Once the cells are released from the pallets, EB315 Cell Unload Pick and Place picks the cells and places them as needed to continue the cycle. If the process requires cells to be resequenced from EB320 Cell Swap Rack than the EB315 Cell Unload Pick and Place will place cells from the Swap Rack back into the SuperTrak pallets at this station to be biased, per the procedure described in EB305, prior to being transferred to the EB355- Mini Stack Build Dial.

3.8.4. EB315 Cell Unload Pick and Place

The Cell Unload Pick and Place is responsible for transporting cells, one or two at a time, between the EB310 Cell Pick, EB320 Cell Swap Rack, and EB355T01 Mini Stack Build Dial stations.

The Cell Unload Pick and Place consists of a servo X axis, servo Z-axis, and servo rotary axis to carry and manipulate the EOAT between stations as required by the process. The EOAT has two independently controlled grippers with each capable of transporting a Cell. A set of eight vacuum cups per gripper is supplied by vacuum from a pair of SMC vacuum generators. The vacuum cups on each gripper are mounted to a tooling plate that is pneumatically actuated in the Z-axis

to give the EOAT the capability of picking or placing a single part at a time, from either gripper, as may be required during a resequencing process.

During a typical cycle the Cell Unload Pick and Place will pick two Cells simultaneously from SuperTrak pallets at EB310, transport these Cells to EB355T01, and place them to the top of the partially built Mini Stacks located within the fixtures at this station.

During a resequencing cycle the Cell Unload Pick & Place will be moving cells back and forth between the EB310 and EB320 stations as required to replace any Cells or Mini Stacks failed during processing. Since the nests on the EB320 Swap Rack is oriented 90 degrees to the other stations cells picked or placed to/from here will need to be rotated 90 degrees.

During a cell reject cycle the Cell Unload Pick and Place will drop the rejected cell onto the EB320T01 Cell Reject Conveyor.

3.8.5. EB320 Cell Swap Rack

The Cell Swap Rack (see callout **B** in ***Figure 3-6***) provides 40 independent nests that can each be loaded with a cell as a temporary holding location while the cells are resequenced. A resequencing takes place any time a cell is rejected in the Cell Processing equipment between EB090 Tab Knurling and EB310 Cell Pick or if a Mini Stack is rejected on the EB355- Mini Stack Build Dial. As soon as a cell or Mini Stack is rejected the system immediately beings a resequencing mode. The build recipe orders a replacement cell to be created. Every cell in front of the replacement cell must be set aside downstream so that the replacement cell can be loaded to a stack where it is needed. Each of the “resequenced cells” are picked off the SuperTrak conveyor by EB315 Cell Unload Pick & Place gantry (two at a time) and are placed into specific nests on EB320 Cell Swap Rack (one at a time). EB320R01 continues picking cells from the SuperTrak and placing them to EB320 until the replacement cell arrives at EB310 Cell Pick. EB315 then picks the replacement cell, places the replacement cell to EB355 Mini Stack Build Dial, and then begins retrieving the cells (in the proper sequence) from EB320 and placing them onto empty SuperTrak pallets at EB310 to be biased before being transferred to the EB355 Mini Stack Dial.

The rack has four layers of 10 nests each of which can be actuated via pairs of SMC rodless cylinders for access by the EB315 Cell Unload Pick and Place. Layers are indexed as needed so that cells can be loaded or unloaded when necessary or are located under the top layer when not needed.

All the layers feature two lock pins that can be inserted to prevent the tooling from moving during robot position teaching activities. A holder with sensing houses each lock pin. The lock pin can be engaged to secure the tooling in a fixed position.

3.8.6. EB320R01 Mini Stack Load Robot

The Mini Stack Load Robot is responsible for removing completed Mini Stacks from the EB355 Mini Stack Build Dial, transferring them to the EB352 Z-Height Inspection station, and then placing the ‘good’ Mini Stacks to the EB360T02 Stacking dial (position 2). Rejected Mini Stacks will be placed to the EB356 Soft Stack Reject cart.

The Fanuc M20iD/35M robot End of Arm Tool (EOAT) has a 1-up mechanical gripping action using two SMC pneumatic actuators for gripping the Mini Stack top to bottom. Its design is capable of gripping a Mini Stack in any state of its build to have the functionality to reject partially built stacks. The tool also has a pneumatic pushing action that is designed to ‘strip’ the Mini Stack from the gripper when placing to the stacking nest at EB360.

A pressure switch on the EOAT is used to confirm that the tool has a Mini Stack in its gripper.

REFERENCE	***For more information about the robot equipment, refer to the equipment supplier documentation (Fanuc Robot M-10iA Mechanical Unit Operator's Manual pg. 14-37).***

3.8.7. EB320T01 Reject Conveyor

The Reject Conveyor (see callout **D** in ***Figure 3-6***) utilizes a Dorner 3200 series conveyor to transport rejected battery cells out to an operator. The flat belt conveyor features flights spaced at intervals that allow a single cell to be placed between each flight. The flights are detected by a through-beam sensor. Each index of the conveyor belt repositions one pitch, advancing the battery cells one slot forward. A button at the operator end of the conveyor allows the operator to drive the conveyor independently to remove battery cells as needed.

REFERENCE	***For more information about the conveyor, refer to the equipment supplier documentation (Dorner 3200 Series Flat Belt LPZ Conveyors Installation, Maintenance & Parts Manual pg. 3).***

3.8.8. EB330 Thermal Barrier Handoff and Barcode Reader

The Thermal Barrier Handoff table (see callout **E** in ***Figure 3-6***) is configured to hold two stacks of thermal barriers in a repeatable position. Stacks are loaded, one at a time, to the table by EB330R01. EB350R01 picks a single thermal barrier from one stack, continuously picking from that stack until it is empty. EB340R01 then moves to the second stack while EB330R01 loads a new stack to the empty side of the table. Each time a stack is placed, and each time a single thermal barrier is picked, pneumatic SMC slide tables advance pusher arms to bias the stack against fixed datum pins to keep the stack aligned in a repeatable position. The slide tables then retract the pusher arms each time EB340R01 approaches to pick the next thermal barrier. A sensor at each stack detects when thermal barriers are present or absent.

After EB350R01 picks a Thermal Barrier it will position it under a bar code reader, located next to the handoff table, to read the bar code. If the bar code read is good, then EB350R01 places the thermal barrier to EB360. If the bar code read fails, then EB350R01 will drop the Thermal Barrier into a reject bin located below the reader.

3.8.9. EB330R01 Dunnage Robot

The Dunnage Robot (see callout **F** in ***Figure 3-6*** is responsible for pulling parts from dunnage and feeding them into the cell. Side Plates, Thermal Barriers, Mid Beams, Top Binder Clips, and Bottom Binder Clips are picked from trays and placed to dedicated staging (handoff) tables to be accessed by other robots within the cell. The Dunnage Robot also picks four side plates from EB330T01 and places the side plates to EB347, and picks two stacks of mid beams from EB330T05 and places them to EB346, picks two stacks of Top Binder Clips from EB330T04 and places them to EB345. And picks two stacks of Bottom Binder Clips from EB330T02 and places the mid-beams to EB340. The robot completes these picks and places as staging tables are emptied of parts in order to keep them replenished.

The Dunnage Robot consists of a Fanuc Robot Transport Unit (RTU) and a Fanuc R-2000IC/210L robot equipped with End of Arm Tooling (EOAT). The RTU is an electric servo-driven linear axis that shuttles the robot along a single axis between multiple pick points. The Fanuc robot manipulates several axes to properly position the EOAT to pick components and place components at various locations around the work envelope.

The EOAT utilizes three different gripping configurations, one for thermal barriers stacks (1-up), one for side plates(4-up), and one for Mid Beam, Top Binder Clip, and Bottom Binder Clip stacks (4-up) and one for tray handling. The

thermal barrier gripping configuration utilizes a pair of pneumatic SMC slide tables that spread and collapse pairs of gripper fingers that close around a stack of thermal barriers while a pair of arms helps retain the stack during transport. The side plate gripping configuration utilizes four pairs of vacuum cups, each pair used to pick a single part. Each pair of vacuum cups has its own dedicated vacuum generator.

Vision equipment (also third-party Fanuc equipment) assists the robot in properly locating trays by inspecting an empty dunnage container to calculate the tray placement coordinates and by inspecting an empty tray on a dunnage stack to calculate the tray pick coordinates (the camera also uses an algorithm to determine the tray height based on the distance between the tray fiducial positions). Two linear lights are used to illuminate the pick area for the Fanuc camera.

REFERENCE	***For more information about the robot, refer to the equipment supplier documentation (Fanuc Generation VI – Robot Transport Unit (RTU) Mechanical Assembly, Operation and Maintenance Manual pg. 3-9, Fanuc Robot R-2000iC Mechanical Unit Operator's Manual 26-65).***

3.8.10. EB330T01, T02, T03, T04, T05 Side Plate, Mid-Beam, Thermal Barrier Conveyors

The Conveyor equipment (see callouts **G**, **H**, and **I** in *Figure 3-6*) transfers trays full of components into the work cell and transfers empty trays out of the work cell.

REFERENCE	***For more information about the conveyor equipment, refer to the equipment supplier documentation (Omni Chain Driven Live Roller Conveyor Straight and Curve Technical Handbook pg. 17-20).***

Each of the component Conveyors utilizes third-party Omni conveyance devices. Powered roller conveyor sections are used to pull full trays into the work cell and to push empty trays out of the work cell. Each powered roller conveyor section has its own motor and motor starter. Each conveyor system has two levels. The lower level is responsible for conveying full dunnage into the work cell and the upper level is responsible for conveying empty dunnage out of the work cell.

Three sensing devices are located on both the input and output sides of the conveyors at the point of passage between the guarded and unguarded areas of the work cell. The sensing devices are in series to aid in the detection and distinction of the object traversing the sensing fields. Each series includes a retro-reflective sensing field, a light curtain sensing field, and another retro-reflective sensing field. The processor monitors the status of the sensing fields and the time delay between the activation of each sensing field to determine if a person or a tray is traversing the field. When a tray traverses, the fields are broken in a very specific time sequence. When the processor detects the inputs within the specified time frame, the safety circuit is overridden momentarily to allow the equipment to pause processing while the tray traverses in or out. Any variation in the timing triggers the processor to disable the safety circuit and disconnect control power.

3.8.11. EB340 Bottom Binder Clip Handoff

The Bottom Binder Clip Handoff table (see callout **O** in *Figure 3-6*) provides a tilted nest that locates Bottom Binder Clip stacks in a repeatable position to ensure they are properly aligned before being placed to the next operation. When EB330R01 releases two stacks of Bottom Binder Clips to the table, the Binder Clips fall into the bottom edge of locating dowel pins. Sensors in the table detect when Binder Clips are present or absent. EB340R01 picks a pair of Binder Clips,

one at a time from the table. Once two stacks of Binder Clips have been picked, EB330R01 picks two more stacks from dunnage on EB330T02 and places them to the table.

3.8.12. EB340R01 Binder Clip/ Mid-Beam Robot

The Binder Clip Load Robot is responsible for picking a pair of Binder Clips or Mid Beams, one at a time, from any one of the three handoff tables EB340, EB345, or EB346 and transporting them the EB340 Registration Table for final registration and bar code reading before being transferred to the EB355 Mini Stack Build Dial as required by the recipe.

The Fanuc M-10 iA/12 robot is a third-party component integrated with the other cell mechanisms. The robot manipulates several axes to properly position EOAT.

The EOAT consists of two independent grippers each with eight vacuum pads capable of holding a single Binder Clip or Mid Beam. When the EOAT is lowered onto a part, vacuum is enabled through the vacuum pads to suction the part against the pads. The vacuum remains turned on until the EOAT is lowered at a release point.

Included in this station is a 2-up registration table and 2-up bar code reader stand. The registration table is used to accurately register both Top and Bottom Binder Clips as well as the Mid Beams against a set of datums. Because all of these components are presented in nested stacks on the EB340, EB345, and EB346 handoff tables the part locational accuracy cannot be held tight enough to be placed directly into the EB355 Mini Stack fixtures. These components are picked from the handoff tables, dropped onto the 2-up registration table, pneumatically crowded to a set of datums, the bar code on each component is read, and then the components are re-acquired by the robot and taken to the EB355 Mini Stack Build Dial where they are placed to fixtures.

REFERENCE 

For more information about the robot, refer to the equipment supplier documentation (Fanuc Robot M-10iA Mechanical Unit Operator's Manual pg. 14-37).

3.8.13. EB345 Top Binder Clip Handoff

The Top Binder Clip Handoff table (see callout **Q** in ***Figure 3-6***) provides a tilted nest that locates Top Binder Clip stacks in a repeatable position to ensure they are properly aligned before being placed to the next operation. When EB330R01 releases two stacks of Top Binder Clips to the table, the binder clips fall into the bottom edge of locating dowel pins. Sensors in the table detect when binder clips are present or absent. EB340R01 picks a pair if binder clips, one at a time, from the table. Once two stacks of binder clips have been fully picked, EB330R01 picks two more stacks from dunnage on EB330T02 and places them to the table.

3.8.14. EB346 Mid-Beam Handoff

The Mid Beam Handoff table (see callout R in Figure 3 6) provides a tilted nest that locates Mid Beam stacks in a repeatable position to ensure they are properly aligned before being placed to the next operation. When EB330R01 releases two stacks of Mid Beams to the table, they fall into the bottom edge of locating dowel pins. Sensors in the table detect when Mid Beams are present or absent. EB340R01 picks a pair if Mid Beams, one at a time, from the table. Once two stacks of Mid Beams have been fully picked, EB330R01 picks two more stacks from dunnage on EB330T02 and places them to the table.

REFERENCE 

For more information about the robot, refer to the equipment supplier documentation (Fanuc Robot M-10iA Mechanical Unit Operator's Manual pg. 14-37).

3.8.15. EB347 Side Plate Handoff

The Side Plate Handoff table (see callout **U** in *Figure 3-6*) provides a tilted nest that locates Side Plates in a repeatable position to ensure they are properly aligned before being placed to the next operation. When EB330R01 releases four Side Plates to the table, the Side Plates fall into the bottom edge of locating dowel pins. Sensors in the table detect when Side Plates are present or absent. EB350R01 picks all four Side Plates from the table at one time. Once all four Side Plates have been picked, EB330R01 picks another set of Side Plates from EB330T01 and places them to the table.

REFERENCE

For more information about the rotary indexer, refer to the equipment supplier documentation (Camco Service Manual RDM Series Index Drives pg. 2).

3.8.16. EB348 Side Plate Reject Conveyor

The Side Plate Reject conveyor (see callout **S** in *Figure 3-6*) utilizes a Dorner 3200 series conveyor to transport rejected Side Plates, that have failed the structural adhesive dispense process, out to an operator for removal from the system. The flat belt conveyor features flights spaced at intervals that allow a single Side Plate to be placed, dispensed side up, between each flight. The flights are detected by a through-beam sensor. Each index of the conveyor belt repositions one pitch, advancing the Side Plates one slot forward. A button at the operator end of the conveyor allows the operator to drive the conveyor independently to remove battery cells as needed.

At the load end of the conveyor a Side Plate Reject Mechanism is used to aid in loading the conveyor with the structural adhesive side of the Side Plate on top to minimize the chances of adhesive contamination with the conveyor belt. The Side Plate Reject Mechanism consists of a set of vacuum cups mounted to a pneumatic vertical motion. The EB350R02 Side Plate Dispense Robot will present a rejected Side Plate that failed the dispense process to the vacuum cups with the dispensed side facing up. The Side Plate Reject Mechanism will grip the Side Plate from the top. After the robot releases hold of the Side Plate and moves clear the Side Plate Reject Mechanism will lower the Side Plate to the conveyor and release.

3.8.17. EB349 Structural Adhesive (SA) Dispense and Inspect

The SA Dispense and Inspect station (see callout T in Figure 3 6) consists of a dispense system and inspection pedestal used to apply adhesive, in a specific pattern, to the top side of the Side Plate and then verify correct application.

The dispense system consists of the following:

A. Dispense Pedestal:
   i. Dispense (Mixing) Nozzle
   ii. Metering Pump- Part A
   iii. Metering Pump- Part B
   iv. Bead Breaker Mechanism
   v. Purge Container
B. Drum Pumps (55 gallon):
   i. Ram Pump- Part A (Qty 2)
   ii. Ram Pump- Part B (Qty 2)
   iii. Switch-Over Valve- Part A
   iv. Switch Over Valve- Part B
   v. Distribution Lines

The Structural Adhesive is a two-part adhesive that is mixed at the dispensing nozzle. Materials (part A and B) are fed from 55-gallon drums from Ram Pumps positioned nearby, outside of the guarded area of the work cell. The materials are fed overhead to the metering pumps located on the dispense pedestal inside of the work cell. The metering pumps feed the correct volumetric amount of part A and B materials to the dispensing nozzle. Side Plates are positioned and moved under the nozzle during dispensing to feed the material as required onto the Side Plate.

Each material component (part A and B) has a redundant Ram Pump, both which are connected through a Switch-Over valve that will allow for manual switch-over from one pump to the other as a 55-gallon drum is depleted. This allows the process to continue uninterrupted during reloading on a full drum.

The Bead Breaker Mechanism is mounted on the dispense pedestal and located below the dispense tip. Its purpose is to cut off any 'strings' or 'blobs' left on the tip of the dispense nozzle to provide a cleaner dispense pattern.

The purge container is mounted on the pedestal directly below the tip to allow the nozzle and pumps to be purged as required by the process and to also catch and drips.

The inspection pedestal consists of the following:

A. Vision Camera (GTR1300) and lighting
B. 3D Scanner (Photoneo PhoXi)- Qty 2

The camera and 3D scanner are used together to check to pattern and profile of the dispensed bead on the Side Plate to verify that they meet specification.

The process starts with the EB350R02 Side Plate Dispense Robot positioning a set of four Side Plates under the dispense nozzle. The robot will move the Side Plates under the nozzle at the correct speed and path, one Side Plate at a time, to get the desired dispense pattern. Once the dispense has been applied to all four Side Plates the robot will statically position the Side Plates under the inspection pedestal for inspection. The two scanners and one camera will take an image of all four Side Plates simultaneously.

REFERENCE ***For more information about the robot, refer to the equipment supplier documentation (Fanuc Robot R-2000iC Mechanical Unit Operator's Manual pg. 26-65).***

3.8.18. EB360 Stack Dial

The Stack Dial (see callout **Y** in *Figure 3-6*) rotates four stacking nests between three robot positions where components are loaded and stacked in each nest and a fourth robot position where the components are unloaded. A Camco 4-position rotary indexer is used to turn a dial plate. The stacking nests are mounted to the top of the dial plate. Sensors above the dial detect when a robot or other object is at the dial. The processor utilizes the sensor information to impede the dial movement when necessary.

REFERENCE ***For more information about the rotary indexer, refer to the equipment supplier documentation (Camco Service Manual RDM Series Index Drives pg. 2).***

3.8.19. EB370R01 Press Load Robot

The Press Load Robot (see callout Z in Figure 3-6) picks a soft stack from EB360 and an ICB from EB405 and then places the ICB and soft stack to the EB460 Assembly Press.

The Fanuc R-2000 iC/210F robot is a third-party component integrated with the other cell mechanisms. The robot manipulates several axes to properly position end of arm tooling (EOAT).

The EOAT has two different gripping configurations. In one configuration, the EOAT compresses and holds a soft stack while transferring the soft stack between the EB360 and EB460 work areas. In this configuration, SMC CQ cylinders are used to move lower fingers to squeeze the soft stack against stationary upper fingers. Rod locks are used to engage in the event of an air pressure loss so that the soft stack is not dropped. In the other configuration, the EOAT uses four vacuum cups to pick and hold an ICB. The ICB is flat when picked. Before the ICB has been picked, cylinders retract to move bumper arms to engage and hold the ICB wings in the flat position during transport. After the ICB has been placed, the cylinders extend to move the bumper arms clear.

REFERENCE

For more information about the robot, refer to the equipment supplier documentation (Fanuc Robot R-2000iC Mechanical Unit Operator's Manual pg. 26-65).

3.8.20. Robot and Vision Calibration Stand

The Robot and Vision Calibration Stand (see callout **AA** in *Figure 3-6*) provides a calibration grid that is used as a reference when calibrating the robot and robot vision equipment. Calibration of the robot and robot vision equipment is documented in the associated Fanuc documentation. There are a total of three Vision Calibration Stands located in the EB300 work cell.

REFERENCE

For information about the robot and vision equipment calibration, refer to the equipment supplier documentation (Fanuc iRVision 2D Camera Application Operator's Manual, Grid Pattern Calibration With A Fixed Camera, Page 160).

3.8.21. Adhesive Dispense and Dispense Robots

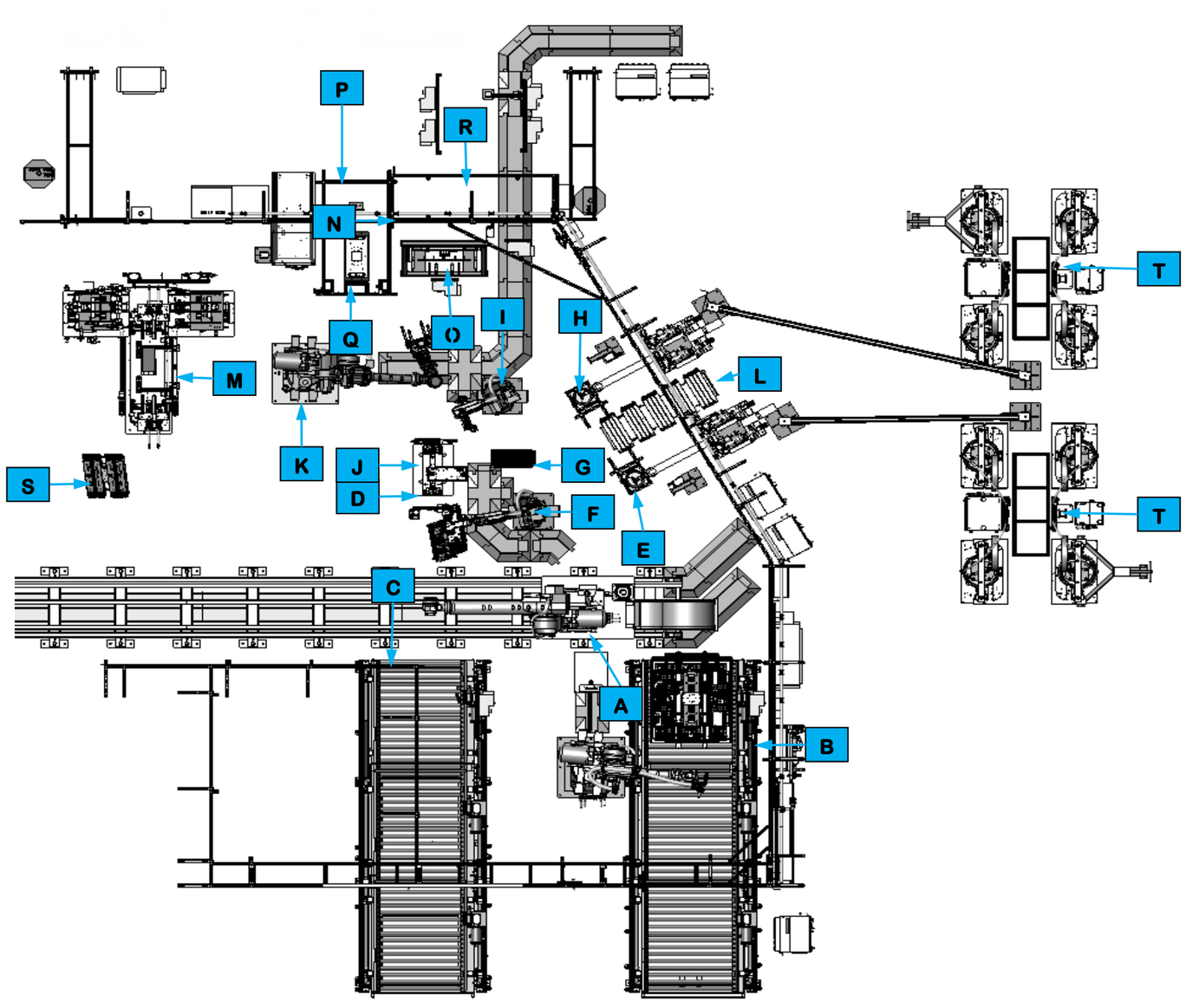
The TIM dispense Robots (see callout **F** in *Figure 3-6*) carry cold plates from the handoff tables to the dispense nozzles to allow adhesive to be placed onto the cold plates. Once the dispense is complete, they will carry the cold plates, with TIM, to the inspection camera to be inspected and with take them to the reject conveyor or the finished cold plate handoff.

The SAM dispense robot (see callout **I** in *Figure 3-6*) will carry 4 side plates from the side plate handoff to the dispense nozzle for SAM. Once here it will guide the side plates to get the adhesive, inspect the adhesive and then take them to the finished side plate handoff table.

The Cell to Cell Dispense (See callout **T** in *Figure 3-6*) unit applies hot melt adhesive to the binder clips and in between each cell. During the application process a camera checks the dispense bead to make sure it meets the criteria for the customer.

3.9. MODULE ASSEMBLY EQUIPMENT

Module Assembly (see ***Figure 3-7***) dispenses TIM to a cooling plate, assembles the TIM-dispensed cooling plate and an ICB to a soft stack (completing the module assembly), prints and applies a barcode label to the module assembly, loads the module assembly to a pallet, completes a traceability BOM check on the module assembly, and conveys the palletized module assembly downstream to the next process.



Equipment Callouts in Figure 3-7		
A	EB400R01	Dunnage Robot
B	EB400T01	Cooling Plate Conveyors
C	EB400T02	Front Plate Conveyors
D	EB410	Cooling Plate Handoff
E	EB420	Dispense and Inspect 1
F	EB420R01	Dispense 1 Robot
G	EB430	Cooling Plate Handoff 2
H	EB440	Dispense and Inspect 2
I	EB440R01	Dispense 2 Robot
J	EB450	Robot 1 to Robot 2 Handoff
K	EB450R01	Press Unload Robot
L	EB450T01	TIM Reject Conveyor
M	EB460	Assembly Press
N	EB470	Label Print and Apply
O	EB480	Drop to Conveyor
P	EB480T01	Conveyance
Q	EB490	Soft Stack Reject
R	EB500	BOM Check
S	EB400	Robot and Vision Calibration Stand
T	EB420R01SC1/2	TIM Dispense Drum Pump

Figure 3-7. Module Assembly equipment layout.

3.9.1. Sequence of Operation

There are four main areas of operation in the cell: dunnage part handling and transfer, assembly press, dispensing, and module assembly handling. Each area operates independently but in coordination with the other operations.

1. At the dunnage handling area, the following operations take place:
    a. EB400R01 Dunnage Robot picks ICBs from EB400T02 ICB Conveyor and places the ICBs to handoff tables at cell EB405.
    b. EB400R01 Dunnage Robot picks cooling plates from EB400T01 Cooling Plate Conveyor and places the cooling plates to EB410 Cooling Plate Handoff.
2. At the assembly press area, the following operations take place:
    a. EB370R01 Press Load Robot acquires and loads a soft stack into the EB460 Assembly Press.
    b. EB370R01 Press Load Robot acquires and loads an ICB into the EB460 Assembly Press ICB Install Tooling.
    c. EB450R01 Press Unload Robot acquires a cooling plate that has had TIM dispensed to it from EB450 Handoff and loads the cooling plate into the EB460 Assembly Press Cooling Plate Install Tooling.
    d. EB460 Assembly Press cycles to install the ICB and cooling plate to the soft stack. Refer to ***Assembly Press Sequence of Operation on page 3-36*** for detailed information about this cycle.
    e. After the EB460 Assembly Press cycle is complete, EB450R01 Press Unload Robot picks the module assembly from the press.
3. At the dispensing area, the following operations take place:
    a. EB420R01 Dispense 1 Robot picks a cooling plate from EB410 Cooling Plate Handoff and places the cooling plate to EB430 Cooling Plate Handoff 2.
    b. EB420R01 Dispense 1 Robot picks another cooling plate from EB410 Cooling Plate Handoff. Meanwhile, EB440R01 Dispense 2 Robot picks the cooling plate from EB430 Cooling Plate Handoff 2.
    c. EB420R01 Dispense 1 Robot moves to EB420 Dispense and Inspect 1. EB440R01 Dispense 2 Robot moves to EB440 Dispense and Inspect 2.
        i. Note that EB420 and EB440 operate independently and alternately so that one is placing a dispensed cooling plate to EB450 Handoff while the other is manipulating a cooling plate at the dispenser.
    d. EB420 and EB440 each dispense 2-part material through mixing valves and onto the cooling plates while EB420R01 and EB440R01 move the cooling plates in a defined pattern so that the material is dispensed around the cooling plates.
    e. When the dispense cycles are complete, EB420R01 and EB440R01 move the cooling plates in front of inspection cameras that check that the material was dispensed properly.
        i. If the inspection fails, EB420R01/EB440R01 moves the failed cooling plate to EB450T01 TIM Reject Conveyor.
        ii. EB450T01 TIM Reject Conveyor transports the failed cooling plate out of the cell.
    f. EB420R01 and EB440R01 wait for EB450 Handoff to be clear. When EB450 Handoff is clear, EB420R01 or EB440R01 places the cooling plate to the EB450 Handoff (only one cooling plate is loaded to the handoff, the other robot remains idle until it can place its cooling plate to the empty handoff).
    g. EB450 Handoff holds the cooling plate in a horizontal orientation until EB450R01 Press Unload Robot is ready to pick the cooling plate. When EB450R01 Press Unload Robot is ready to pick the cooling plate, EB450 Handoff rotates the cooling plate to a vertical orientation for picking. After the cooling plate has

been picked, EB450 Handoff rotates back to the horizontal orientation so the next cooling plate can be placed to it.

h. EB450R01 Press Unload Robot acquires the cooling plate from EB450 Handoff and transports the cooling plate to EB460 Assembly Press.
    i. If the cooling plate is not picked from EB450 Handoff before the TIM cure time has elapsed, then EB450R01 Press Unload Robot picks the cooling plate and places the cooling plate to EB490 Soft Stack Reject.

4. At the module assembly handling area, the following operations take place:
    a. EB450R01 Press Unload Robot picks a module assembly from the EB460 Assembly Press.
        i. If the module assembly failed during the press cycle, EB450R01 Press Unload Robot releases the failed module assembly to EB490 Soft Stack Reject.
    b. EB450R01 Press Unload Robot moves the module assembly to EB470 Label Print and Apply.
    c. EB470 Label Print and Apply prints a product label and applies it to the module assembly.
    d. EB450R01 Press Unload Robot moves the module assembly in front of a camera that reads the product label for traceability.
    e. EB450R01 Press Unload Robot moves the module assembly to EB480 Drop to Conveyor.
    f. EB480 Drop to Conveyor acquires the module assembly, EB450R01 Press Unload Robot releases the module assembly and retracts clear, and EB480 Drop to Conveyor rotates, lowers, and releases the module assembly to a pallet on EB480T01 Conveyance.
    g. EB480T01 Conveyance releases the pallet with the module assembly, transfers the pallet to another section of conveyor that transports the pallet to EB500 BOM Check, and transports an empty pallet to EB480 Drop to Conveyor.
    h. EB500 BOM Check scans the module barcode for traceability. EB480T01 Conveyance then releases the pallet with the module assembly downstream to the Module Final Assembly System. Refer to the ATS Ohio *BET/BEV3 Module Final Assembly Line Operation and Maintenance Manual* for more information.

For more detailed sequences, refer to the ATS timing charts provided to your company.

3.9.2. EB400R01 Dunnage Robot

The Dunnage Robot (see callout **A** in ***Figure 3-7***) picks either two cooling plates or two ICBs from dunnage conveyors and places the ICBs to handoff tables at cell EB300 or the cooling plates to EB410 Cooling Plate Handoff.

The Dunnage Robot consists of a Fanuc Robot Transport Unit (RTU) and a Fanuc R-2000IC/210L robot equipped with End of Arm Tooling (EOAT). The RTU is an electric servo-driven linear axis that shuttles the robot along a single axis between multiple pick points. The Fanuc robot manipulates several axes to properly position the EOAT to pick components and place components at various locations around the work envelope.

The EOAT utilizes two different gripping configurations, one for cooling plates, one for ICBs. The cooling plate and ICB gripping configurations utilize two sets of four vacuum cups, each set used to pick a single part. Additionally, when picking ICBs, two more sets of two vacuum cups are attached to SMC slide tables that extend the vacuum cups to pick the ICB flaps in a flat orientation. Each pair of vacuum cups has its own dedicated vacuum generator.

Vision equipment (also third-party Fanuc equipment) assists the robot in properly locating the dunnage trays by inspecting an empty dunnage container to calculate the tray placement coordinates and by inspecting an empty tray on a dunnage stack to calculate the tray pick coordinates (the camera also uses an algorithm to determine the tray height based on the distance between the tray fiducial positions). Two linear lights are used to illuminate the pick area for the Fanuc camera.

REFERENCE ***For more information about the robot, refer to the equipment supplier documentation (Fanuc Generation VI – Robot Transport Unit (RTU) Mechanical Assembly, Operation and Maintenance Manual pg. 3-9, Fanuc Robot R-2000iC Mechanical Unit Operator's Manual pg. 26-65).***

3.9.3. EB400T01, T02 Cooling Plate and ICB Conveyors

The Conveyor equipment (see callouts **B**,**C**, and **D** in *Figure 3-7*) transfers trays full of components into the work cell and transfers empty trays out of the work cell.

REFERENCE ***For more information about the conveyor equipment, refer to the equipment supplier documentation (Omni Chain Driven Live Roller Conveyor Straight and Curve Technical Handbook pg. 17-20).***

Each of the component Conveyors utilizes third-party Omni conveyance devices. Powered roller conveyor sections are used to pull full trays into the work cell and to push empty trays out of the work cell. Each powered roller conveyor section has its own motor and motor starter. Each conveyor system has two levels. The lower level is responsible for conveying full dunnage into the work cell and the upper level is responsible for conveying empty dunnage out of the work cell.

Three sensing devices are located on both the input and output sides of the conveyors at the point of passage between the guarded and unguarded areas of the work cell. The sensing devices are in series to aid in the detection and distinction of the object traversing the sensing fields. Each series includes a retro-reflective sensing field, a light curtain sensing field, and another retro-reflective sensing field. The processor monitors the status of the sensing fields and the time delay between the activation of each sensing field to determine if a person or a tray is traversing the field. When a tray traverses, the fields are broken in a very specific time sequence. When the processor detects the inputs within the specified time frame, the safety circuit is overridden momentarily to allow the equipment to pause processing while the tray traverses in or out. Any variation in the timing triggers the processor to disable the safety circuit and disconnect control power.

3.9.4. EB410 Cooling Plate Handoff

The Cooling Plate Handoff table (see callout **E** in *Figure 3-7*) provides a tilted nest that locates cooling plates in a repeatable position to ensure they are properly aligned before being placed to the next operation. When EB400R01 releases two cooling plates to the table, the cooling plates fall into the bottom edge of locating dowel pins. Sensors in the table detect when cooling plates are present or absent. EB420R01 picks a single cooling plate from the table. Once both cooling plates have been picked, EB400R01 picks two more cooling plates from EB400T01 and places the two cooling plates to the table.

3.9.5. EB420 Dispense and Inspect 1

The Dispense and Inspect 1 equipment (see callout **F** in *Figure 3-7*) dispenses a two-part material through a mixing nozzle and onto a cooling plate and then inspects the cooling plate to ensure the material was dispensed correctly.

The dispensing equipment consists of proprietary Atlas Copco controllers, drum pumps and metering valves that were consigned by GM to be integrated with the rest of the equipment. The two-part material is dispensed out of drums, through separate lines, to metering valves. The metering valves control the amount of material that is pushed through a mixing nozzle. The mixing nozzle blends the materials and dispenses the material as a solid bead that gets applied onto a

cooling plate. The EB420R01 Dispense 1 Robot holds the cooling plate and moves the cooling plate in a defined path so that the material is dispensed in the required pattern.

After a dispense cycle is completed, a pneumatic rotary table turns a wire beneath the mixing nozzle to cut away any excess material that may continue flowing from the nozzle. The severed material falls into a purge bucket below the nozzle. The purge bucket is also used to collect material during periodic purge cycles that occur automatically as programmed.

After the TIM has been dispensed to a cooling plate, the EB420R01 Dispense 1 Robot positions the cooling plate below a Matrox camera. A North Coast edge lit LED backlight illuminates the cooling plate while the camera inspects the cooling plate to ensure the material was properly dispensed. If the inspection fails, the EB420R01 Dispense 1 Robot releases the cooling plate to EB450T01 TIM Reject Conveyor. If the inspection passes, the EB420R01 Dispense 1 Robot releases the cooling plate to EB450 Handoff.

REFERENCE	***For more information about the dispense equipment, refer to the equipment supplier documentation (Atlas Copco). This equipment was consigned by GM to ATS for integration. GM should have the proper supplier documentation.***

3.9.6. EB420R01 Dispense 1 Robot

The Dispense 1 Robot (see callout **G** in *Figure 3-7*) picks a cooling plate from EB410 and then either places the cooling plate to EB430 or holds the cooling plate at EB420 while TIM is dispensed to it. If a cooling plate TIM dispense fails, the Robot places the cooling plate to EB450T01 TIM Reject Conveyor.

The Fanuc M20iA-35M robot is a third-party component integrated with the other cell mechanisms. The robot manipulates several axes to properly position end of arm tooling (EOAT).

The EOAT consists of a gripper frame that holds four vacuum cups and two slide tables with locating pins. The locating pins are extended to align with the cooling plate datums so that the cooling plates are picked in a repeatable position. The vacuum cups, supplied by two vacuum generators, grip the cooling plate until it is placed. Before placing a cooling plate, the slide tables retract the locating pins so that they do not interfere with the placement. After the cooling plate is released the slide tables extend the locating pins again in preparation for the next cooling plate pick.

REFERENCE	***For more information about the robot, refer to the equipment supplier documentation (Fanuc Robot R-2000iC Mechanical Unit Operator's Manual pg. 26-65).***

3.9.7. EB430 Cooling Plate Handoff 2

The Cooling Plate Handoff 2 (see callout **H** in *Figure 3-7*) holds a cooling plate temporarily before it has TIM dispensed to it. The EB420R01 Dispense 1 Robot places a cooling plate to the Handoff so that the EB440R01 Dispense 2 Robot can pick the cooling plate and transport it to the EB440 Dispense equipment.

The Handoff consists of an elevated horizontal bottom plate with six guide blocks and sensors. The guide blocks ensure that the cooling plate is loaded and oriented in a repeatable position. The sensors detect when the cooling plate is present.

3.9.8. EB440 Dispense and Inspect 2

The Dispense and Inspect 2 equipment (see callout **I** in *Figure 3-7*) dispenses a two-part material through a mixing nozzle and onto a cooling plate and then inspects the cooling plate to ensure the material was dispensed correctly.

The dispensing equipment consists of proprietary Atlas Copco controllers, drum pumps and metering valves that were consigned by GM to be integrated with the rest of the equipment. The two-part material is dispensed out of drums, through separate lines, to metering valves. The metering valves control the amount of material that is pushed through a mixing nozzle. The mixing nozzle blends the materials and dispenses the material as a solid bead that gets applied onto a cooling plate. The EB440R01 Dispense 2 Robot holds the cooling plate and moves the cooling plate in a defined path so that the material is dispensed in the required pattern.

After a dispense cycle is completed, a pneumatic rotary table turns a wire beneath the mixing nozzle to cut away any excess material that may continue flowing from the nozzle. The severed material falls into a purge bucket below the nozzle. The purge bucket is also used to collect material during periodic purge cycles that occur automatically as programmed.

After the TIM has been dispensed to a cooling plate, the EB440R01 Dispense 2 Robot positions the cooling plate below a Matrox camera. A North Coast edge lit LED backlight illuminates the cooling plate while the camera inspects the cooling plate to ensure the material was properly dispensed. If the inspection fails, the EB440R01 Dispense 2 Robot releases the cooling plate to EB450T01 TIM Reject Conveyor. If the inspection passes, the EB440R01 Dispense 2 Robot releases the cooling plate to EB450 Handoff.

REFERENCE

For more information about the dispense equipment, refer to the equipment supplier documentation (Atlas Copco). This equipment was consigned by GM to ATS for integration. GM should have the proper supplier documentation.

3.9.9. EB440R01 Dispense 2 Robot

The Dispense 2 Robot (see callout **J** in *Figure 3-7*) picks a cooling plate from EB430 and holds the cooling plate at EB440 while TIM is dispensed to it. If a cooling plate TIM dispense fails, the Robot places the cooling plate to EB450T01 TIM Reject Conveyor.

The Fanuc M20iA-35M robot is a third-party component integrated with the other cell mechanisms. The robot manipulates several axes to properly position end of arm tooling (EOAT).

The EOAT consists of a gripper frame that holds four vacuum cups and two slide tables with locating pins. The locating pins are extended to align with the cooling plate datums so that the cooling plates are picked in a repeatable position. The vacuum cups, supplied by two vacuum generators, grip the cooling plate until it is placed. Before placing a cooling plate, the slide tables retract the locating pins so that they do not interfere with the placement. After the cooling plate is released the slide tables extend the locating pins again in preparation for the next cooling plate pick.

REFERENCE

For more information about the robot, refer to the equipment supplier documentation (Fanuc Robot R-2000iC Mechanical Unit Operator's Manual pg. 26-65).

3.9.10. EB450 Rotary Transfer Table

The Robot 1 to Robot 2 Handoff (see callout **K** in *Figure 3-7*) is used to hold a cooling plate that has had TIM dispensed to it. The EB420R01 or EB440R01 Robot loads a cooling plate to the mechanism and the EB450R01 Robot picks the cooling plate from the mechanism.

The mechanism holds a handoff plate in a horizontal orientation for most of the cycle. In the horizontal orientation, four vacuum cups (supplied by two vacuum generators) are used to grip a cooling plate. Two slide tables advance locating pins that engage the cooling plate datums in a repeatable orientation. The cooling plate is held in the horizontal orientation until the EB450R01 Robot is ready to pick the cooling plate. A SMC rotary actuator then rotates the handoff plate (and cooling plate) to a vertical orientation. The slide tables retract the locating pins and the EB450R01 Robot then grips the cooling plate. Once the Robot has gripped the cooling plate, the vacuum generators release vacuum from the cups and the Robot retreats with the cooling plate. The rotary actuator then rotates back to horizontal and the slide tables extend the locating pins in preparation for the loading of the next cooling plate.

The Handoff mechanism features a gravity pin that can be inserted to lock the tooling in the horizontal or in the vertical orientation, depending on what is needed. A holder with sensing houses the gravity pin. An operator removes the pin from the holder and inserts the pin into a through-hole in the tooling.

3.9.11. EB450R01 Press Unload Robot

The Press Unload Robot (see callout **L** in *Figure 3-7*) is used to transfer cooling plates to the EB460 Assembly Press and to transfer module assemblies from the Assembly Press through the remaining cell operations.

The Fanuc R-2000iC/210F robot is a third-party component integrated with the other cell mechanisms. The robot manipulates several axes to properly position end of arm tooling (EOAT).

The EOAT utilizes a pair of SMC CQ cylinders to move lower gripper arms to squeeze an object (either a module assembly or a cooling plate) against stationary upper gripper arms. The gripper arms are fitted with inserts for cooling plates and inserts for module assemblies. The robot positions the EOAT as needed so that the proper inserts are located for the product being picked.

Rod locks are used to engage in the event of an air pressure loss so that the soft stack is not dropped.

The EOAT is equipped with two pneumatic valves so that the pressure can be changed depending on which product is being picked. When picking a cooling plate, a lower pressure is utilized so as not to damage the component. When picking a module assembly, a higher pressure is utilized to securely hold the module. A pressure switch monitors the pressure applied and communicates the pressure to the controller.

REFERENCE

For more information about the robot, refer to the equipment supplier documentation (Fanuc Robot M-20iA Mechanical Unit Operator's Manual pg. 13-40).

3.9.12. EB450T01 TIM Reject Conveyor

The TIM Reject Conveyor (see callout **M** in *Figure 3-7*) holds cooling plates that failed the TIM vision inspection and conveys the failed cooling plates out of the cell.

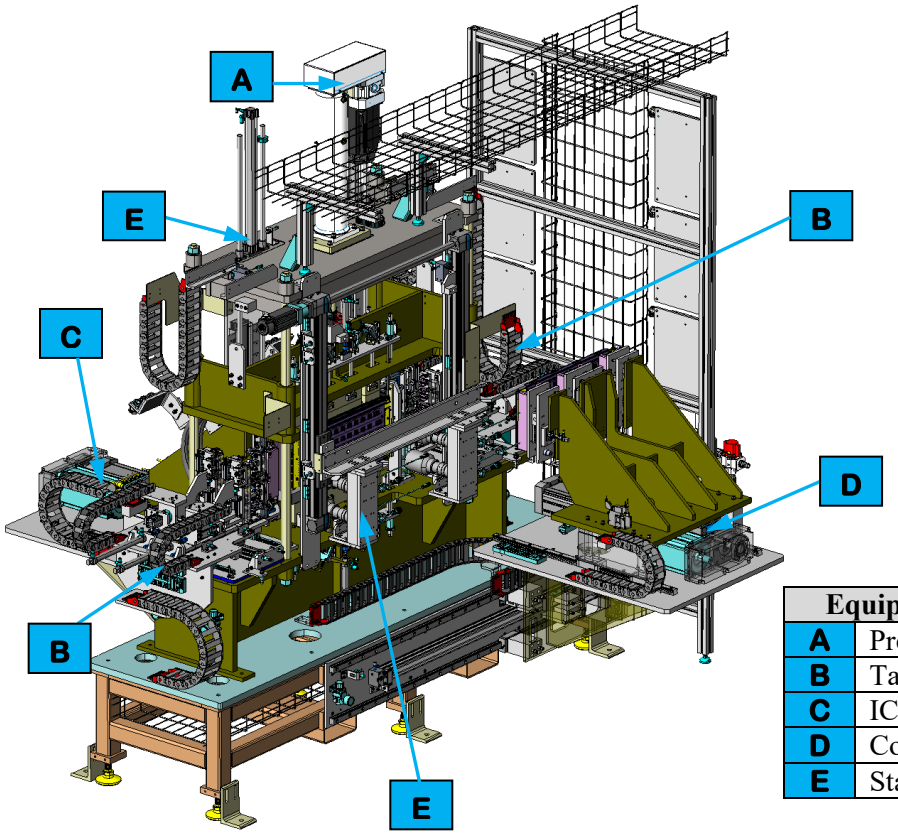
The mechanism utilizes a proprietary Dorner 2200 series conveyor with sensing. The conveyor starts and stops incrementally to stagger the placement of cooling plates until the earliest-placed cooling plate reaches the end opposite

end of the conveyor. An operator must periodically remove the rejected cooling plates. Once the conveyor is full of cooling plates, no more rejects can be placed to it.

REFERENCE ***For more information about the conveyor, refer to the equipment supplier documentation (Dorner 2200 Series Center Drive Conveyors Installation, Maintenance & Parts Manual pg. 3).***

3.9.13. EB460 Assembly Press

The EB460 Assembly Press (see ***Figure 3-8***) is where all the components come together to complete the assembly of a module. The Assembly Press utilizes five mechanisms to install, press, and verify the assembly of the components: a Press, two Tab Locator Tools, an ICB Install Tool, a Cooling Plate Install Tool, and a Stacking Verification Vision Tool.



Equipment Callouts in Figure 3-7	
A	Press
B	Tab Locator Tool
C	ICB Install Tool
D	Cooling Plate Install Tool
E	Stacking Verification Vision Tool

Figure 3-8. An illustration of the Assembly Press mechanisms.

3.9.13.1. Assembly Press Sequence of Operation

The following is the sequence of events that comprise a complete cycle at the Assembly Press.

1. The ICB Install Tool shuttles to a clear position.
2. EB370R01 Press Load Robot acquires a soft stack and loads the soft stack into the Press.
3. The ICB Install Tool shuttles to the work position.
4. EB370R01 Press Load Robot acquires an ICB and loads the ICB to the ICB Install Tool.
5. The ICB Install Tool acquires the ICB.
6. EB370R01 Press Load Robot releases the ICB and retracts clear.

7. At the same time the ICB is being loaded, EB450R01 Press Unload Robot acquires a cooling plate with TIM dispensed to it and loads the cooling plate into the Cooling Plate Install Tool.
8. The Press lowers and over-compresses the soft stack to a specific height to allow the ICB and cooling plate to be installed.
9. The Tab Locator Tools on both sides of the Press advance and grip the soft stack tabs.
10. The Stacking Verification Vision Tool lowers, checks the soft stack tabs, and raises clear.
11. The ICB Install Tool folds the ICB fingers inward.
12. The ICB Install Tool moves toward the soft stack to a mid-position where the soft stack tabs begin to engage the ICB fingers.
13. The Tab Locator Tools on both sides of the Press release the soft stack tabs and then retract to a mid-position.
14. The ICB Install Tool moves to a final position where the soft stack tabs are fully engaged with the ICB and the ICB is installed to the soft stack.
15. The Stacking Verification Vision Tool lowers, checks the soft stack tabs, and raises clear.
16. The Tab Locator Tools retract clear.
17. The ICB Install Tool releases the ICB, retracts clear, and retracts the fold tooling.
18. The Cooling Plate Install Tool advances to install the cooling plate to the soft stack.
19. The Cooling Plate Install Tool releases the cooling plate, retracts, and then shuttles sideways clear of the Press.
20. The Press raises slightly. Probes engage the latching features of the ICB and cooling plate to ensure the latching features are fully engaged. The Probes then retract clear.
21. EB450R01 Press Unload Robot approaches and grips the module assembly.
22. The Press raises clear.
23. EB450R01 retreats with the module assembly.

The paragraphs that follow provide detailed descriptions of each Assembly Press mechanism.

3.9.13.2. Press

The Press assembly (see callout **A** in ***Figure 3-8***) compresses a soft stack while an ICB and a cooling plate are installed and then probes the components to ensure the latching mechanisms have been engaged.

The Press assembly utilizes a propriety Promess servo press and four identical probe tools, two probe tools on the top, two probe tools on the bottom. The servo press applies downward force to compress the soft stack to a known height. Each probe tool utilizes a SMC pneumatic cylinder to engage four probe contacts that check that the part latching features project through the part. Each probe contact compresses slightly if the latching feature is properly engaged. Sensors detect the probe contact compression, signaling that the latch is engaged. The cylinder then retracts the probe contacts clear.

Two sides of the Press assembly feature a gravity pin that can be inserted to prevent the tooling from falling during maintenance activities. Holders with sensing house the gravity pins. An operator removes the pins from the holders and inserts the pins into the through-holes in the tooling plates, securing the vertical tooling in the raised position.

REFERENCE

For more information about the servo press, refer to the equipment supplier documentation (Promess MotionPRO User's Manual pg. 8-11).

3.9.13.3. Tab Locator Tools

The two Tab Locator Tools (see callout **B** in ***Figure 3-8***) grip the soft stack tabs to aid in their insertion into an ICB. The two Tab Locator Tools are mirror-images with the same components and same operation.

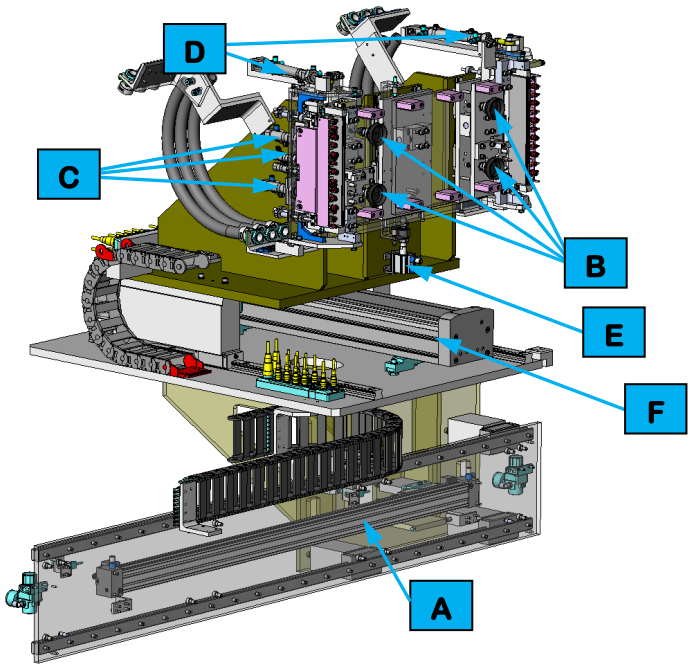
Each Tab Locator Tool has two nearly identical devices with their own horizontal and vertical pneumatic actuators. One set of tooling is for 2P parts, one set of tooling is for 3P parts. A rodless cylinder is used to move the correct tooling in line with the soft stack as needed.

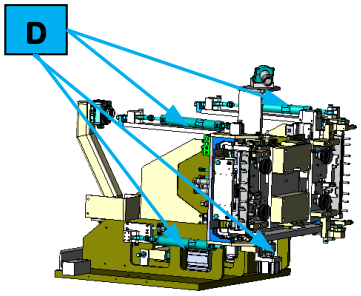
Once the proper tooling is aligned with the soft stack, a pair of horizontal pneumatic cylinders advance tab fingers fully toward the soft stack to gather the tabs. A pair of vertical pneumatic cylinders then close the tab fingers to bring all the soft stack tabs together. Stacker Verification Vision Tools then scan the tabs to ensure that the tabs are present and have not been damaged.

After the vision check is complete, the ICB Install Tool advances to engage the tabs with the ICB. Once the tabs have been started into the ICB, the vertical pneumatic cylinders spread the tab fingers apart to release the tabs. One of the horizontal pneumatic cylinders then retracts the mechanism to a mid-position. The ICB Install Tool finishes advancing to complete the insertion of the tabs to the ICB. The Stacker Verification Vision Tools then scan the tabs again to ensure that the tabs have not been damaged, and the horizontal pneumatic cylinder fully retracts the tooling clear.

3.9.13.4. ICB Install Tool

The ICB Install Tool (see callout **C** in ***Figure 3-8***, see ***Figure 3-9***) installs an ICB to a soft stack.





Equipment Callouts in Figure 3-8	
A	Servo Actuator
B	Vacuum Cups
C	2P/3P Vacuum Cup Cylinders
D	Fold Cylinders
E	Compensation Cylinder
F	Servo Actuator

Figure 3-9. An illustration the ICB Install Tool equipment.

The base of the ICB Install Tool features three mechanisms to provide movements in the x-, y-, and z-axes. A Servo Actuator (see callout **A** in ***Figure 3-9***) provides x-axis movement to shuttle the mechanism clear so that a soft stack can be loaded to the Press and then to shuttle the mechanism back to the home (work) position. A servo actuator (see callout **F** in ***Figure 3-9***) provides y-axis movement to position the tooling at home, at a mid-position where the ICB fingers begin to engage the soft stack tabs, and to a fully extended position where the ICB is pressed onto the soft stack. A compact cylinder (see callout **E** in ***Figure 3-9***) provides z-axis movement to lower the tooling to compensate for the over-compression of the soft stack that allows the ICB and cooling plate to be installed. The compact cylinder pressure is overcome to lift the tooling back up when the soft stack is decompressed.

The actual ICB tooling has three mechanisms that hold the ICB, pull the ICB folding fingers flat, and fold the ICB fingers inward 90°. When an ICB is first presented to the mechanism, four vacuum cups (see callout **C** in ***Figure 3-9***) hold the base of the ICB firmly against the tooling. The two sides of the tooling both feature 2P and 3P vacuum cup configurations (quick change out) that are independently actuated by different cylinders (see callout **C** in ***Figure 3-9***). When the 3P tooling is needed, the cylinders for the 2P tooling are fully retracted. When the 2P tooling is needed, the cylinders for the 3P tooling are fully retracted. Each tooling set has two cylinders that provide three positions: fully retracted (not in use), fully extended (vacuum cups engage the ICB folding fingers), and mid-position (folding fingers are pulled back against datums). The top and bottom of the folding finger tooling features two compact cylinders (see callout **D** in ***Figure 3-9***) that extend to pivot the folding finger mechanisms 90° so that the fingers move inward for installation to a soft stack, and retract to pivot the folding finger mechanisms back to the flat position for when an ICB is first loaded to the tooling.

A Matrox camera (not shown in ***Figure 3-9***) is positioned behind the tooling to scan the bar code on the ICB to ensure that the correct ICB has been loaded and for traceability purposes.

REFERENCE

For more information about the bar code camera, refer to the equipment supplier documentation (Matrox Iris GTR Install and Technical Manual pg. 22-56).

3.9.13.5. Cooling Plate Install Tool

The Cooling Plate Install Tool (see callout **D** in ***Figure 3-8***) installs a cooling plate to a soft stack.

The base of the Cooling Plate Install Tool features two mechanisms to provide movements in the x- and y-axes. A servo actuator provides x-axis movement to shuttle the mechanism clear so that a soft stack can be unloaded from the Press and then to shuttle the mechanism back to the home (work) position. A servo actuator provides y-axis movement to position the tooling at home and to a position where the cooling plate is pressed onto the soft stack.

The actual cooling plate tooling features two locating pins that are extended by cylinders that extend through the cooling plate datums to locate the cooling plate in a repeatable position. Once the cooling plate has been loaded and located, four vacuum cups grip and hold the cooling plate. The cylinders then retract the locating pins before the cooling plate is pressed onto the soft stack. The vacuum cups release the cooling plate after it has been installed to the soft stack.

3.9.13.6. Stacking Verification Vision

The Stacker Verification Vision Tool (see callout **E** in ***Figure 3-8***) checks the soft stack tabs to ensure they are not bent before and after installation of the ICB.

The Tool consists of two backlights, each attached to a pneumatic cylinder, and four cameras attached to a servo-driven gantry. During a cycle, the cylinders extend the backlights behind the soft stack tabs to provide illumination for the cameras. A servo motor then drives two pairs of cameras along belt-driven linear actuators. Each of the Matrox cameras utilize a Moritex telecentric lens to inspect a tab. The cameras are lowered to inspect the first group of two tabs, then lowered to inspect the next group of two tabs, and so on until all the tabs have been inspected. The servo motor then raises the cameras clear, and the cylinders raise the backlights clear. During each Press cycle, the tabs are inspected twice – once before the tabs are inserted into the ICB, and again after the tabs are inserted into the ICB.

The backlight tooling and the camera tooling vertical motions both feature gravity pins that can be inserted to prevent the tooling from falling during maintenance activities. Holders with sensing house the gravity pins. An operator removes the pins from the holders and inserts the pins into the through-holes in the tooling plates, securing the vertical tooling in the raised position. There are a total of four gravity pins for the tooling.

REFERENCE ***For more information about the camera equipment, refer to the equipment supplier documentation (Matrox Iris GTR Install and Technical Manual pg. 22-56).***

3.9.14. EB470 Label and Print Apply

The Label and Print Apply mechanism (see callout **O** in *Figure 3-7*) prints a product label, applies the label to a completed module assembly, and then reads the product label.

The mechanism utilizes a propriety CTM Labeling Systems printer applicator attached to a drawer slide. The printer applicator prints and tamps a label onto a complete module assembly held by the EB450R01 Press Unload Robot. The drawer slide provides the ability to pull the printer applicator out of the cell to a position where the printer supplies can be changed.

After the label has been applied to the module assembly, the EB450R01 Press Unload Robot repositions the module in front of a Matrox camera with lighting. The camera reads the product label barcode for traceability.

REFERENCE ***For more information about the print applicator, refer to the equipment supplier documentation (CTM Labeling Systems 3600a Printer Application Maintenance and Service Manual Chapters 1 & 2).***

3.9.15. EB480 Drop to Conveyor

The Drop to Conveyor mechanism (see callout **P** in *Figure 3-7*) acquires a module assembly from the EB450R01 Press Unload Robot, rotates the module assembly, and sets the module assembly onto a pallet for transport out of the cell.

The Drop to Conveyor mechanism utilizes a pair of upper gripper fingers, actuated by a pair of SMC CQ cylinders, and a pair of lower gripper fingers, actuated by another pair of SMC CQ cylinders. The cylinders actuate the gripper fingers closed around a module assembly and actuate the gripper fingers open to release the module assembly. Rod locks are used to engage in the event of an air pressure loss so that the module assembly is not dropped. The mechanism also utilizes a SMC rotary actuator to turn the gripper tooling over 90°, and a SMC cylinder to lower the gripper tooling for placement and to raise for picking.

The gripper tooling and rotary tooling motions both feature gravity pins that can be inserted to prevent the tooling from falling during maintenance activities. Holders with sensing house the gravity pins. An operator removes the pins from the holders and inserts the pins into the through-holes in the tooling plates, securing the tooling in the raised position.

3.9.16. EB480T01 Conveyance

The Conveyance equipment (see callout **Q** in *Figure 3-7*) transports empty pallets into the EB480 Drop to Conveyor mechanism, transports pallets with module assemblies out of the EB480 Drop to Conveyor mechanism and to an EB500 BOM Check mechanism, and then releases the pallets with module assemblies onto the Module Final Assembly System EX010 Module Input VTU conveyor.

The Conveyance equipment consists of Bosch BS2 conveyor sections, a Bosch PE 2X Lift Position Unit, and two Bosch HQ 2U Lift Transfer Units. The conveyor sections use roller chains to transport pallets through the work area. Cushioned stops are located throughout the conveyance with RFID tag readers at decision points and work positions. Pneumatic-actuated pallet Lift Transfer Units are used to transfer the pallets from one perpendicular conveyor section to another. A

pneumatic-actuated Lift Position Unit is used to raise a pallet off the conveyor and hold the pallet while a module assembly is loaded to it.

REFERENCE	***For more information about the conveyance equipment, refer to the equipment supplier documentation (Bosch Belt Section BS 2 pg. 4-7, Bosch BS 2C-…, BS 2R… Belt Sections Assembly Instructions pg. 13-15, Bosch HQ 2U Lift Transverse Unit Assembly Instructions pg. 12-14, Bosch PE 2X Positioning Unit Assembly Instructions pg. 11-14).***

3.9.17. EB490 Soft Stack Reject

The Soft Stack Reject equipment (see callout **R** in *Figure 3-7*) provides an area where a reject cart can be docked so that the cart can be loaded with rejected components. An operator can then extract the cart from the dock when rejected components need to be removed.

The dock consists of an extruded aluminum frame with light curtain sensing fields, cart guide rails, part sensing, a latch, and fixture lift/ locate device. Light curtains are located at the front of the dock (where the cart passes through on its way in and out of the dock) and along the bottom of the dock (where the cart rests). The light curtains detect the presence or absence of the cart and communicates the status to the processor. The cart guide rails help to guide the reject cart into and out of the dock. Part sensors detect when parts have been placed onto the reject cart. A latch mechanism is provided to lock the reject cart into the dock. The fixture lift/locate device is used to lift the fixture from the top of the cart to a repeatable position so that rejected parts are always accurately placed onto the cart tooling.

The reject cart consists of a rolling cart with a pair of Bosch transfer roller sections that allow a removable fixture to be slid onto and off the cart. A latch stopper finger holds the removable fixture on the cart. A latch release mechanism allows an operator to toggle the stopper finger open so that the removable fixture can be freed from the cart. The removable fixture includes rest plates, guideposts, and guide blocks that help hold and secure rejected components placed to them. A rejected soft stack (or module assembly) can be loaded onto the fixture. Cooling plates that have sat idle after the TIM material cure time has elapsed can also be loaded onto the fixture.

REFERENCE	***For more information about the light curtain, refer to the equipment supplier documentation (Sick deTec4 Prime Safety Light Curtain Operating Instructions pg. 13-20).***

3.9.18. EB500 BOM Check

The BOM Check position (see callout **S** in *Figure 3-7*) is used to look up all the components installed in a module on a pallet to confirm that the correct components are present and that all operations have been successfully completed. The position includes a North Coast hex ring light and a Matrox GTR camera mounted above the EB480T01 Conveyance. The ring light illuminates the camera field of view. The camera captures an image of the module bar code so that the system can read the bar code and look up the associated data. The pallet with the module is then released downstream onto the Module Final Assembly System. If the data is correct, the module continues into the Module Final Assembly System. If the data is incorrect, the pallet with the module is released to the EX005T01 Set In/Out position so that the module can be removed from the pallet.

REFERENCE

For more information about the camera, refer to the equipment supplier documentation (Matrox Iris GTR Install and Technical Manual pg. 22-56).

3.9.19. Robot and Vision Calibration Stand

The Robot and Vision Calibration Stand (see callout **T** in *Figure 3-7*) provides a calibration grid that is used as a reference when calibrating the robot and robot vision equipment. Calibration of the robot and robot vision equipment is documented in the associated Fanuc documentation.

REFERENCE

For information about the robot and vision equipment calibration, refer to the equipment supplier documentation (Fanuc iRVision 2D Camera Application Operator's Manual, Grid Pattern Calibration With A Fixed Camera, Page 160).

4. SYSTEM OPERATION

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4.1. OPERATOR INTERFACE DEVICES

4.1.1. Summary

The following table identifies the common interface devices that are located at each of the Cells.

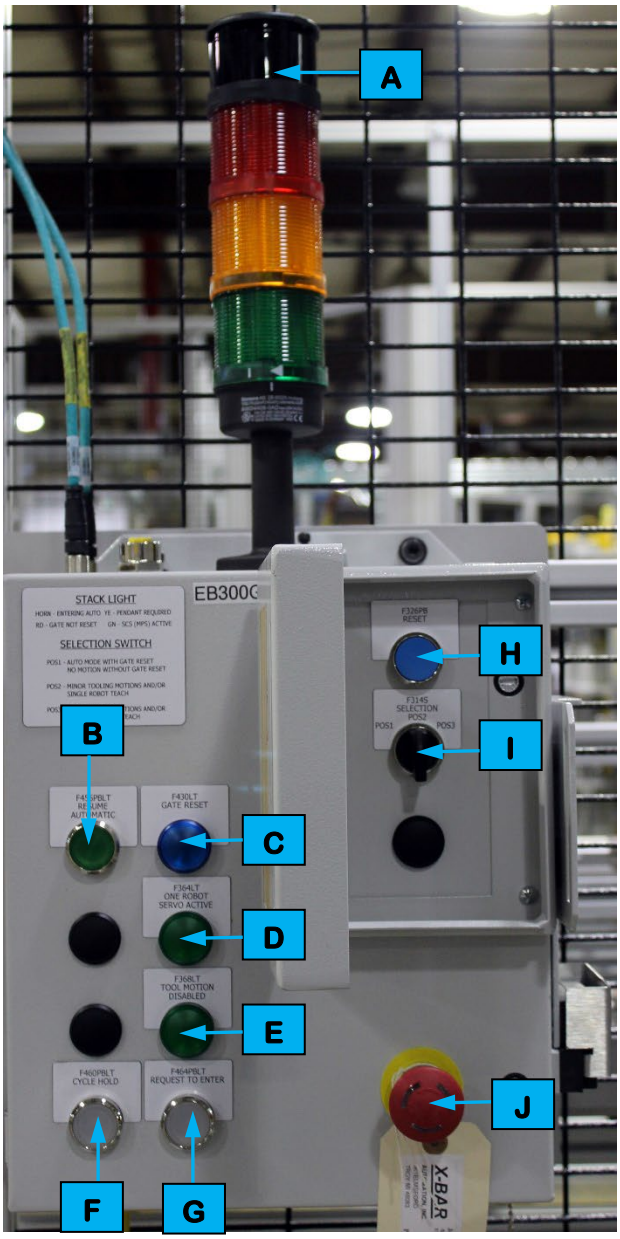
COMMON INTERFACE DEVICE TABLE				
	Cell Load (EB020)	**Cell Processing (EB040)**	**Cell Stacking (EB300)**	**Module Assembly (EB400)**
Entrance Gate Box	✓	✓	✓	✓
HMI	✓	✓	✓	✓
PHMI	✓	✓	-	✓
Safety Device Junction Box	✓	-	✓	✓
PDP	✓	✓	✓	✓
MCP	✓	✓	✓	✓
IDCP	✓	-	✓	✓
Armorstart	✓	✓	✓	✓
Main Air Supply Equipment	✓	✓	✓	✓
Station/Device Air Supply Equipment	✓	✓	✓	✓
Servo Control Panel	-	✓	✓	✓
Robot Controller	✓	-	✓	✓
Chiller	-	✓	-	-
Laser Generator	-	✓	-	-
Dust Collector	-	✓	-	-
Conveyor Pull Cord	-	-	-	-
Atlas Copco Dispense Controller	-	-	-	✓
Remote Cycle Start Button	-	-	✓	✓
Zebra Printer	-	-	-	✓

COMMON INTERFACE DEVICE TABLE				
	Cell Load (EB020)	**Cell Processing (EB040)**	**Cell Stacking (EB300)**	**Module Assembly (EB400)**
SuperTrak Controller	-	✓	-	-
Keithley Multimeter	-	✓	-	-

4.1.2. Entrance Gate Box

Each cell has an entrance gate box (see ***Figure 4-1***) at each guard door. Each gate box provides numerous controls, used as follows.

> **NOTE** ***Consult your GM-UAW Lockout training for a proper understanding of the MPS system. Chapter 4 details the procedure for using the Gate Box.***



Device Callouts in Figure 4-1	
A	Stack Light indicators
B	RESUME AUTOMATIC button
C	Gate Reset indicator
D	One Robot Servo Active indicator
E	Tool Motion Disabled indicator
F	CYCLE HOLD button
G	REQUEST TO ENTER button
H	RESET button
I	SELECTION toggle switch
J	E-STOP button

Figure 4-1. An illustration of an entrance gate box.

Stack Light Indicators

On top of the entrance gate box is a stack light (see **A** in ***Figure 4-1***) with three colored indicator lights and a horn. The lights and horn are used to indicate the status of the gate reset relay and the MPS system. When activated, each indicator identifies the following condition:

- Red Indicator (Flashing) – gate is not reset
- Yellow Indicator (Solid) – hazardous motion has been enabled and pendant is required
- Green Indicator (Solid) – MPS system is active, all hazardous motion has been disabled
- Horn – entering automatic mode

RESUME AUTOMATIC button

The RESUME AUTOMATIC button (see **B** in ***Figure 4-1***) is used to restart the cell after the safety system is reset and all other control devices have been placed in the proper state for automatic operation. An indicator light inside the button can illuminate solid, flash off and on, or go dark to indicate the following:

- Steady On – all stations are in auto
- Normal Flash – all stations are ready for auto
- Rapid Flash – at least one station is not in auto or is not ready for auto
- Off – no stations are in auto or are not ready for auto

Gate Reset Indicator

The Gate Reset indicator (see **C** in ***Figure 4-1***) illuminates to indicate the gate is closed and reset.

One Robot Servo Active Indicator

The One Robot Servo Active indicator (see **D** in ***Figure 4-1***) illuminates to indicate the gate is not reset, one of the robot servo contactors has been successfully enabled, an any other robots are disabled by the Entrance Gate Box.

Tool Motion Disabled Indicator

The Tool Motion Disabled indicator (see **E** in ***Figure 4-1***) illuminates to indicate when the gate is not reset and the tool outputs are disabled by the entrance gate box.

CYCLE HOLD Button

The CYCLE HOLD button (see **F** in ***Figure 4-1***) stops the cell after the cycle has been completed. Inside the button is a white indicator that flashes when the button is pressed and turns solid when the cell has come to rest at the end of the cycle. The indicator will also flash if the Position Selector is not in “Pos1” after closing and resetting the Entrance Gate Box.

REQUEST TO ENTER Button

The REQUEST TO ENTER button (see **G** in ***Figure 4-1***) stops the cell after the cycle has been completed. Inside the button is a white indicator that flashes when the button is pressed and turns solid when the cell has come to rest at the end of the cycle. Once the cycle is complete and all devices have come to a stop and the button is solid, the gate can be opened. The indicator will also flash if the Position Selector is not in “Pos1” after closing and resetting the Entrance Gate Box.

RESET Button

The RESET button (see H in *Figure 4-1*) re-energizes the gate reset function once the gate has been closed and the Fortress Interlocks slide switch has been re-inserted into the gate box.

SELECTION Toggle Switch

The three-position selector switch (see I in *Figure 4-1*) allows maintenance personnel to selectively enable or disable hazardous and non-hazardous tooling motions within the cell for routine maintenance tasks. The selector switch provides the following levels of control:

- Pos1 – allows automatic operation if the gate is reset; disables all tooling motion with the gate open. The switch must be in this position for automatic mode.
- Pos2 – allows only non-hazardous (minor) tooling motion within the cell and/or single robot teach.
- Pos3 – allows all tooling motion within the cell, with hazardous (major) motion requiring the use of an enabling pendant. This position also allows all robot teach.

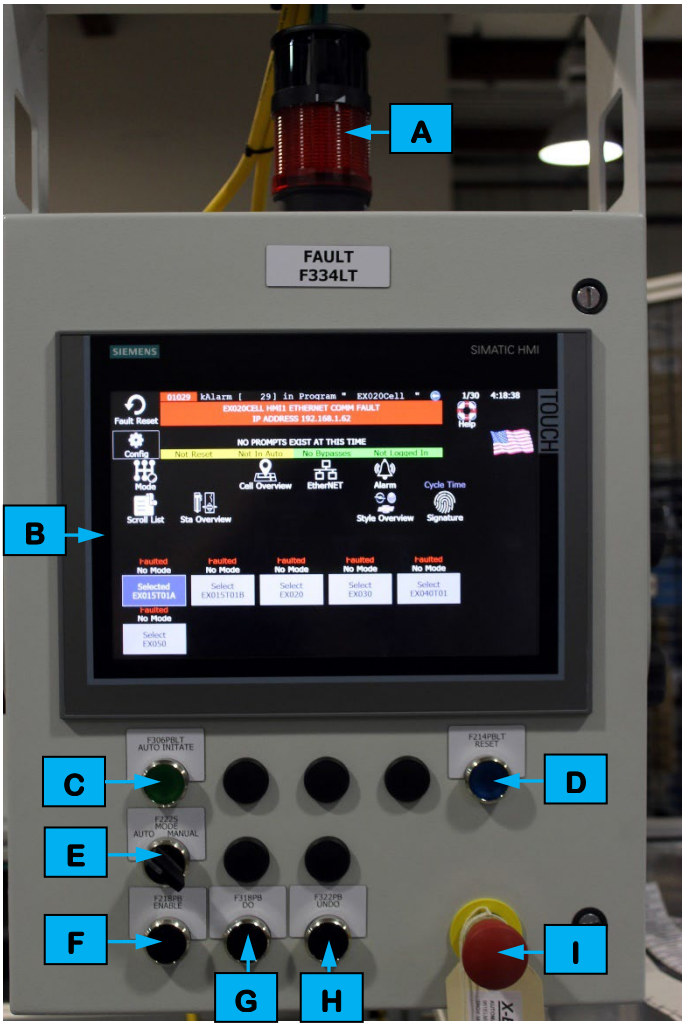
The selector switch does not affect non-motion output power, such as indicators, vacuum, and horns.

E-STOP Button

The EMERGENCY STOP button (see J in *Figure 4-1*) immediately removes control power from the cell. The EMERGENCY STOP button requires the button to be pulled back out after it has been pressed in. After pressing an EMERGENCY STOP button, follow the recovery procedure outlined in Chapter 4.

4.1.3. HMI

Each cell has its own HMI terminal (see ***Figure 4-2***) that provides operator interface with the equipment. The devices contained within the terminal are detailed in the section that follows.



Device Callouts in Figure 4-2	
A	Stack Light indicators
B	Touch Panel
C	AUTO INITIATE button
D	RESET button
E	AUTO/MANUAL key
F	ENABLE button
G	DO button
H	UNDO button
I	E-STOP button

Figure 4-2. An illustration of a remote HMI terminal.

Touch Panel

A Siemens Simatic Touch Panel provides the main means of operator interface with the equipment. The Touch Panel features a touch-sensitive screen that displays control and setup screens. More detailed information on these screens can be found at ***4.2 HMI Screens***.

AUTO INITIATE Button

The AUTO INITIATE button begins an automatic cycle (if conditions allow). An indicator light inside the button can illuminate steady, flash off and on, or go dark to indicate the following:

- Steady On – all stations are in auto
- Normal Flash – all stations are ready for auto

- Rapid Flash – at least one station is not in auto and is not ready for auto
- Off – no stations are in auto and are not ready for auto

DO Button

The DO button initiates an action prompted on the cell HMI (if conditions allow). In Manual Mode, the DO button also will perform a manual action highlighted on the Scroll List screen if the action is mechanically clear.

UNDO Button

The UNDO button undoes the action prompted on the cell HMI (if conditions allow). In Manual mode, the UNDO button will also perform the inverse manual action highlighted on the Scroll List screen if the action is mechanically clear.

RESET Button

The RESET button enables a power reset. An indicator light inside the button can illuminate steady, flash, or go dark to indicate the following:

- Steady On – power is reset
- Flashing – ready for reset
- Off – not ready for reset

AUTO/MANUAL Key

The AUTO/MANUAL selector toggles the cell between automatic mode and manual mode. In manual mode, many of the interlocks are overridden to allow for more complete control of the equipment. While the interlocks are overridden, certain hazards are present. As such, the switch should typically be set to AUTO.

ENABLE Button

The ENABLE button permits minor tooling motion while gates are open. Hold the button with one hand and use the other to press the DO button in conjunction with the Scroll List screen to initiate an action.

E-STOP Button

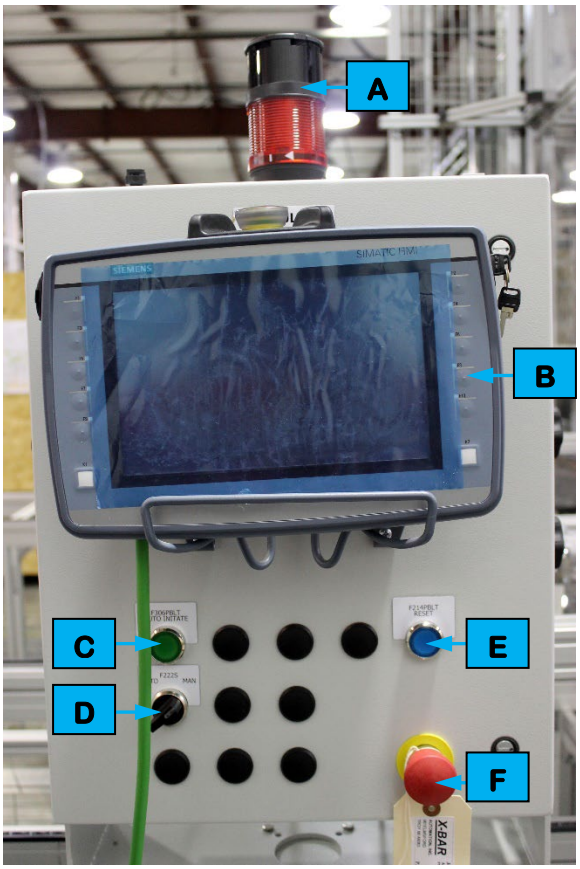
The EMERGENCY STOP button immediately removes control power from the cell. The EMERGENCY STOP button requires the button to be pulled back out after it has been pressed in. After pressing an EMERGENCY STOP button, follow the recovery procedure outlined in ***4.3.5 Recovering from an Emergency Stop***.

Stack Light Indicators

A tower with a stack light provides visual indicators as to the status of the equipment. The red light illuminates when a fault is present.

4.1.4. Portable HMI

Some cells have an enclosure that houses a Portable HMI (PHMI, see ***Figure 4-3***). Controls and indicators on the enclosure are duplicates of those located elsewhere in the system. These duplicated controls can be activated from the most convenient location.



Device Callouts in Figure 4-3	
A	Stack Light Indicator with Horn
B	Mobile Panel
C	AUTO INITIATE button
D	AUTO/MANUAL selector
E	RESET button

Figure 4-3. An illustration of a portable HMI enclosure.

In addition to a connection port for the PHMI, the enclosure features the following controls and indicators.

Stack Light Indicator

The red stack light illuminates when a fault is present.

Mobile Panel

The PHMI is an HMI that is small enough to carry and allows a person to get closer to the equipment for manual operation. The PHMI has a built-in enabling pendant to enable/disable tool motion. The PHMI manually controls only tooling motion and is not a robot teach pendant.

AUTO INITIATE Button

The AUTO INITIATE button begins an automatic cycle (if conditions allow). An indicator light inside the button can illuminate steady, flash off and on, or go dark to indicate the following:

- Steady On – all stations are in auto
- Normal Flash – all stations are ready for auto
- Rapid Flash – at least one station is not in auto and is not ready for auto
- Off – no stations are in auto and are not ready for auto

AUTO/MANUAL Selector

The AUTO/MANUAL selector toggles the cell between automatic mode and manual mode. In manual mode, many of the interlocks are overridden to allow for more complete control of the equipment. While the interlocks are overridden, certain hazards are present. As such, the switch should typically be set to AUTO.

RESET Button

The RESET button enables a power reset. An indicator light inside the button can illuminate steady, flash, or go dark to indicate the following:

- Steady On – power is reset
- Flashing – ready for reset
- Off – not ready for reset

E-STOP Button

The EMERGENCY STOP button immediately removes control power from the cell. The EMERGENCY STOP button requires the button to be pulled back out after it has been pressed in. After pressing an EMERGENCY STOP button, follow the recovery procedure outlined in *4.3.5 Recovering from an Emergency Stop*.

4.1.5. Safety Device Junction Box

The Safety Device Junction Box provides connectivity and interface from the MCP to the cell by picking up wiring for light screens, safety mats, auxiliary power for valve manifolds, and receptacles for DeviceNet. The junction box features the following controls and indicators.

Amber Light

An amber indicator light sits atop the junction box and is used to identify when the cell safety circuit is muted.

Override Active Indicator

An override active indicator light illuminates whenever the AUTO/OVERRIDE key is set to OVERRIDE.

AUTO/OVERRIDE Key

The AUTO/OVERRIDE key is used to toggle the operating mode of the light screens and other safety devices. The override function can only be used for 120- seconds at a time. The switch must be held in the OVERRIDE position.

RESET GUARDS Button

The RESET GUARDS button is used to reset the guard safety circuit.

4.1.6. Power Distribution Panel

The Power Distribution Panel (PDP) supplies AC power to all robots, motors, and other devices in the cell. The PDP also supplies 120 VAC power to various cell components. The PDP is supplied from the plant bus. A main disconnect switch (identified as Lockout Point E-1) is used to enable and disable control power. Indicator lights on the front of the panel illuminate to identify when the processor power is enabled and when the control power is enabled. Refer to the ECPL placards on each PDP for information about locking out the cell energy sources.

4.1.7. Main Control Panel

The Main Control Panel (MCP) is a proprietary enclosure housing the cell processor, DeviceNet scanners, Ethernet module, and other miscellaneous components. The MCP is a proprietary "PLC-in-a-box" from Allen-Bradley.

4.1.8. Integrated Drive Contactor Panel

Power is distributed from the cell PDP to an Integrated Drive Contactor Panel (IDCP). This enclosure houses the safety contactors that enable power to the cell conveyors. The enclosure has an independent disconnect switch that can be used to disrupt power to all cell conveyors. Refer to the ECPL placards on each PDP for information about locking out the cell energy sources.

4.1.9. Armorstart Motor Starter

Each conveyor in each cell has a separate motor starter that is used to enable or disable power to the individual conveyor motor. The motor starter is a proprietary device with a rotary disconnect. A lockout hole in the handle allows a lock to be installed for energy control purposes. Refer to the ECPL placards on each PDP for information about locking out a conveyor motor.

4.1.10. Main Air Supply Equipment

Each cell requires compressed air and has its own air processing equipment that processes air supplied from the plant and distributes the processed air to the cell equipment. The air processing equipment has a shutoff valve (Lockout Point A-1) that removes the flow of processed air from the plant through the cell equipment. Turning the valve to the off position disconnects air pressure to the cell valve packs and vents the pressure through a muffler. A lockout hole in the handle of the valve allows a lock to be installed for energy control purposes. Refer to the ECPL placards on each PDP for information about locking out the cell energy sources.

4.1.11. Station/Device Air Supply Equipment

Specific devices, and groups of devices, have independent air shutoff valves that can be used to disconnect the air supply from only the associated equipment. Turning the valve to the off position disconnects air pressure to the devices and vents the pressure through a muffler. A lockout hole in the handle of the valve allows a lock to be installed for energy control purposes. Refer to the ECPL placards on each PDP for information about locking out the cell energy sources.

4.1.12. Servo Control Panel

Designated cells have a dedicated control panel that provides complete energy control and monitoring of all the servo motors within the cell. The outside of the panel enclosure features indicators that illuminate to identify when control power is on. A fused disconnect is located on the outside of the enclosure and is used to enable or disable control power for the associated servo drives. Refer to the GM standards and to the ATS electrical drawings for more information about the contactor panel equipment and functionality. Refer to the ECPL placards on each PDP for information about locking out the cell energy sources.

4.1.13. Robot Controller

Each robot has its own proprietary controller. Each controller features an electrical disconnect and a pneumatic disconnect (for robot end of arm tooling that utilizes vacuum equipment). Power is distributed from the cell Power Distribution Panel (Lockout Point E-1) to the robot controller. The robot controller distributes power to the robot. During normal cycling, the robot controller is automatically directed by the cell processor. By removing automatic control from the cell processor, interface buttons and other controls provide manual control of the robot. To remove power from the entire robot (480V), turn the electrical disconnect switch and pneumatic shutoff valve to off and install locks. Refer to the ECPL placard at the cell for more information.

REFERENCE

For more information about the robot equipment, refer to the equipment supplier documentation (Fanuc Robot* R-2000iC *Mechanical Unit Operator's Manual pg. 25).

4.1.14. Chiller

A Riedel chiller pumps coolant through the EB040 laser heads to keep the tooling cool. The chiller is a proprietary device with its own controls and interface devices.

REFERENCE

For more information about the chiller equipment, refer to the equipment supplier documentation (Riedel Chiller Operating Instructions pg. 17-20).

4.1.15. Laser Generator

A Trumpf laser generator has two fiber cables that provide a beam-sharing connection to two laser cutting heads inside of a semi-light-tight chamber. The laser generator and associated equipment is located around the outer perimeter of the chamber. The laser generator supplies the energy for the laser heads to cycle. The laser generator is a proprietary device with its own controls and interface devices.

REFERENCE

For more information about the laser equipment, refer to the equipment supplier documentation (Trumpf Operator's Manual TruDisk 1000-8002 Chapter 3).

4.1.16. Dust Collector

A Donaldson Torit evacuation system removes debris and fumes from the laser chamber. The evacuation system includes a duct spark cooler to mitigate sparks in the collection system by creating turbulence in the air flow stream. The dust collector is a proprietary device with its own controls and interface devices.

REFERENCE

For more information about the dust collector equipment, refer to the equipment supplier documentation (Donaldson Torit Downflo LS Installation, Operation and Maintenance Manual pg. 3-8).

4.1.17. Conveyor Pull Cord

Each of the dunnage conveyors at EB020, EB300, and EB400 have a conveyor pull cord that is used to indicate the loading or unloading of dunnage at a conveyor. Pull cords are utilized when loading and unloading is done manually. Stack lights are used in conjunction with the pull cords to indicate status.

4.1.18. Dispense Controller

Each of the TIM dispensers has its own proprietary controllers. The dispensing equipment consists of proprietary Atlas Copco controllers, drum pumps and metering valves that were consigned by GM to be integrated with the rest of the equipment.

REFERENCE 	***For more information about the dispense equipment, refer to the equipment supplier documentation (Atlas Copco). This equipment was consigned by GM to ATS for integration. GM should have the proper supplier documentation.***

4.1.19. Dispense Robots

The TIM dispense Robots carry cold plates from the handoff tables to the dispense nozzles to allow adhesive to be placed onto the cold plates. Once the dispense is complete, they will carry the cold plates, with TIM, to the inspection camera to be inspected and with take them to the reject conveyor or the finished cold plate handoff.

The SAM dispense robot will carry 4 side plates from the side plate handoff to the dispense nozzle for SAM. Once here it will guide the side plates to get the adhesive, inspect the adhesive and then take them to the finished side plate handoff table.

4.1.20. Remote Cycle Start Button

The reject conveyors at EB300 Cell Stacking and at EB400 Module Assembly each have a REMOTE CYCLE START button that provides an operator the ability to manually start the reject conveyor to transport rejected parts out of the cell.

4.1.21. Printer

The EB400 Module Assembly Label and Print Apply mechanism prints a product label, applies the label to a completed module assembly, and then reads the product label. The mechanism utilizes a propriety CTM Labeling Systems printer applicator attached to a drawer slide. The printer applicator prints and tamps a label onto a complete module assembly held by the EB450R01 Press Unload Robot. The drawer slide provides the ability to pull the printer applicator out of the cell to a position where the printer supplies can be changed.

REFERENCE 	***For more information about the print applicator, refer to the equipment supplier documentation (CTM Labeling Systems 3600a Printer Application Maintenance and Service Manual Chapters 1 & 2).***

4.1.22. SuperTrak Controller

The EB040 Cell Processing ATS SuperTrak™ conveyor system is a flexible high-speed pallet transport system with its own proprietary controller.

REFERENCE 	***For more information about the SuperTrak™ equipment, refer to the equipment supplier documentation (ATS Operation and Maintenance Manual SuperTrak™ GEN3 Modular Conveyor pg. 19-43).***

4.1.23. Keithley Multimeter

The EB040 Cell Processing EB050/EB060/EB070 OCV Station utilizes three Keithley DMM6500 digital multimeters to conduct Open Circuit Voltage (OCV) tests on each battery cell through the contact tooling. Each multimeter is a proprietary device with its own controls that communicates test results to the PLC.

REFERENCE

For more information about the multimeter, refer to the equipment supplier documentation (Keithley Model 2700 Multimeter/Switch System User's Manual Chapter 1 pg. 5).

4.2. HMI SCREENS

4.2.1. Summary

The following table identifies the HMI screens that are used at each of the Cells.

COMMON HMI SCREEN TABLE				
	Cell Load (EB020)	**Cell Processing (EB040)**	**Cell Stacking (EB300)**	**Module Assembly (EB400)**
Select	✓	✓	✓	✓
Help	-	✓	✓	✓
Config	✓	✓	✓	✓
Mode	✓	✓	✓	✓
Cell Overview	✓	✓	✓	✓
Cell Power & IO Overview	✓	✓	✓	✓
Station (Tool) Overview	✓	✓	✓	✓
Scroll List	✓	✓	✓	✓
Ethernet Overview	✓	✓	✓	✓
Ethernet Ports & Devices	✓	✓	✓	✓
Ethernet Switch Status	✓	✓	✓	✓
Alarm	✓	✓	✓	✓
Maintenance History	✓	✓	✓	✓
Throughput Overview	✓	✓	✓	✓
Station Throughput	✓	✓	✓	✓
Style Overview	✓	✓	✓	✓
Signature	✓	✓	✓	✓
Robot	✓	-	✓	✓
Servo	-	✓	✓	✓
Service	✓	✓	✓	✓
PMP	✓	-	-	-
SuperTrak	-	✓	-	-
Rejects	-	✓	-	-
Cam BC Image	-	✓	✓	✓
OCV Check	-	✓	-	-
Table Data	-	-	✓	-
Barcode	-	✓	✓	✓
Nest Data	-	-	✓	-
Camera/Print	-	-	-	✓

COMMON HMI SCREEN TABLE				
	Cell Load (EB020)	**Cell Processing (EB040)**	**Cell Stacking (EB300)**	**Module Assembly (EB400)**
TIM/Press	-	-	-	✓
Press	-	-	-	✓
Dispense Expiration	-	-	-	✓

The following flow chart identifies the screen navigation paths.

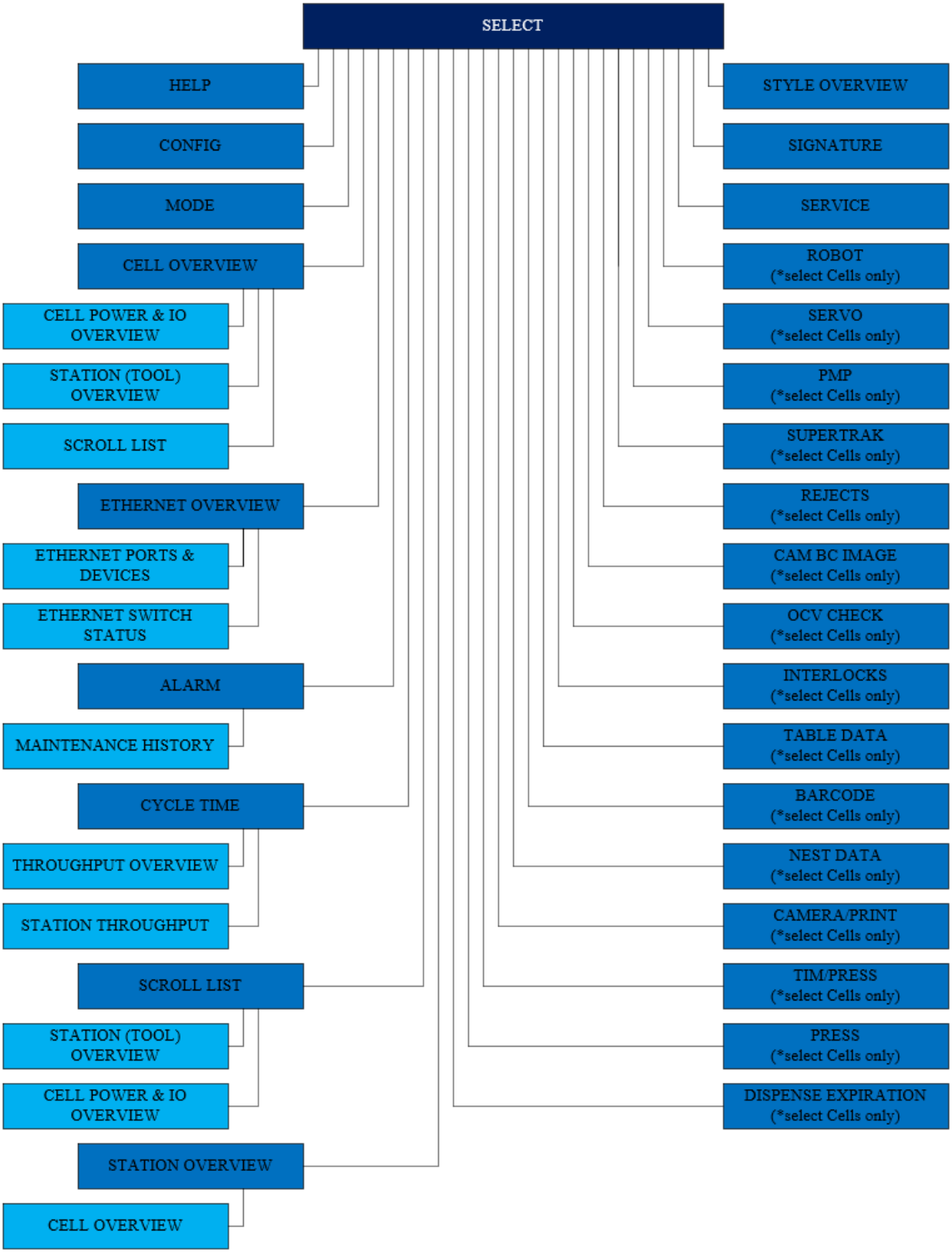


Figure 4-4. Screen navigation flow chart

4.2.2. Screen Header

Each screen that displays on the touch panel features a common header (see ***Figure 4-5***).

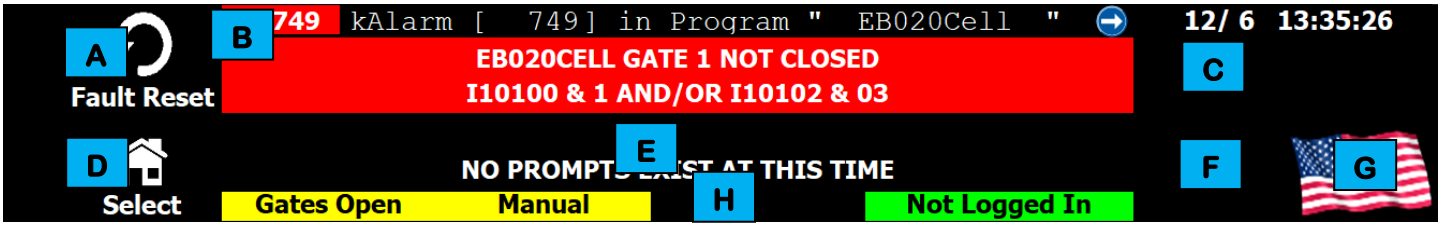


Figure 4-5. An illustration of an example screen header.

Each header features several areas of information and control, used as follows:

- **A** This touch-button clears the alarm message detailed on the screen.
- **B** This part of the header details the highest priority alarm. When an alarm displays, this area details the message number, message detail, program issuing the message, and the message itself. When no alarms are active, this area displays the screen name. Critical alarms that indicate the machine is stopped display in red.
- **C** This touch-button (when available) navigates to a Help screen that may provide further details regarding the alarm message. When no alarm is active, the area displays the date and time.
- **D** The function of this button varies and can be used for the following, depending upon what screen is displayed:
  Select Screen – Navigates to the Select screen.
  Config Screen – Navigates to the Config screen.
  Return – Navigates back to the previously displayed screen.
- **E** This part of the header details operator prompts. When a prompt displays (in blue or yellow), this area details the message number, message detail, program issuing the message, and the message itself. When no prompts are active "*No Prompts Exist At This Time*" is displayed.
- **F** This touch-button (when available) returns to the previous screen.
- **G** This touch-button toggles the language displayed on the touch panel.
- **H** This area of the header (bottom) displays various states, depending upon the selections on the screen below. States displayed in this area include: *Gates OK*, *Bypasses Present*, and *All Processes On*.

4.2.3. Select Screen

Touching the **SELECT** button on the top of any screen navigates directly to a screen (see ***Figure 4-6***) that provides a menu of the screens available at the terminal.

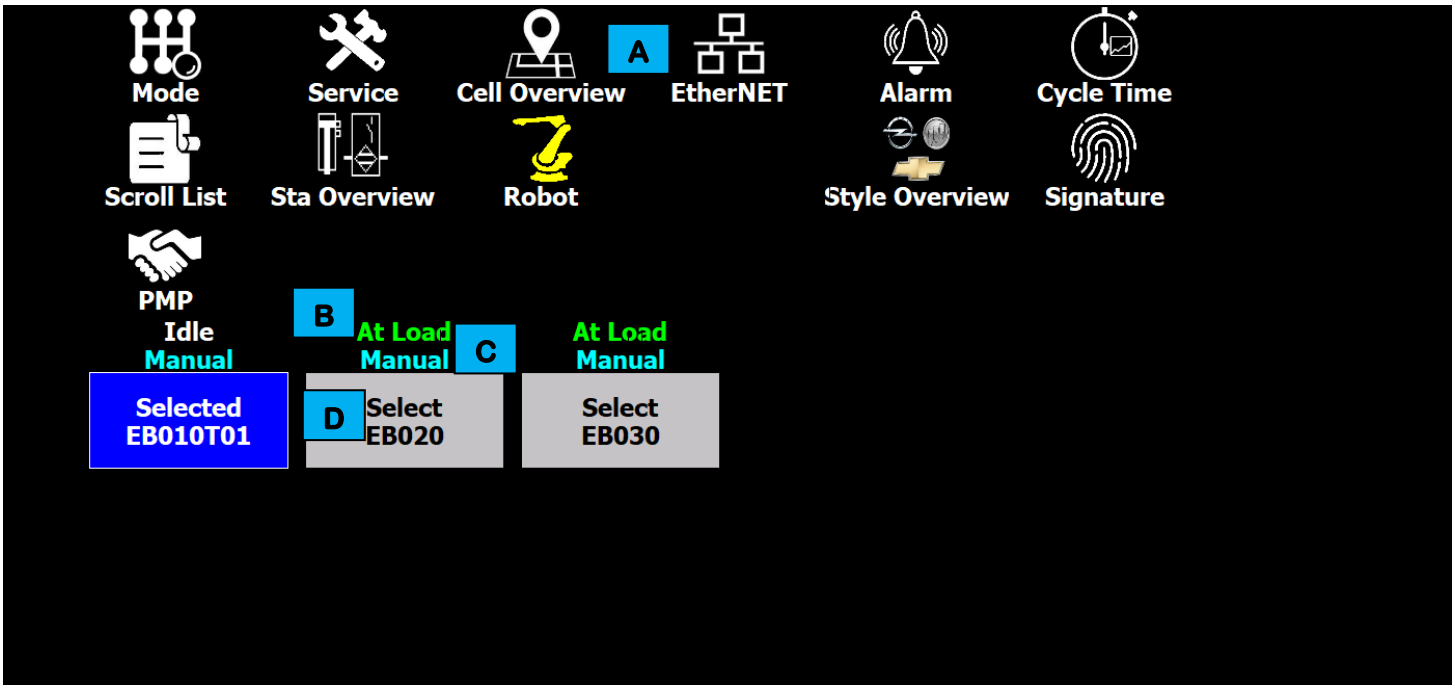


Figure 4-6. An illustration of an example Select screen.

Each Select screen features several areas of information and control, used as follows:

A These touch-buttons open the indicated screen. The button availability varies with the control program selected at the bottom of the screen.

B This area of the screen identifies the status of the station, such as *Faulted* or *At Load*.

C This area of the screen identifies the current state or mode of the station, such as *Manual* or *Auto*.

D This indicator identifies the PLC HMI program operating the HMI.

4.2.4. Help Screen

When available, touching the **HELP** button on the screen header navigates to a screen that provides further details regarding the fault or warning message displayed in the header. The screen is for informational use.

4.2.5. Config Screen

Touching the **CONFIG** button on the Select screen navigates directly to a screen (see ***Figure 4-7***) that can be used to change the HMI date and time and to close the HMI application.

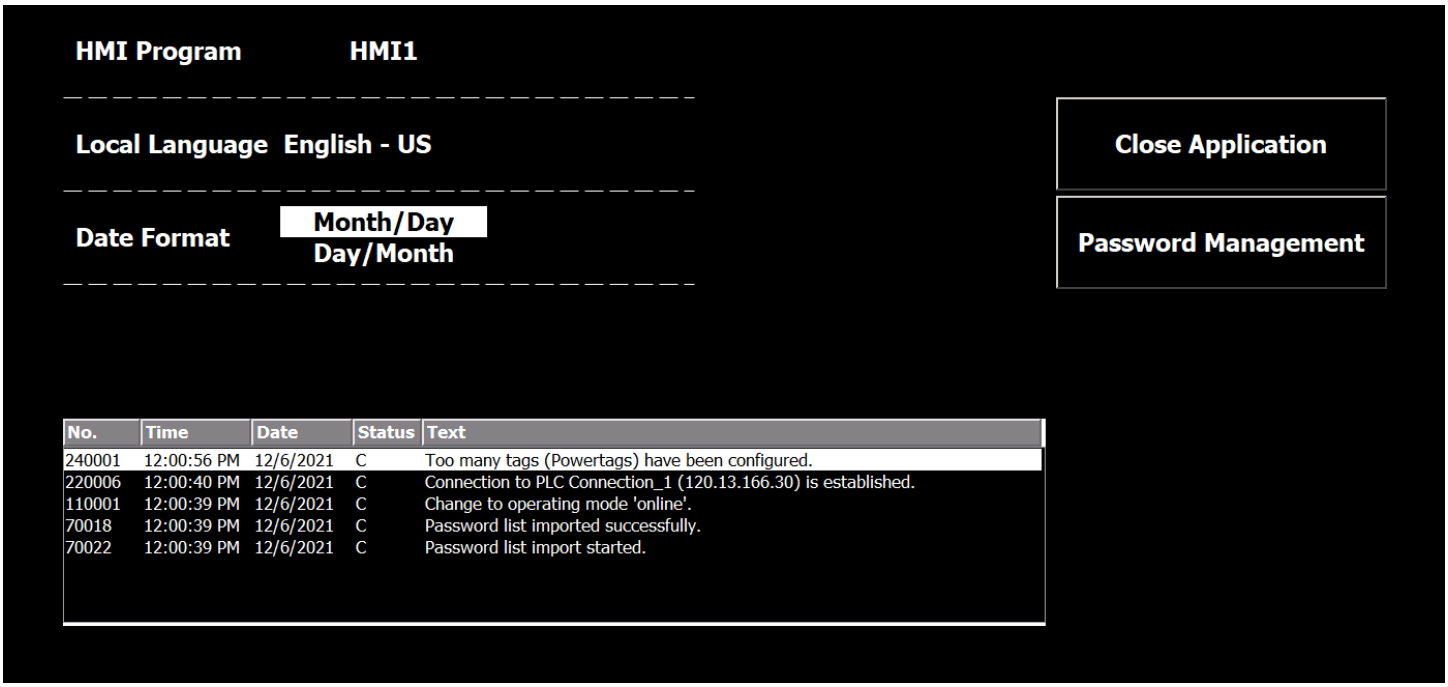


Figure 4-7. An illustration of an example Config screen.

4.2.6. Mode Screen

Touching the **MODE** button on the Select screen navigates directly to a screen (see ***Figure 4-8***) that can be used to toggle the system operating mode.

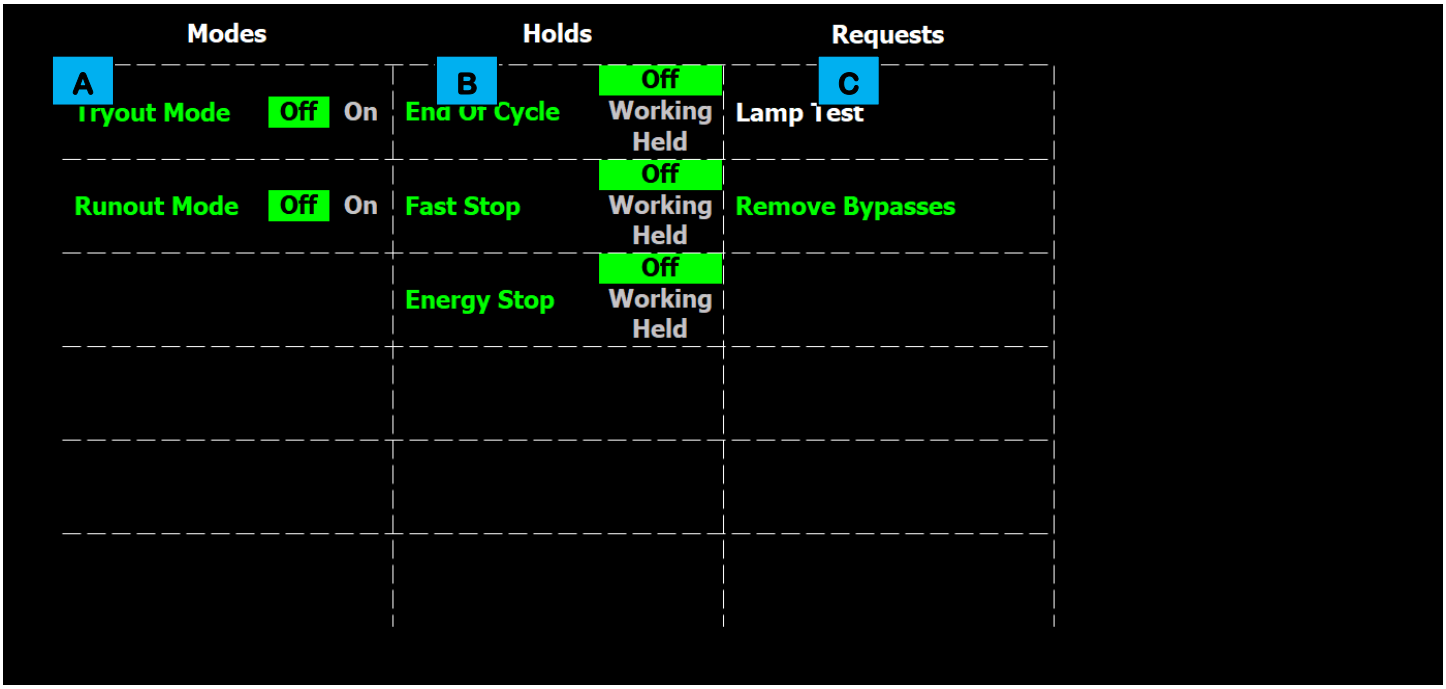


Figure 4-8. An illustration of an example Mode screen.

Each Mode screen features several areas of information and control, used as follows:

A This column provides selection of the following modes:
- *Tryout Mode* – When active, the area devices actuate through their cycles without using parts. This mode simulates the area actions without performing any actual work on the parts. This function should only be necessary during setup and for troubleshooting.
- *Runout Mode* – When active, new pallets of parts are no longer presented to the area, allowing the pallets currently in the area to complete processing. Once the pallets currently in the area have completed processing, the area comes to a stop.

B This column provides selection of the following holds:
- *End of Cycle* – When activated, the area completes the current cycle and then comes to a controlled stop.
- *Fast Stop* – When activated, the area equipment terminates the current cycle and comes to a stop.
- *Energy Stop* – When activated, the system comes to a controlled stop for a low-energy shutdown, such as over a weekend.

C This column provides selection of the following actions:
- *Lamp Test* – When activated, the various physical indicator lights and audible devices associated with the system (stack lights, button indicators, etc.) are enabled. All devices remain enabled while the button is touched and return to their live states once the button is released. This function is useful for checking for dead light bulbs.
- *Remove Bypasses* – When activated, all bypasses available are removed from the equipment.
- *All Processes On* – When activated, all available processes are enabled.
- *All Processes Off* – When activated, all available processes are disabled.

4.2.7. Cell Overview Screen

Touching the **CELL OVERVIEW** button on the Select screen navigates directly to a screen (see ***Figure 4-9***) that provides a graphical representation of the cell. It identifies the operational or faulted state of the cell level equipment and if stations within that cell have an active fault.

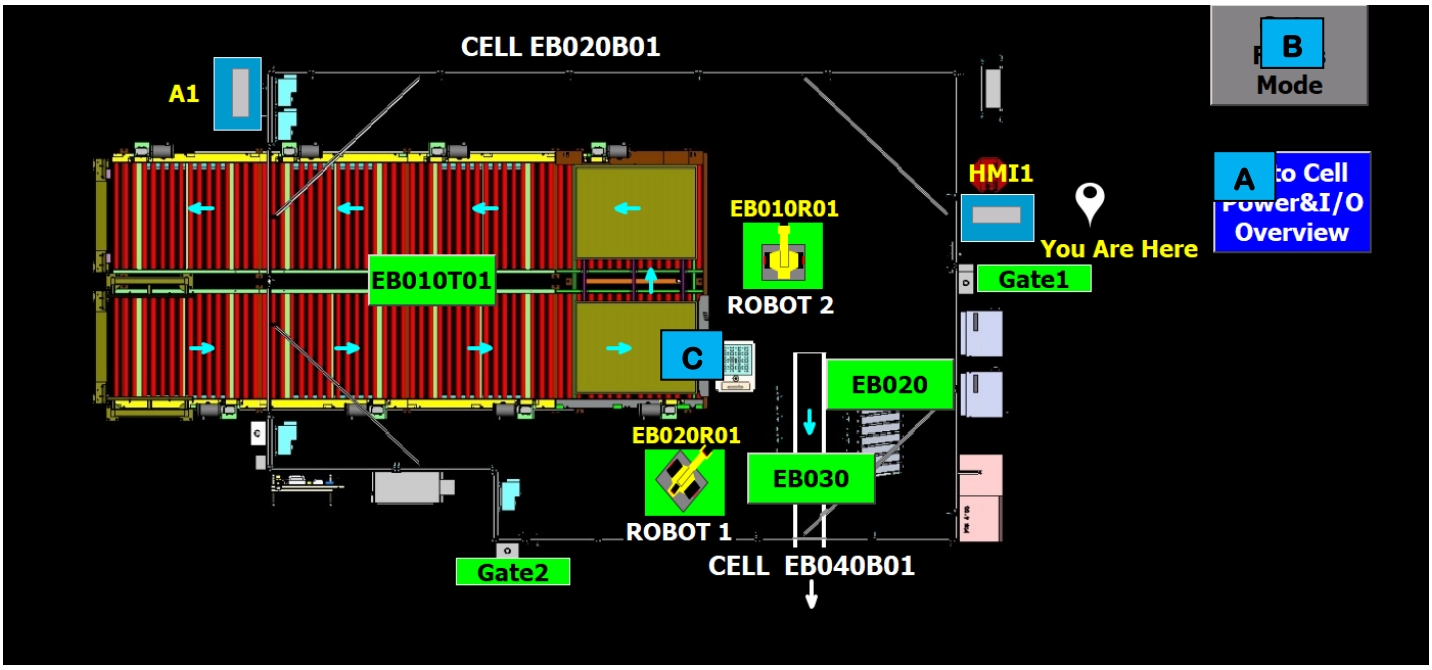


Figure 4-9. An illustration of an example Cell Overview screen.

Each Cell Overview screen features several areas of information and control, used as follows.

A This touch-button displays the Cell Power & I/O Overview screen.

B This indicator identifies the state of the cell control program. Green denotes the equipment is operational. Red denotes an active fault.
The indicator also serves as a button with multiple actions, depending on the screen set up. When `Goto Faults Mode` is active (blue button, touching the indicator displays the related fault message in the screen header. When `Goto Faults Mode` is inactive (gray button), touching the button navigates to the Station (Tool) Overview screen.

C Touch any of the buttons containing the name of a station to toggle the display to the associated area.

4.2.8. Cell Power & IO Overview Screen

Touching the **GOTO CELL POWER&IO OVERVIEW** button on the Cell Overview screen navigates directly to a screen (see *Figure 4-10*) that identifies the status of the cell power supplies and safe I/O blocks.

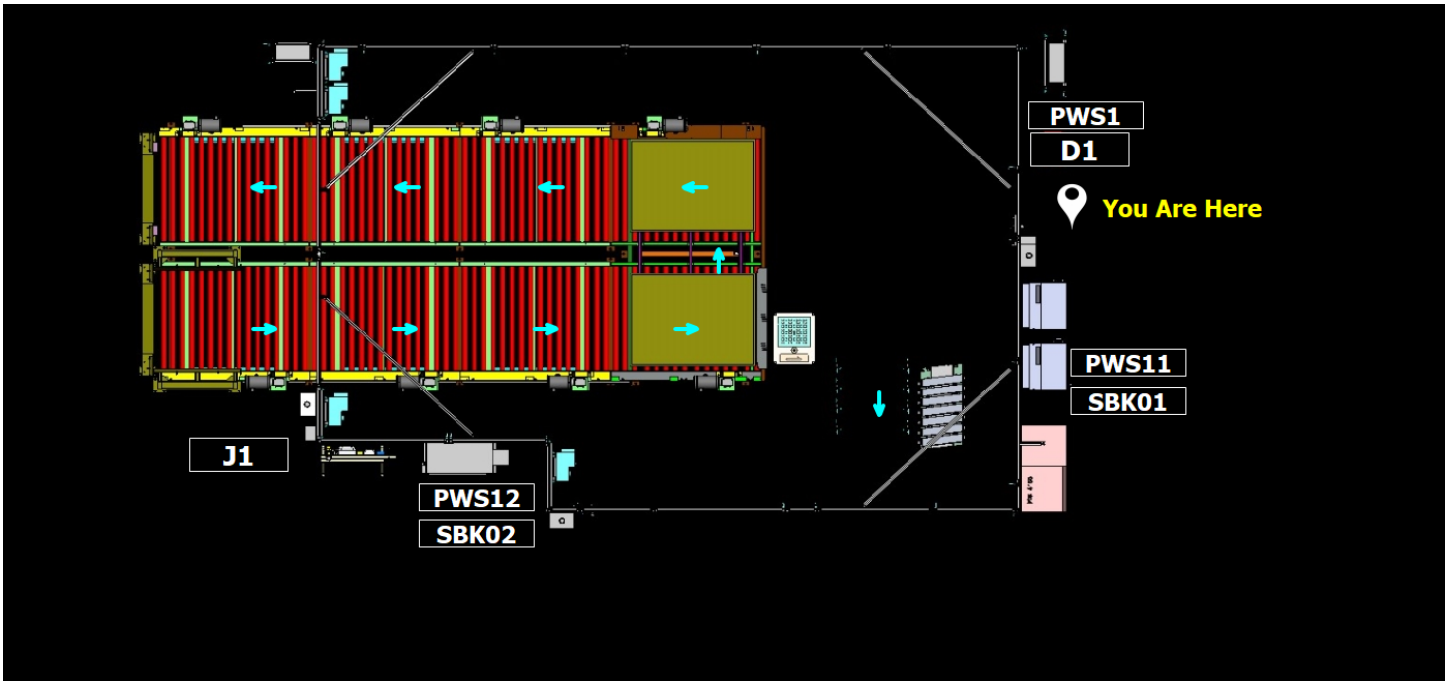


Figure 4-10. An illustration of an example Cell Power and I/O screen.

The screen is a display only. Black indicators identify a non-faulted state. Red indicators identify devices with power or other faults.

4.2.9. Station (Tool) Overview Screen

Touching the **STA OVERVIEW** button on the Select screen navigates directly to a screen (see ***Figure 4-11***) that displays station data.

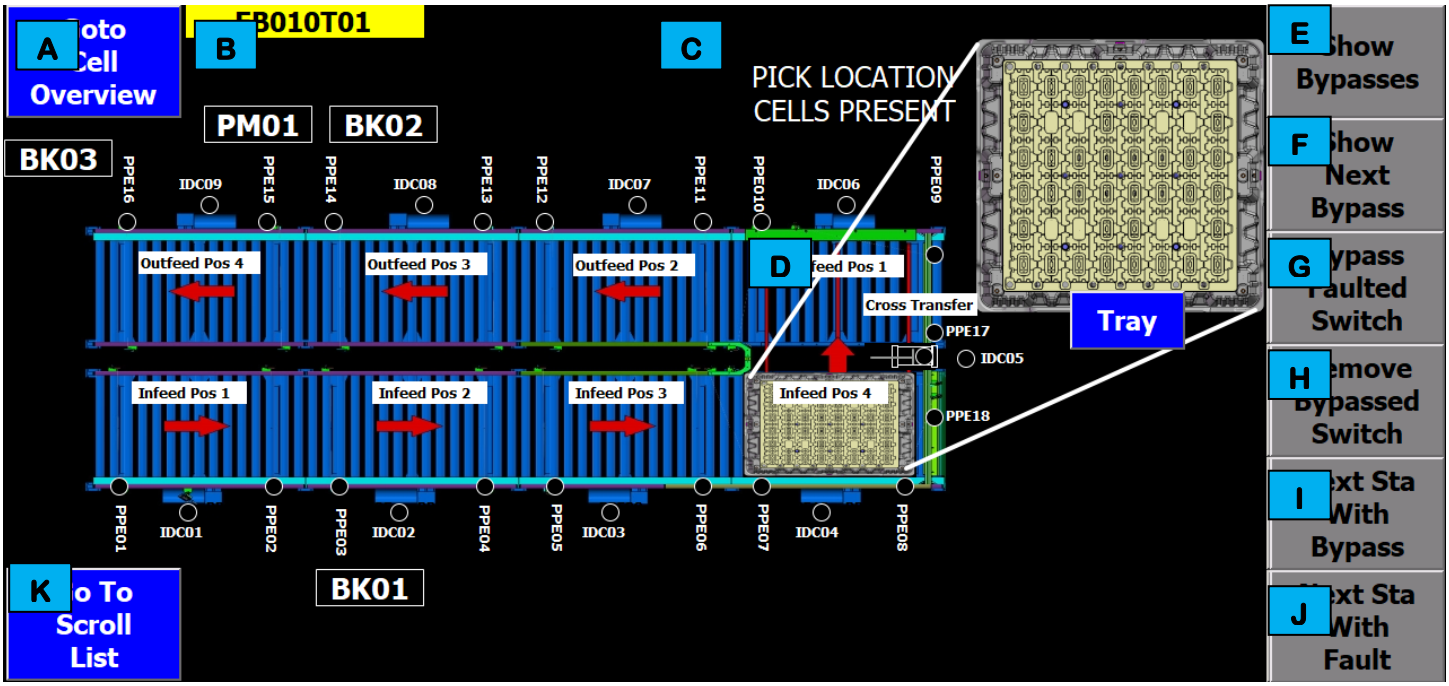


Figure 4-11. An illustration of an example Station Overview screen.

Each Station Overview screen features several areas of information and control, used as follows.

- **A** This touch-button displays a screen that provides a graphic representation (with state identifiers) of the area controlled by the PanelView HMI.
- **B** This indicator identifies which station is being displayed.
- **C** This indicator identifies the number of bypasses present. When no bypasses are present the indicator is not visible.
- **D** This area of the screen provides a graphical representation of the station. When an indicator is flashing red, the display is showing where the faulted device that is causing the currently displayed alarm message in the banner area is located.
- **E** This touch-button function changes depending on the presence of bypassed sensors. When the button is gray, none of the sensors on the station are bypassed. When the button is blue, it can be pressed to display the first bypassed sensor on the station. The accompanying alarm message will be shown in the alarm banner and the indicator in area **D** will illuminate red.
- **F** If more than one sensor is bypassed, this touch-button will cycle the screen display to show the next bypass.
- **G** If a faulted sensor has been configured in the PLC code as able to be bypassed, this touch-button will override the faulted device switch. The machine will default to the device fault timer for continued operation.
- **H** This touch-button removes an override from the displayed bypassed device switch.
- **I** This touch-button will select the next station with an active bypass. The Station Overview screen for the next station will replace the graphics shown for the currently selected Station Overview screen.
- **J** This touch-button selects the next station with an active alarm. The Station Overview screen for the next station will replace the graphics shown for the currently selected Station Overview screen.

K This touch-button opens a screen that can be used to determine mechanism states and manually actuate devices.

4.2.10. Scroll List Screen

Touching the **SCROLL LIST** button on the Select screen navigates directly to a screen (see ***Figure 4-12***) that identifies the current state of devices and provides the ability to manually actuate device functions within the selected station.

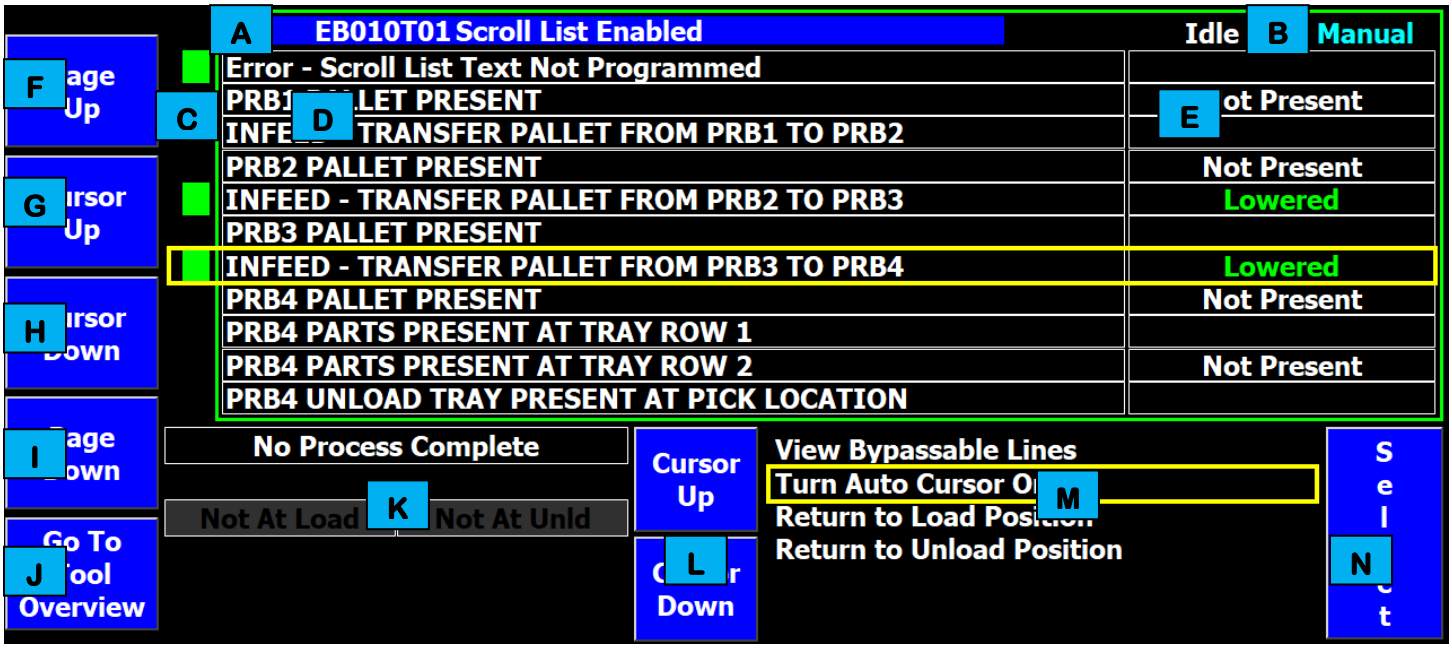


Figure 4-12. An illustration of an example Scroll List screen.

Each Scroll List screen features several areas of information and control, used as follows.

A This indicator identifies the selected station and if the scroll list is enabled (blue). When the scroll list is disabled, it will either prompt the operator (yellow) (area **D**) to re-enable the scroll list or display red, indicating another HMI has manual control of the station.

B These indicators identify the current state and mode of the station.
The program mode must be set to Manual for the screen to be operational.
The switch on the HMI cabinet must also be set to Manual.

C This row uses indicators to identify if a motion is clear (green) or is unavailable (black). Attempting to actuate a non-clear motion will display a prompt as to what tooling interference is restricting operation.

D This row lists the sequential actions for the station, one page at a time. A yellow box denotes the selected action. Use the touch-buttons on the left side of the screen [items **F** through **I**] for list navigation.

E This row identifies the current state of each action.

F This touch-button scrolls the action list [area **D**] up one page.

G This touch-button scrolls the action selector [top] upward one action.

H This touch-button scrolls the action selector [top] down one action.

I This touch-button scrolls the action list [area **D**] down one page.

J This touch-button displays the selected station Tool Overview screen.

K This area uses built-in and user-configurable indicators to identify the progress of the station cycle.

L These touch-buttons scroll the Scroll List Function List (bottom) selector up or down, one option at a time.

M This area lists the options for the selected action, one page at a time.

A yellow box denotes the selected function. Use the **SELECT** button [item **N**] to interface with the option (interface in top list).

N This touch-button chooses the selected function [item **M**].

4.2.11. EtherNet Overview Screen

Touching the **ETHERNET** button on the Select screen navigates directly to a screen (see ***Figure 4-13***) that identifies the current state of each EtherNet connection at the cell.

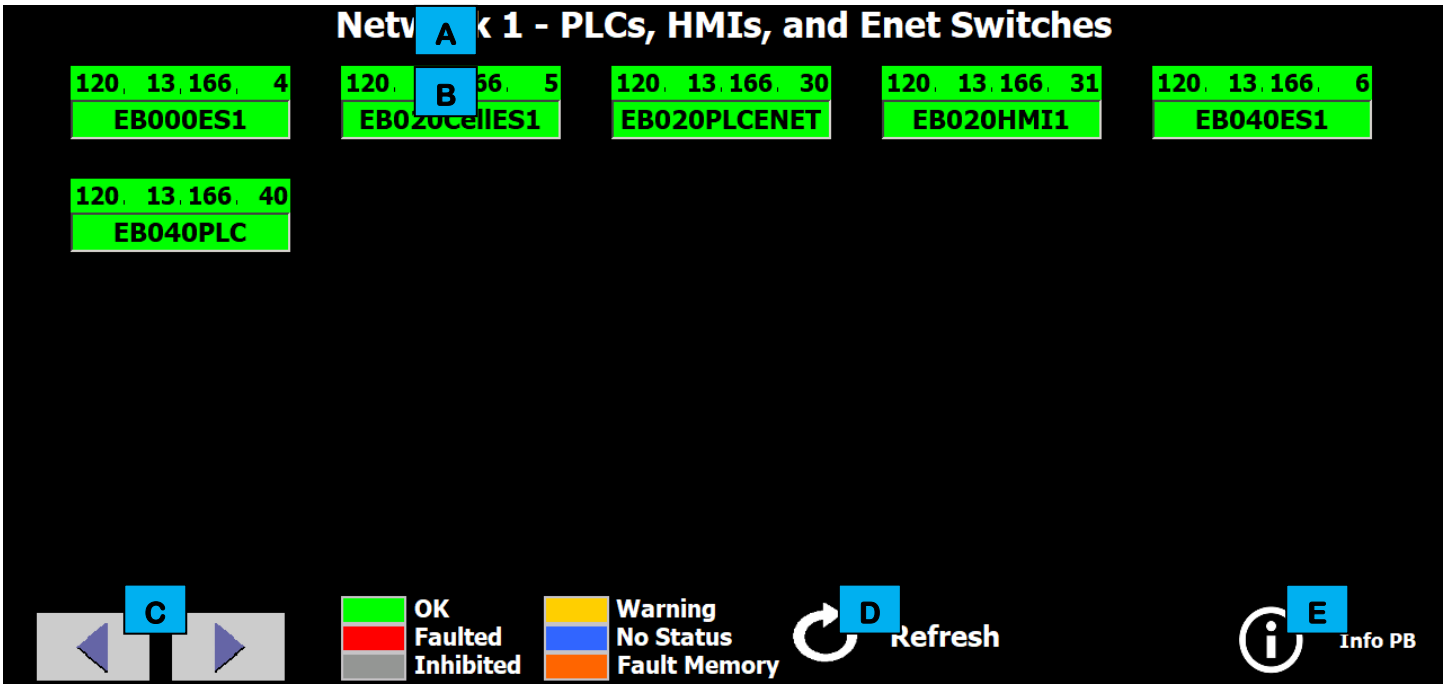


Figure 4-13. An illustration of an example EtherNet Overview screen.

Each EtherNet Overview screen features several areas of information and control, used as follows.

A This area of the screen identifies the EtherNet network currently displayed.

B Each device features a two-part indicator. The top of the indicator identifies the node number associated with the device. The bottom of the indicator identifies the device program name. The bottom of the screen identifies the meaning of each indicator color.
Touching a device displays a selection menu that provides access to the additional EtherNet screens (Device, Linear, Switch Port, and Switch).

C These buttons are used to scroll through the complete list of EtherNet device connections.

D This button refreshes the connection statuses.

E This button displays helpful information about the screen and buttons. Touching the button once displays the information fields. Touching the button again turns the information fields off.

4.2.12. EtherNet Device Screen

From the EtherNet Overview screen, touch an EtherNet device to display a popup menu. From the menu, touch the **SHOW DEVICE DETAILS** button. The EtherNet Device screen (see *Figure 4-14*) displays the detailed device status.

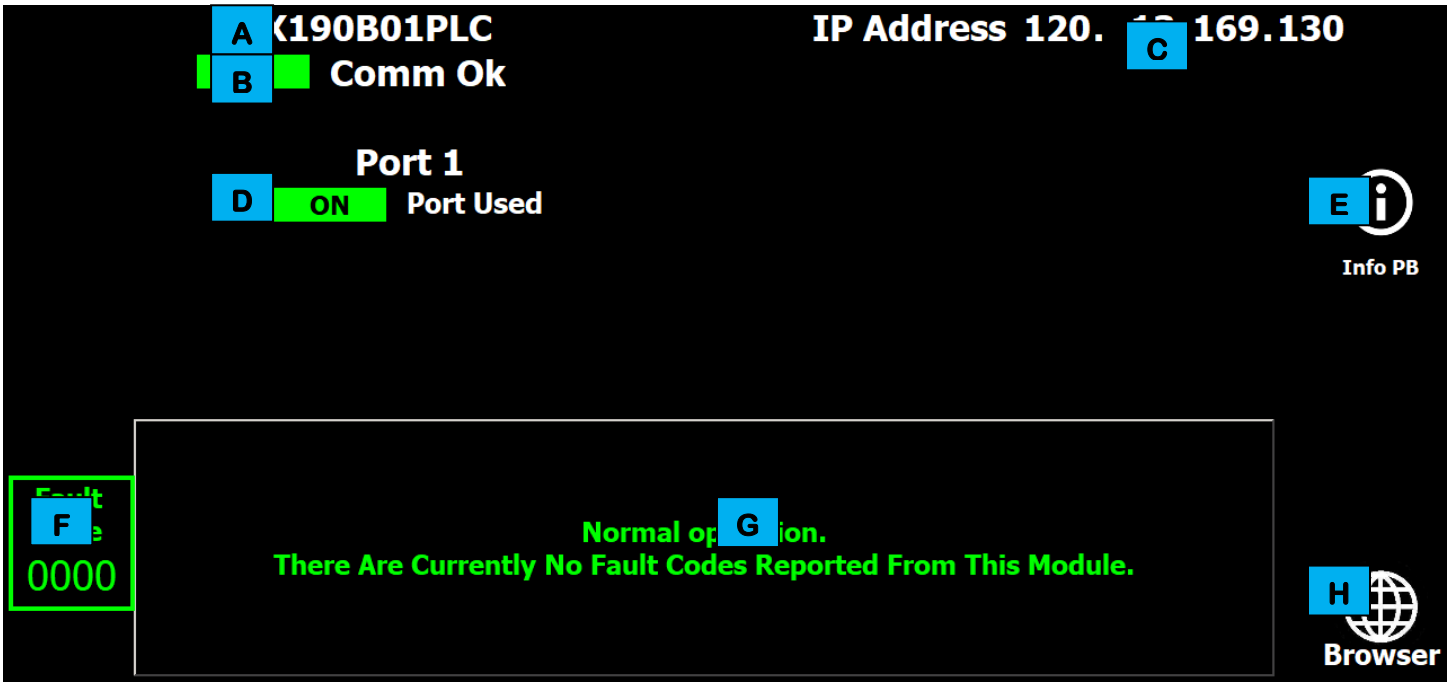


Figure 4-14. An illustration of an example EtherNet Device screen.

Each EtherNet Device screen features several areas of information and control, used as follows.

- **A** This field displays the device name.
- **B** This field displays the overall device status.
- **C** These fields display the device addresses.
- **D** These fields display the status of the ports.
- **E** This button displays helpful information about the screen and buttons. Touching the button once displays the information fields. Touching the button again turns the information fields off.
- **F** This field displays the current fault message code number.
- **G** This field displays the current fault message.
- **H** Some (but not all) devices have an internal web server. Touching this button provides access to that server.

4.2.13. EtherNet Linear Screen

From the EtherNet Overview screen, touch an EtherNet device to display a popup menu. From the menu, touch the **SHOW LINEAR NETWORK** button. The EtherNet Linear screen (see ***Figure 4-15***) displays devices as they are connected on the network.

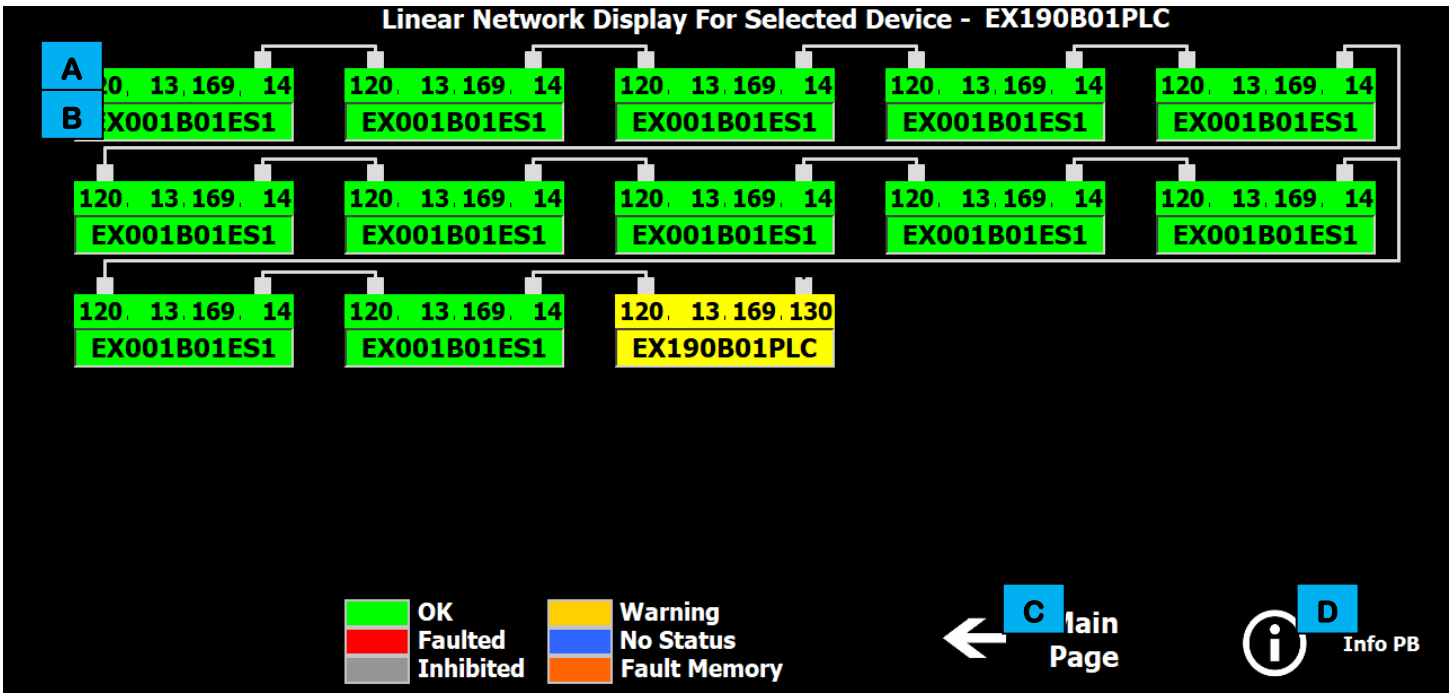


Figure 4-15. An illustration of an example EtherNet Linear screen.

Each EtherNet Linear screen features several areas of information and control, used as follows.

- **A** This field identifies the device IP address.
- **B** This field identifies the device name.
- **C** This button navigates back to the main page.
- **D** This button displays helpful information about the screen and buttons. Touching the button once displays the information fields. Touching the button again turns the information fields off.

4.2.14. EtherNet Switch Port Screen

From the EtherNet Overview screen, touch an EtherNet device to display a popup menu. From the menu, touch the **SHOW PORTS & DEVICES** button. The EtherNet Switch Port screen (see *Figure 4-16*) shows the switch port status with connected device status.

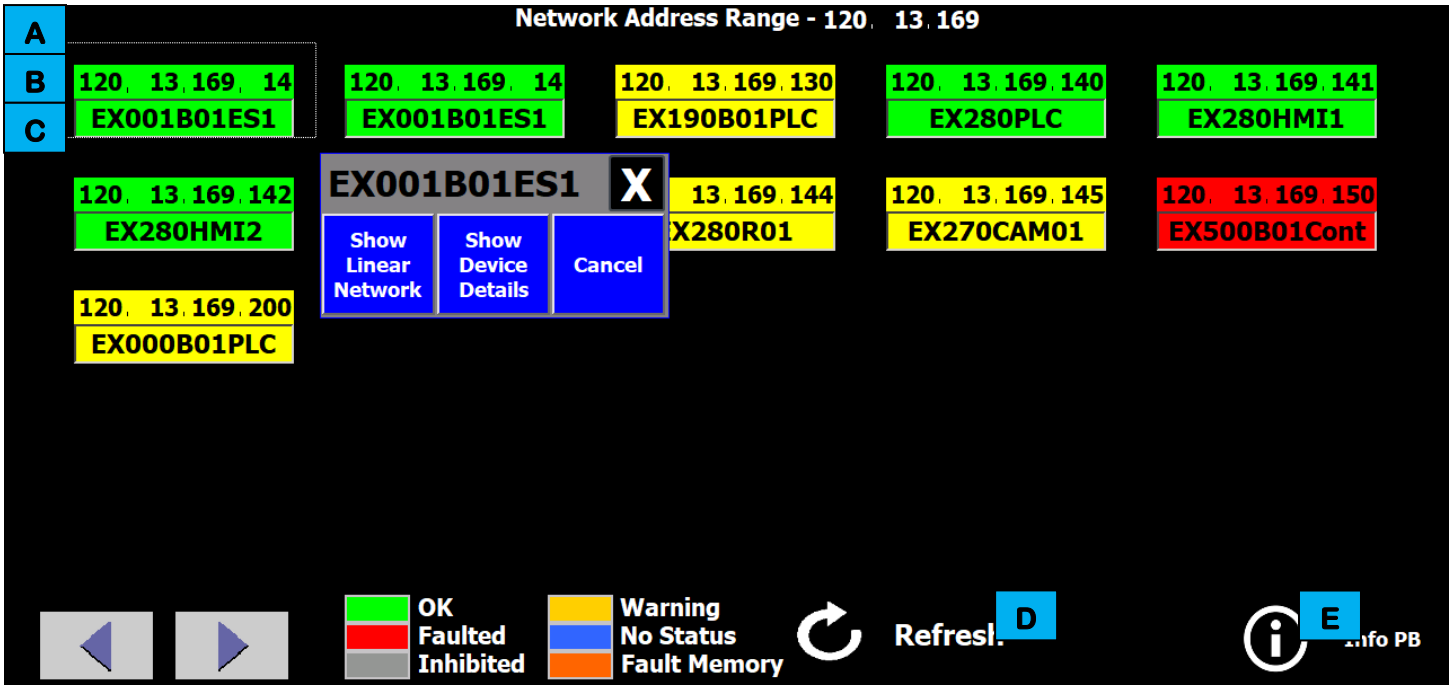


Figure 4-16. An illustration of an example EtherNet Switch Port screen.

Each EtherNet Switch Port screen features several areas of information and control, used as follows.

- **A** This field identifies the port that the device is attached to.
- **B** This field identifies the device IP address.
- **C** This field identifies the device name.
- **D** This button navigates back to the main page.
- **E** This button displays helpful information about the screen and buttons. Touching the button once displays the information fields. Touching the button again turns the information fields off.

4.2.15. Alarm Screen

Touching the **Alarm Screen** button on the Select screen navigates directly to a screen (see *Figure 4-17*) that identifies currently active alarms.

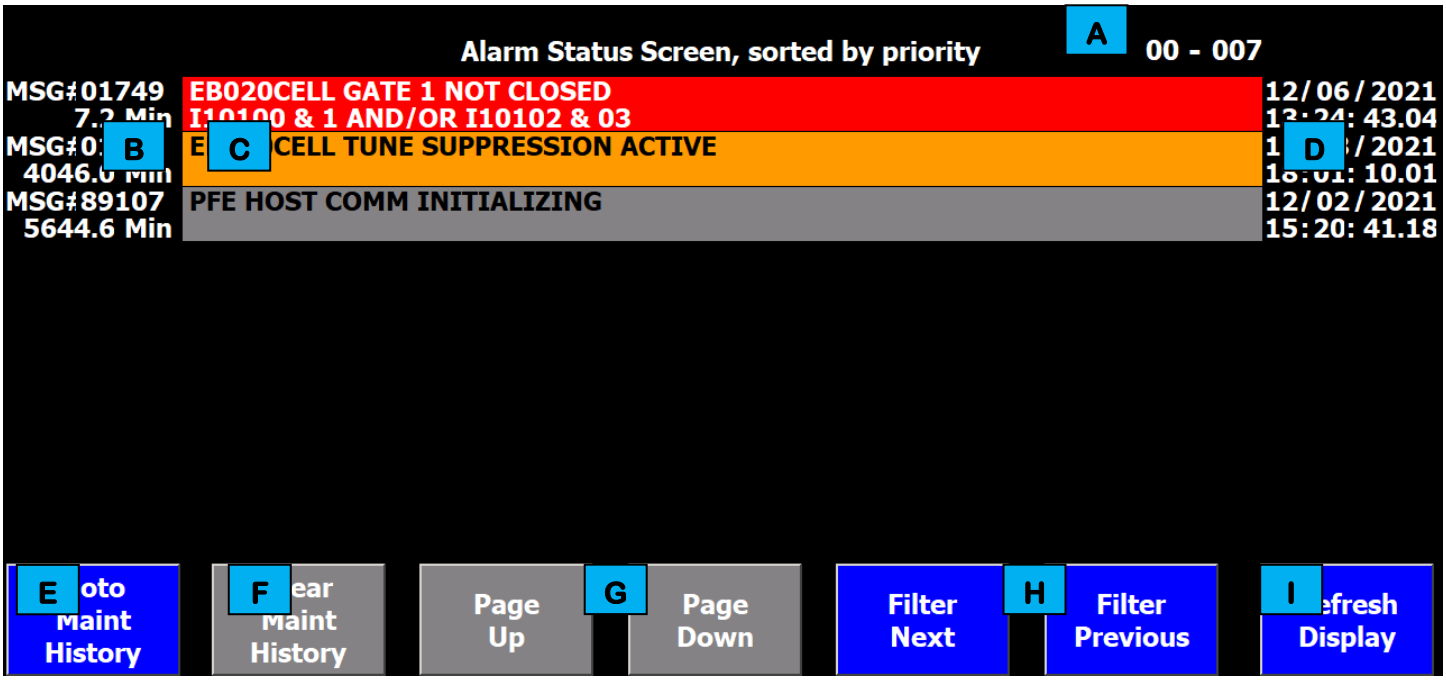


Figure 4-17. An illustration of an example Alarm screen.

Each Alarm screen features several areas of information and control, used as follows.

- **A** This area identifies the range of pages of alarm messages or if the PLC is regenerating the alarm list.
- **B** This area lists the alarm number associated with the message and the time elapsed since the alarm occurred.
- **C** This area lists the current alarm messages, with the highest priority at the top and descending in order.
- **D** This area lists the time and data of the alarm occurrence.
- **E** This touch-button opens a screen that displays past alarm messages.
- **F** This touch-button is not used on the active Alarm screen.
- **G** These touch-buttons scroll up or down through the list of alarms until the highest priority alarm is displayed first or the lowest priority alarm is displayed last.
- **H** These touch-buttons toggle filters used to sort the alarms listed.
- **I** This touch-button refreshes the messages on the screen to identify the highest priority alarm.

4.2.16. Maintenance History Screen

Touching the **GOTO MAINT HISTORY** button on the Alarm screen navigates directly to a screen (see ***Figure 4-18***) that lists alarms that have previously occurred.

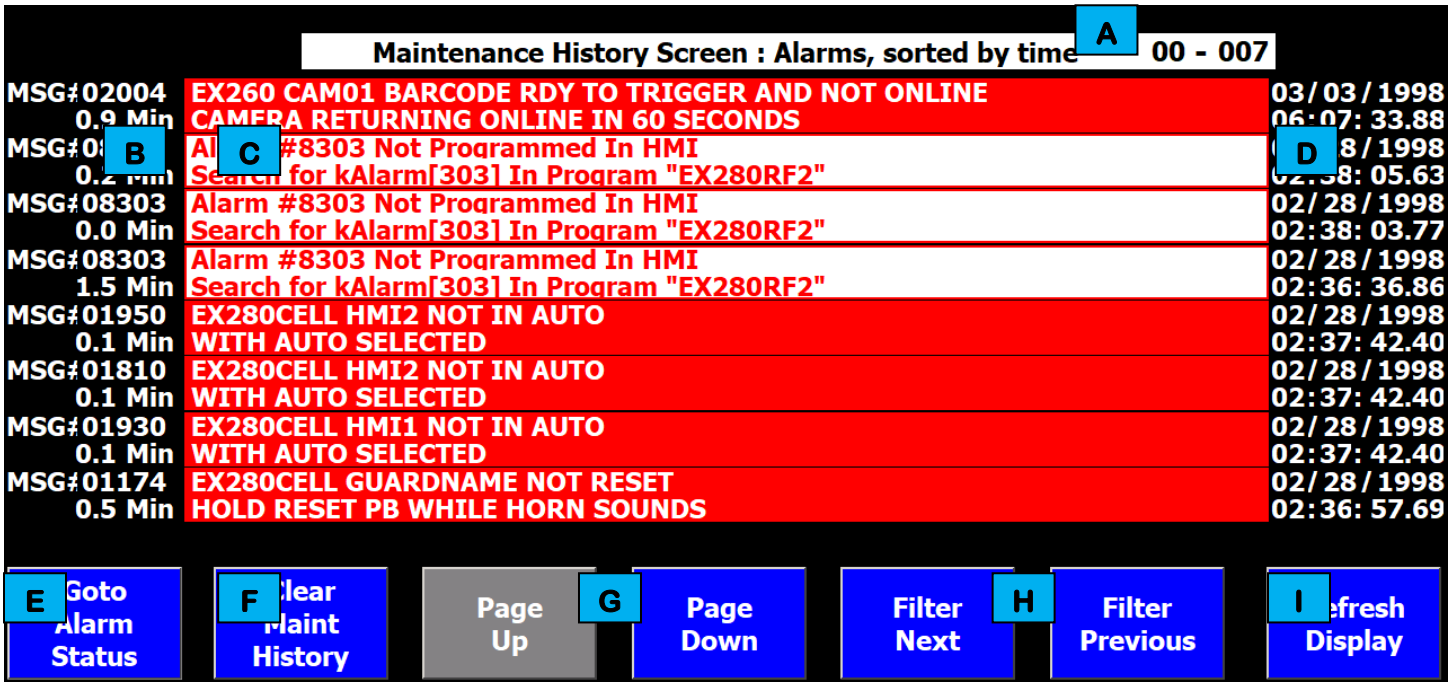


Figure 4-18. An illustration of an example Maintenance History screen.

Each Maintenance History screen features several areas of information and control, used as follows.

- **A** This area of the screen indicates historical alarms are being displayed, what filter is applied to the alarm messages, and what portion of the alarm history is being displayed. It also shows if the PLC is currently regenerating the alarm list.
- **B** This area of the screen lists the alarm number associated with the message and the time elapsed since the alarm occurred. Each alarm displayed on the screen has its own alarm number and elapsed time indicator.
- **C** This area of the screen lists the historical alarm messages, with the most recent at the top and descending in order. Up to eight messages can be displayed.
- **D** This area of the screen indicates when the alarm was initially active.
- **E** This touch-button returns to the active Alarm screen.
- **F** This touch-button erases the data on the Maintenance History screen (historical fault data).
- **G** These touch-buttons scroll up and down through the list of alarms (from oldest to most recent) until the newest alarm is displayed first.
- **H** These touch-buttons allow the historical alarms to be sorted by priority or time.
- **I** This touch-button refreshes the messages on the screen to identify the latest recovered alarms.

4.2.17. Throughput Overview Screen

Touching the **CYCLE TIME** button on the Select screen navigates directly to a screen (see ***Figure 4-19***) that displays data about the system cycle.

Figure 4-19. An illustration of an example Throughput Overview screen.

Each Throughput Overview screen features several areas of information and control, used as follows.

- **A** This touch-button opens a screen that provides more detailed cycle data for a single station.
- **B** This touch-button displays a dialog menu that allows the list to display for all types or for a specific type. Touch the **CLOSE** button in the dialog to close the menu.
- **C** This touch-button toggles the data fields (items **M**, **N**, and **O**) to display either the current cycle data or the last cycle data.
- **D** This touch-button resets the data on the screen.
- **E** This column identifies the programmed cycle times.
- **F** This column identifies the station names.
- **G** This column identifies the type of part (toggled by the **SELECT TYPE** button).
- **H** This column identifies the quantity produced.
- **I** This column identifies the number of minutes of faulted system downtime.
- **J** This column identifies the number of minutes of faulted station downtime.
- **K** This column identifies the average cycle time.
- **L** This column identifies the current status.
- **M** This column identifies the current/last type of part.
- **N** This column identifies the current/last cycle time.
- **O** This column identifies the current/last wait time.

4.2.18. Station Throughput Screen

Touching the **STATION TPUT** button on the Throughput Overview screen navigates directly to a screen (see ***Figure 4-20***) that displays detailed production data for a specific station.

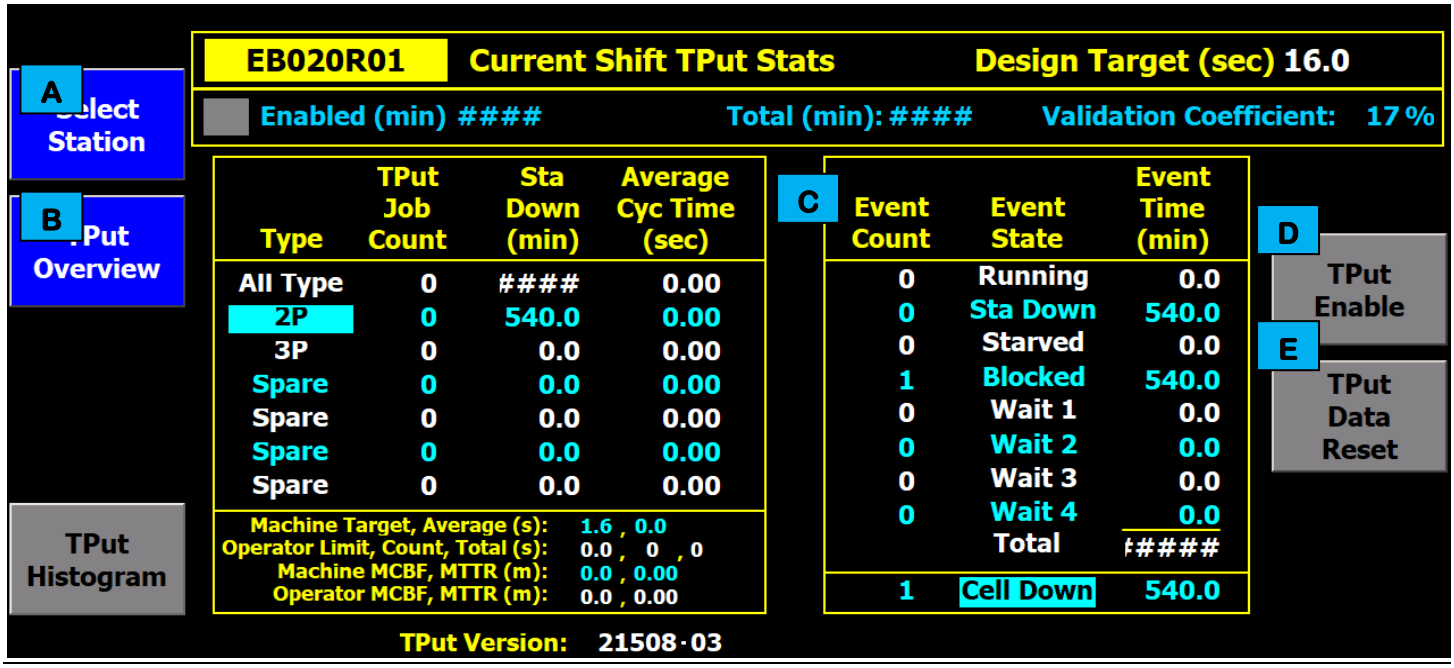


Figure 4-20. An illustration of an example Station Throughput screen.

Each Station Throughput screen features several areas of information and control, used as follows.

- **A** This touch-button changes the station currently displaying data.
- **B** This touch-button returns to the Throughput Overview screen.
- **C** This area of the screen displays detailed production statistics.
- **D** This touch-button toggles the station data collection on or off.
- **E** This touch-button resets the station data on the screen.

4.2.19. Style Overview Screen

Touching the **STYLE OVERVIEW** button on the Select screen navigates directly to a screen (see ***Figure 4-21***) that displays style data. Touch the **EDIT** button to change a part number as needed. Refer to your company operating procedures for the proper use of this screen.

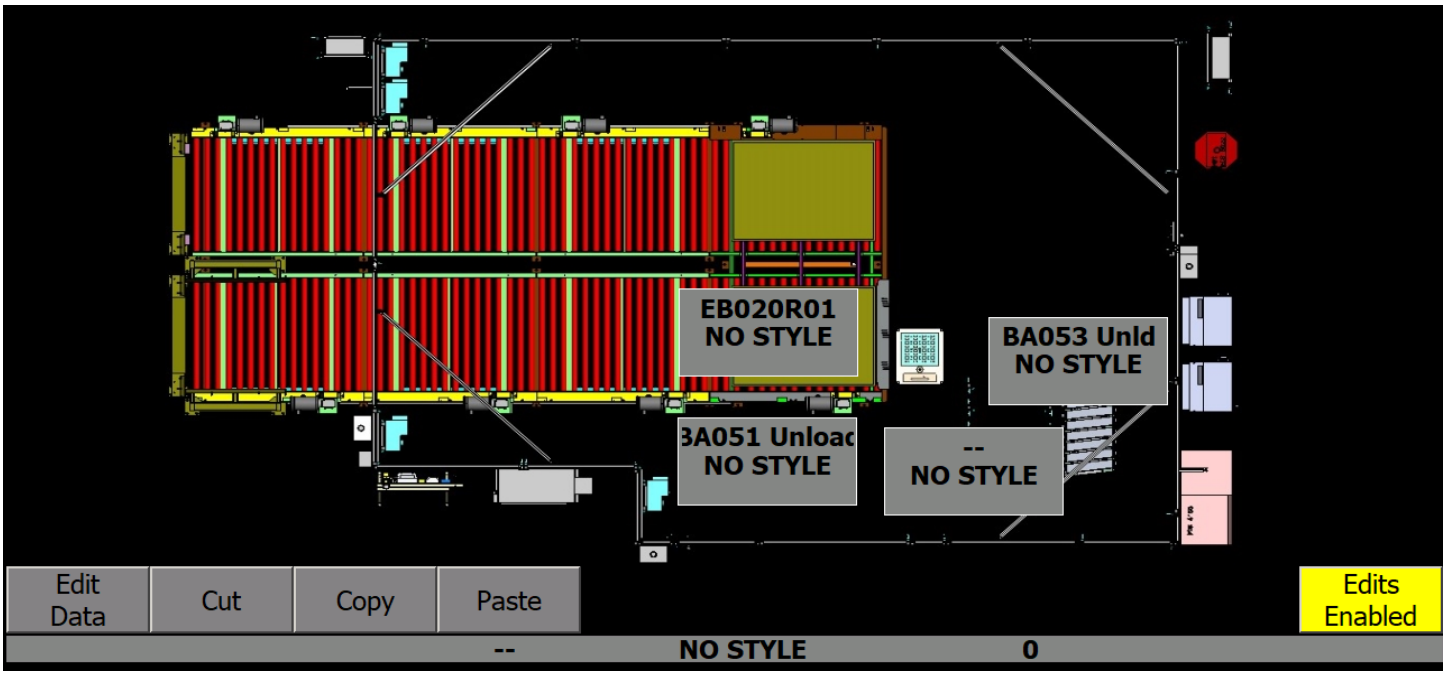


Figure 4-21. An illustration of an example Style Overview screen.

4.2.20. Signature Screen

Touching the **SIGNATURE** button on the Select screen navigates directly to a screen (see ***Figure 4-22***) that identifies the status of the safety-type devices associated with the cell. Refer to your company operating procedures for more

information about this screen. The signature will come from the PLC program, from there you will either use the “Use Current Signature” or the “Use Current Device Signature”, Then press the “Do” button to set your signature.

Figure 4-22. An illustration of an example Signature screen.

4.2.21. Robot Screen

Touching the **ROBOT** button on the Select screen navigates directly to a screen (see *Figure 4-23*) that provides interface with the cell robot(s).

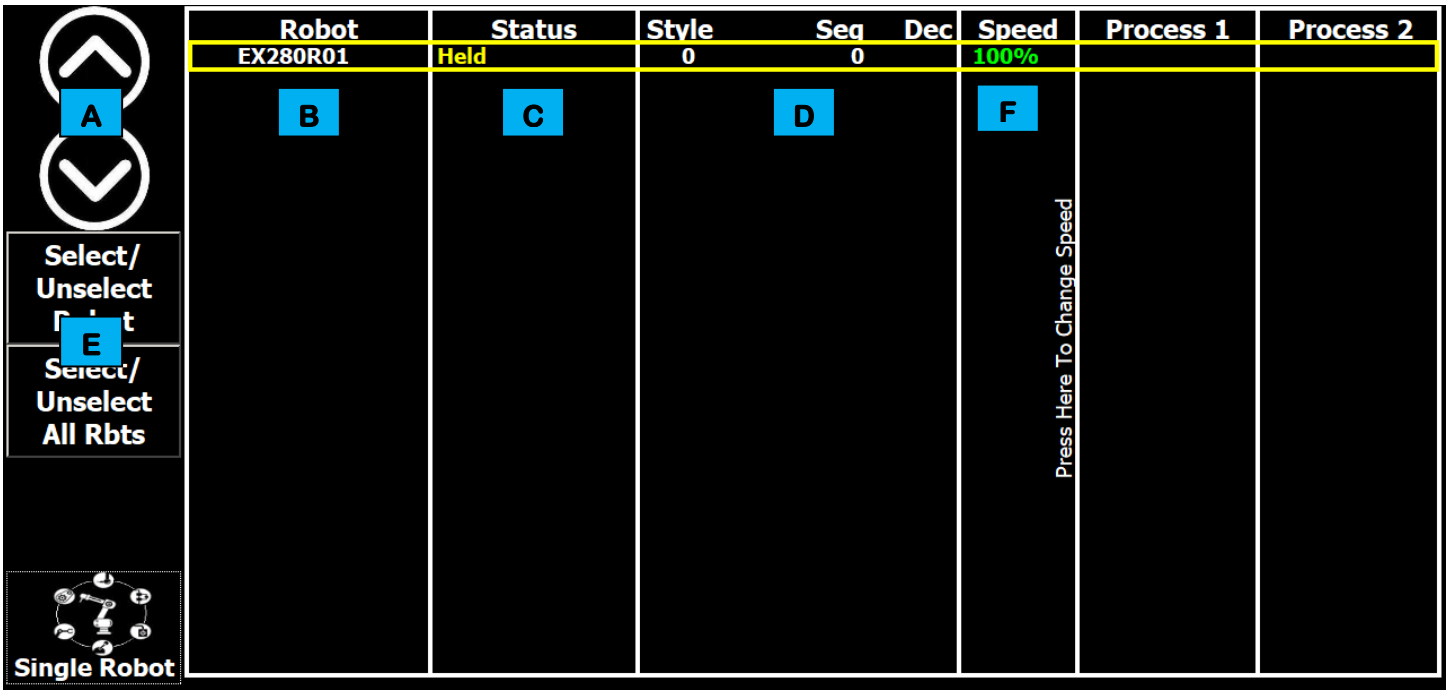


Figure 4-23. An illustration of an example Robot screen.

Each Robot screen features several areas of information and control, used as follows.

- **A** These touch-buttons scroll the robot selection field up or down.
- **B** These fields identify the robot names.
- **C** These fields identify the robot status, such as: `At Home`, or `Held`.
- **D** These fields identify the robot style and the motion segment the robot is in (where the robot is).
- **E** These touch-buttons select or de-select the robot.
- **F** This field is used to change the speed of the robot on the HMI by touching it you can change the speed.

4.2.22. Servo/VFD Screen

Touching the **SERVO/VFD** button on the Select screen navigates directly to a screen (see ***Figure 4-24***) that provides interface with the cell servo motor.

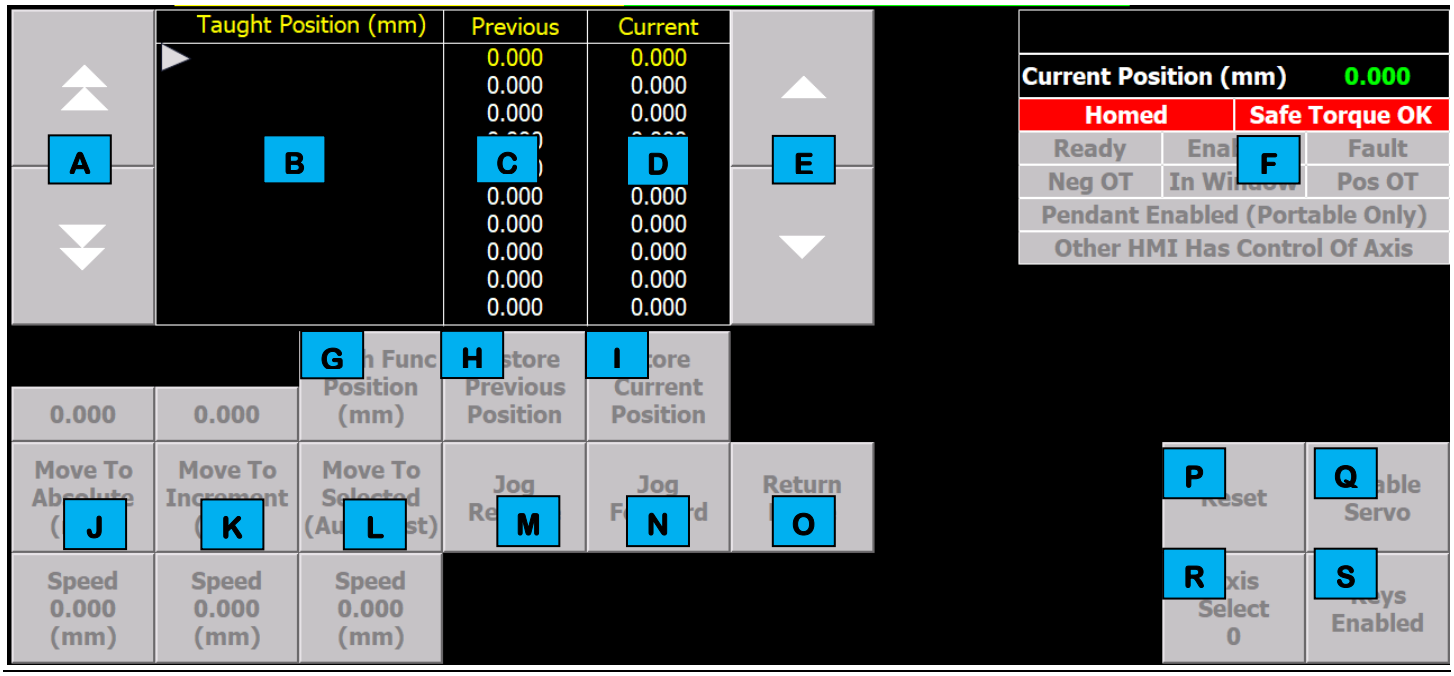


Figure 4-24. An illustration of an example Servo/VFD screen.

Each Servo/VFD screen features several areas of information and control, used as follows.

- **A** These buttons move the position selector (▶) up and down the list of positions (**B**), one page at a time.
- **B** This area of the screen lists the taught servo motor positions. The currently selected position is identified with a right arrow (▶).
- **C** This area of the screen lists the last stored coordinate for each servo motor position.
- **D** This area of the screen lists the current coordinate for each servo motor position.
- **E** These buttons move the position selector (▶) up and down the list of positions (**B**), one line at a time.
- **F** These indicators identify the Servo motor status.
- **G** This button scrolls through the settings that can be taught (position, speed, acceleration deceleration).
- **H** This button restores the settings to the previously taught setting (the value as it appears in Column **C**).

I This button saves the live coordinate as the stored coordinate for the selected servo motor position (in area **B**). Press the DO button on the HMI for confirmation.

J This area of the screen provides the ability to move the servo motor to a specific coordinate. Touch the field to manually enter a specific coordinate. Touch the **MOVE TO ABSOLUTE** button to force the servo motor to move the entered coordinate. Press the DO button on the HMI to complete the move.

K This area of the screen provides the ability to move the servo motor in specific increments. Touch the field to manually enter a specific increment amount. Touch the **MOVE TO INCREMENT** button to force the servo motor to move only the amount manually entered. Press the DO button on the HMI to complete the move.

L This touch-button sends the servo motor to the stored coordinate of the currently selected position (in area **B**). Press the DO button on the HMI to complete the move.

M This touch-button jogs the servo motor backward. The servo motor jogs for the duration that the button is held. Press the DO button on the HMI to complete the move.

N This touch-button jogs the servo motor forward. The servo motor jogs for the duration that the button is held. Press the DO button on the HMI to complete the move.

O This touch-button sends the servo motor to the stored home position (when the button is blue (enabled)). Press the DO button on the HMI to complete the move.

P This touch-button resets the servo motor after a fault (when the button is blue (enabled)).

Q This touch-button enables or disables the servo motor power (when the button is blue (enabled)).

R This touch-button toggles which servo motor is controlled. Touching the button changes the selection between servo axis 1 and servo axis 2.

S This touch-button toggles control of the servo motor. When the button is gray, the servo motor is under automatic control and is directed by the processor. Touching the button enables the screen buttons and removes auto mode from the servo.

4.2.23. Service Screen

Touching the **SERVICE** button on the Select screen navigates directly to a screen (see *Figure 4-25*) that can be used to manually interface with the cell cycle and process equipment.

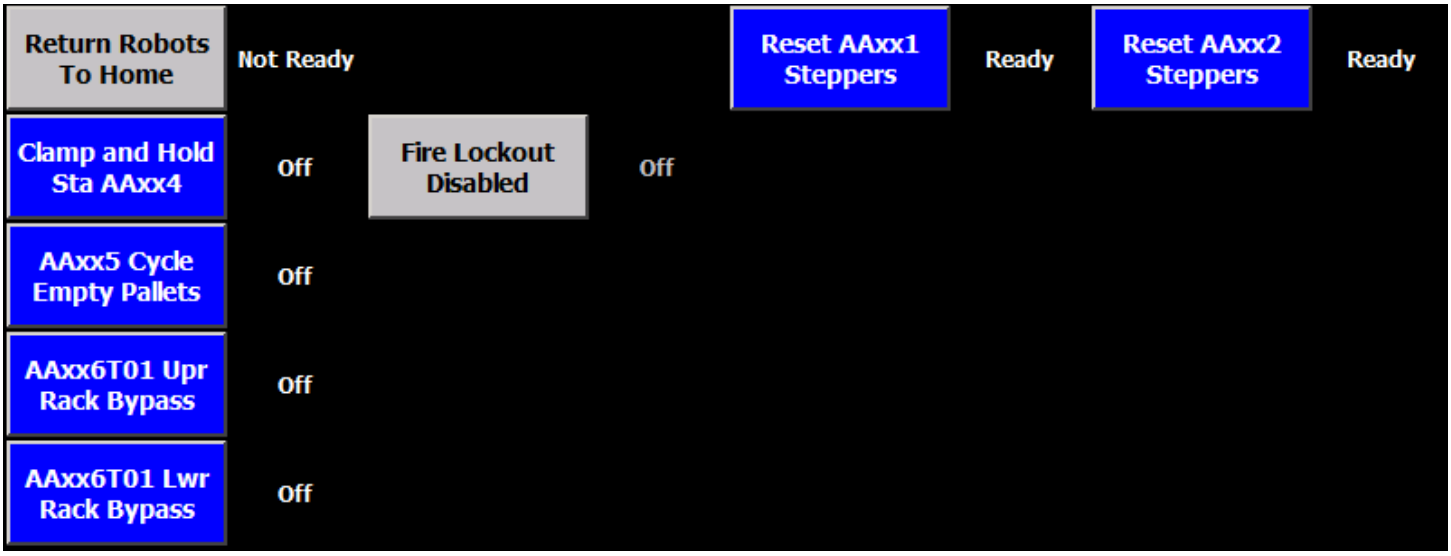


Figure 4-25. An illustration of an example Service screen.

4.2.24. PMP Screen

Touching the **PMP** button on the Select screen navigates directly to a screen (see ***Figure 4-26***) that displays many operator interface options.

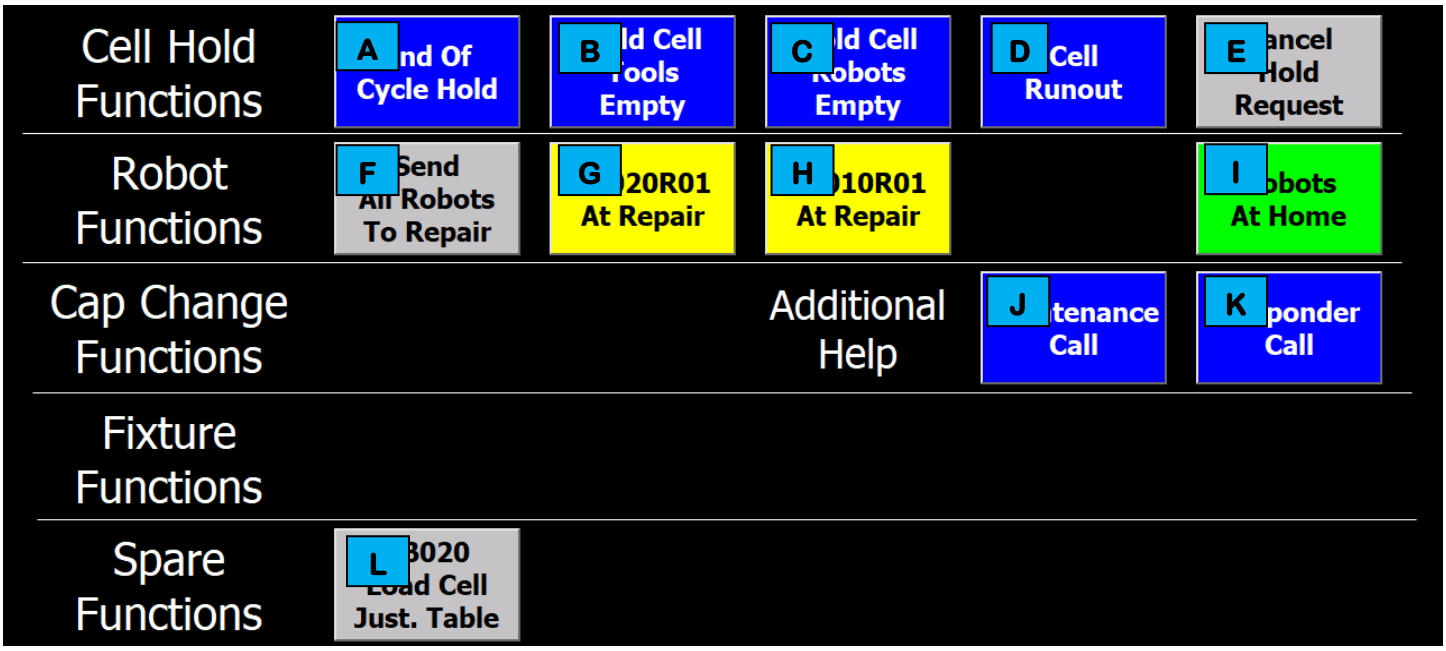


Figure 4-26. An illustration of an example PMP screen.

The PMP screen features several areas of information and control, used as follows.

- **A** Place the Cell into End of Cycle Hold – stop all processes when robots have finished the current cycle and are empty
- **B** Stop all processes when the tools are empty
- **C** Stop all processes when robots are empty
- **D** Finish processing current parts then stop the cell
- **E** Cancel any hold request – return to auto mode
- **F** Send all robots to their repair position – used if maintenance is needed on a robot
- **G** Status of if EB020R01 is at the repair position or not
- **H** Status of if EB010R01 is at the repair position or not
- **I** Status of if all robots are at home or not
- **J** Call for maintenance
- **K** Call for a responder
- **L** Alert the cell that parts have been hand loaded to the justification table

4.2.25. Supertrak Screen

Touching the **SUPERTRAK** button on the Select screen navigates directly to a screen (see *Figure 4-27*) that shows the SuperTrak pallet status.

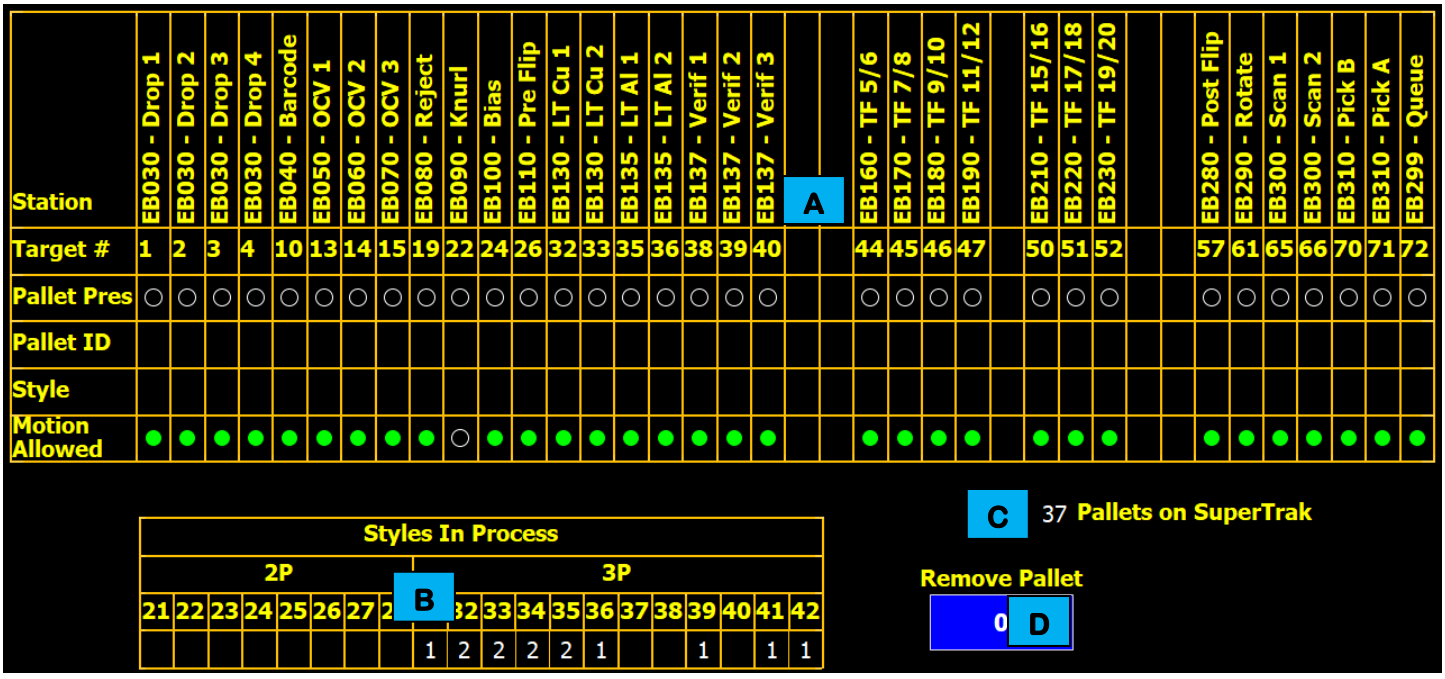


Figure 4-27. An illustration of an example SuperTrak screen.

The SuperTrak screen features several areas of information and control, used as follows.

- **A** Current pallet status
- **B** Cell styles
- **C** Quantity of pallets on the SuperTrak.
- **D** Allows pallet ID and associated data to be cleared from the SuperTrak.

4.2.26. Rejects Screen

Touching the **REJECTS** button on the Select screen navigates directly to a screen (see ***Figure 4-28***) that displays the last 10 rejected parts unloaded from the SuperTrak.

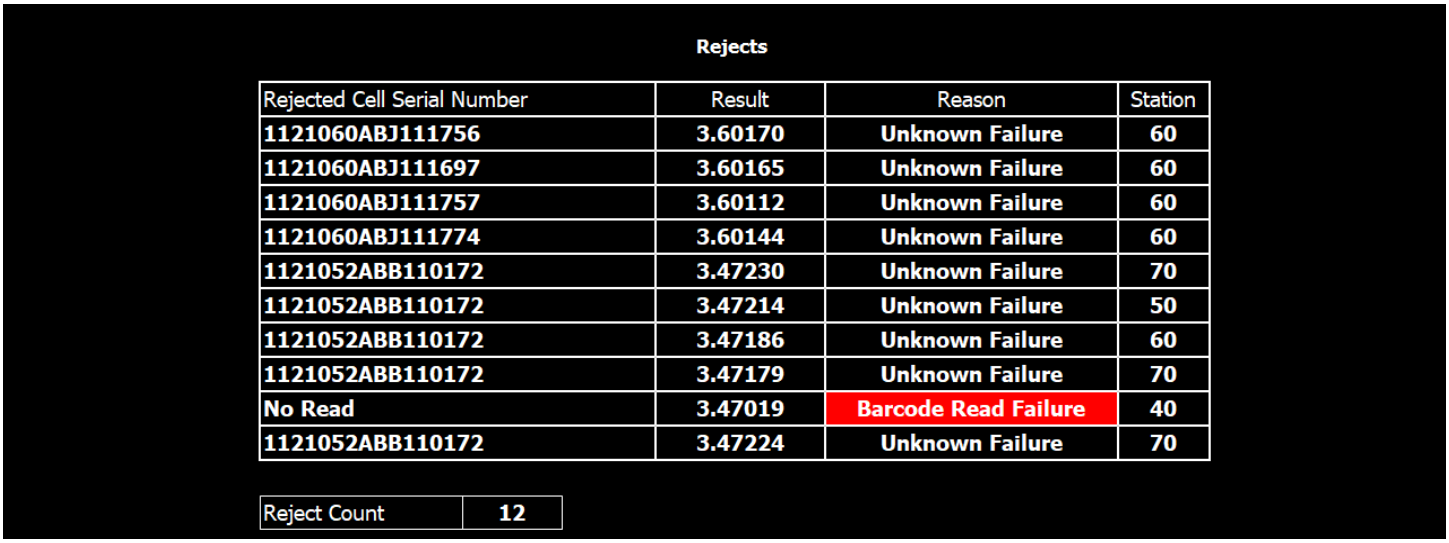


Figure 4-28. An illustration of an example Rejects screen.

This screen is read only.

4.2.27. Camera Bar Code Image Screen

Touching the **CAMERA IMAGE** button on the Barcode screen navigates directly to a screen (see ***Figure 4-29***) that displays the last image taken by the barcode camera.

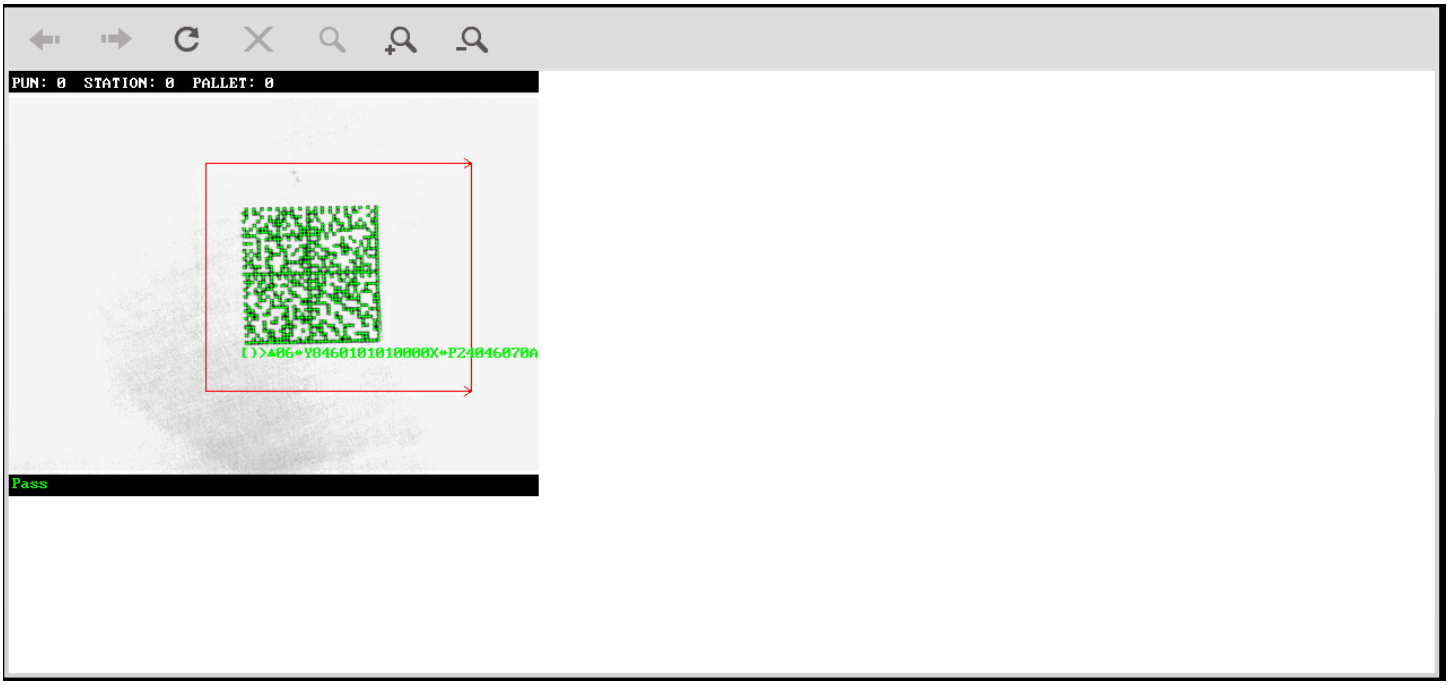


Figure 4-29. An illustration of an example Camera Bar Code Image screen.

This screen has no functions and is read only.

4.2.28. OCV Check Screen

Touching the **OCV CHECK** button on the Select screen navigates directly to a screen (see ***Figure 4-30***) that displays the OCV control.

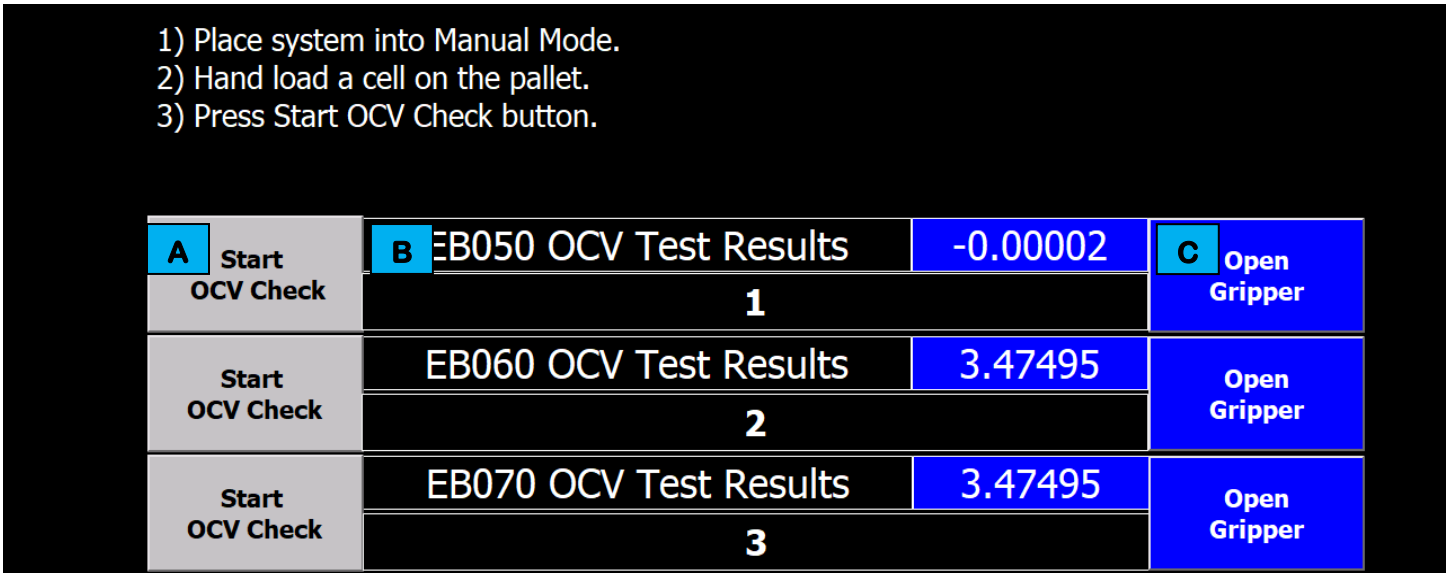


Figure 4-30. An illustration of an example OCV Check screen.

The OCV Check screen features several areas of information and control, used as follows.

- **A** Initiate an OCV test
- **B** Displays OCV test results
- **C** Open the grippers to gain access to the part

4.2.29. Table Data Screen

Touching the **TABLE DATA** button on the Select screen navigates directly to a screen (see *Figure 4-31*) that **DISPLAYS CURRENT READ ONLY STATUS OF PARTS ON THE RESEQUENCING TABLE.**

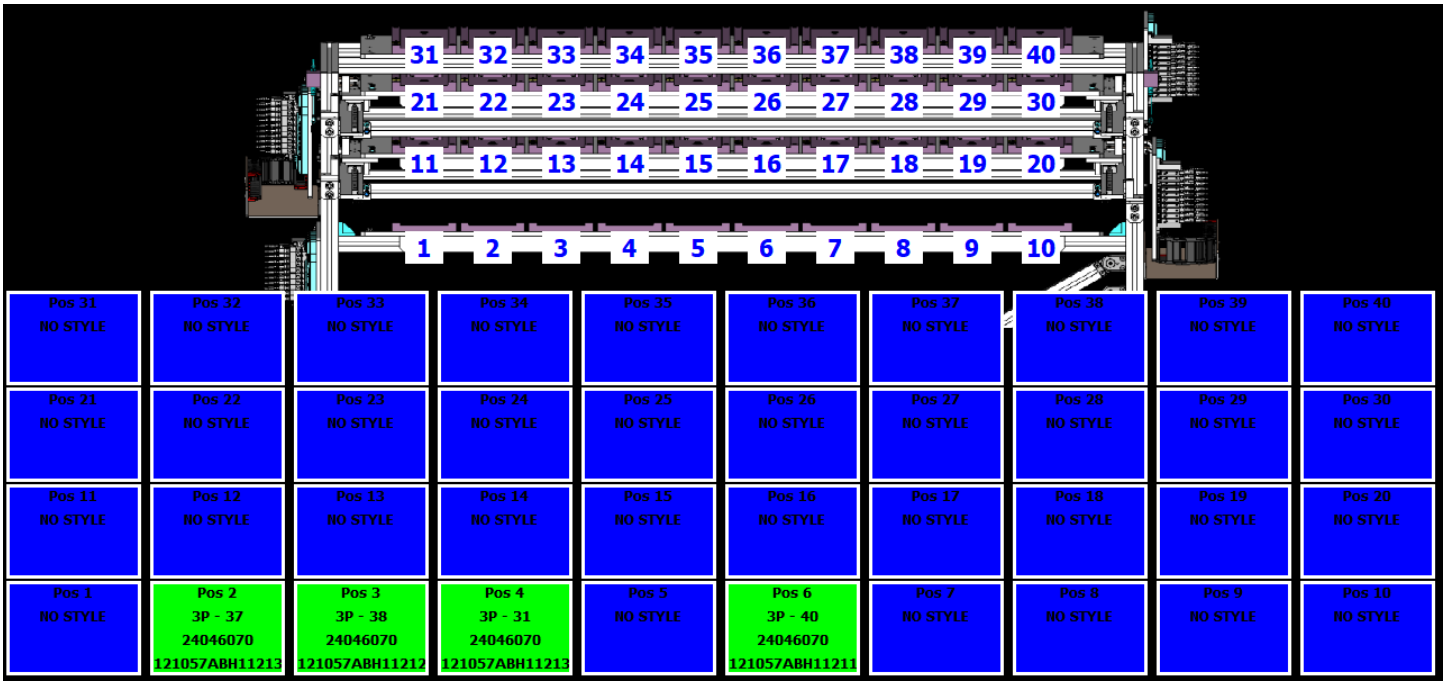


Figure 4-31. An illustration of an example Table Data screen.

Read only.

4.2.30. Barcode Screen

Touching the **BARCODE** button on the Select screen navigates directly to a screen (see ***Figure 4-32***) that displays barcode data.

Figure 4-32. An illustration of an example Barcode screen.

The **BARCODE** screen features several areas of information and control, used as follows.

A Navigates to the **CAMERA BARCODE IMAGE** screen discussed in ***Section 4.2.27***

B Triggers a single barcode read and displays the read data

4.2.31. Nest Data Screen

Touching the **NEST DATA** button on the Select screen navigates directly to a screen (see ***Figure 4-33***) that displays read only data for the stack selected on the stacking dial.

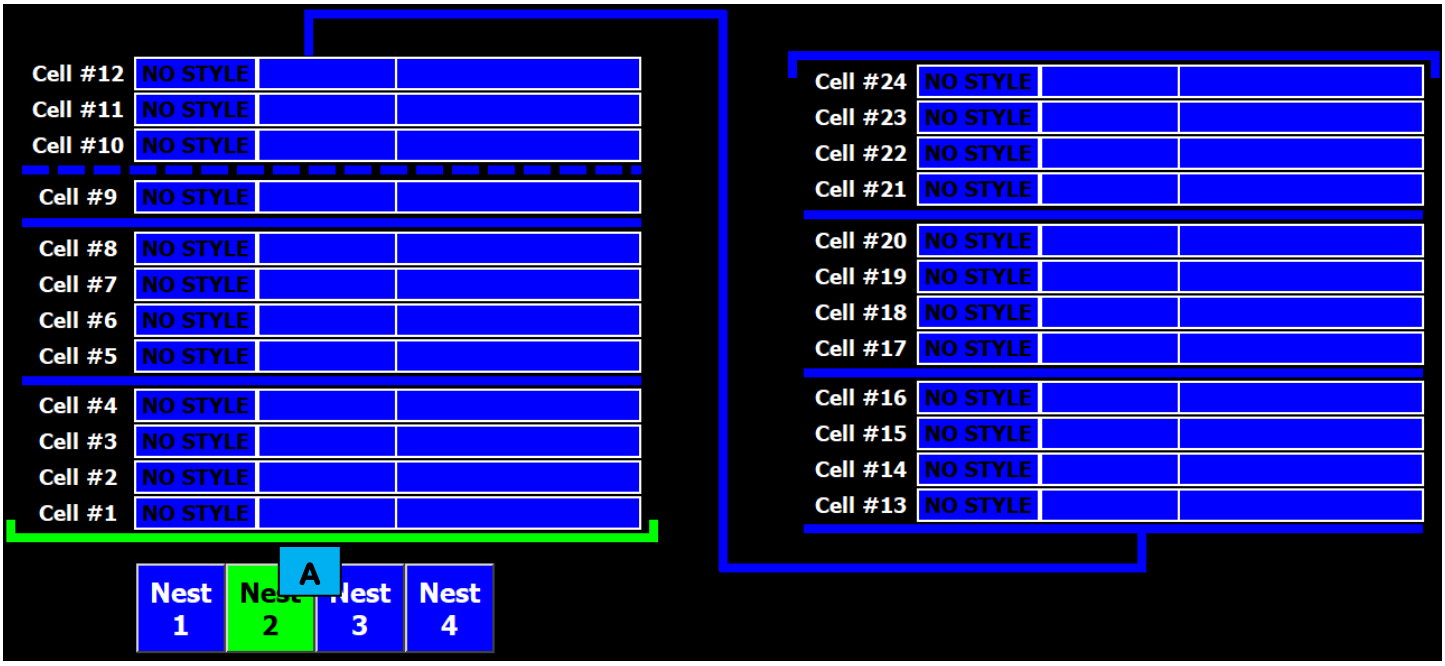


Figure 4-33. An illustration of an example Nest Data screen.

This screen provides read only data for the nest currently being loaded with cells. The active nest is highlighted in green at the bottom of the screen (**A**).

4.2.32. Camera/Print Screen

Touching the **BARCODE** button on the Select screen navigates directly to a screen (see ***Figure 4-34***) that brings the user to the barcode screen.

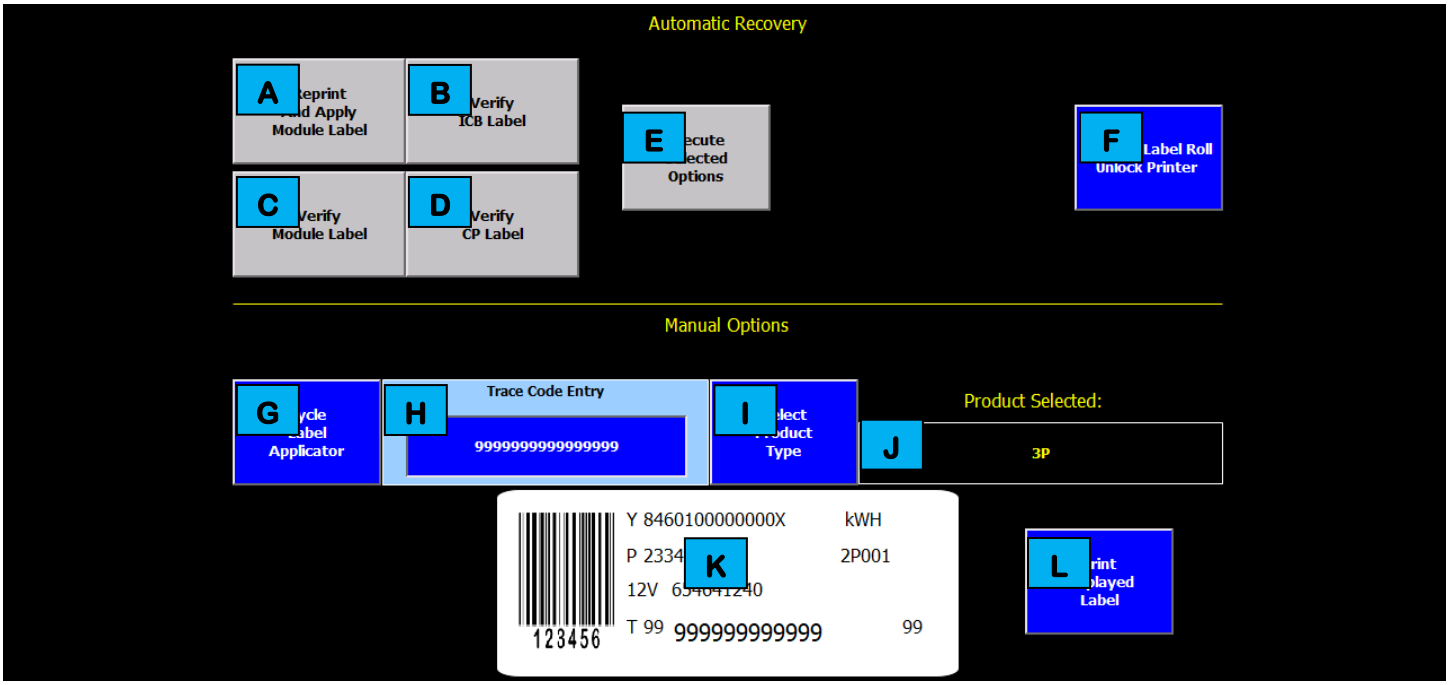


Figure 4-34. An illustration of an example Camera/Print screen.

The Rejects screen features several areas of information and control, used as follows.

- **A** This button is used to reprint the Label and Apply it
- **B** This button is used to verify the ICB Label
- **C** This button is used to verify the Module Label.
- **D** This button is used to verify the CP Label.
- **E** This button is used to execute the selected options
- **F** This button is used to unlock the printer and allow the Label roll to be changed.
- **G** This is the Cycle Label Applicator
- **H** This is the where the trace code is shown.
- **I** This button is used to select different product types.
- **J** This is where you see the selected product
- **K** This is the displayed label.
- **L** This prints the displayed label.

4.2.33. TIM/Press Screen

Touching the **VISION** button on the Select screen navigates directly to a screen (see ***Figure 4-35***) that displays the options for vision.

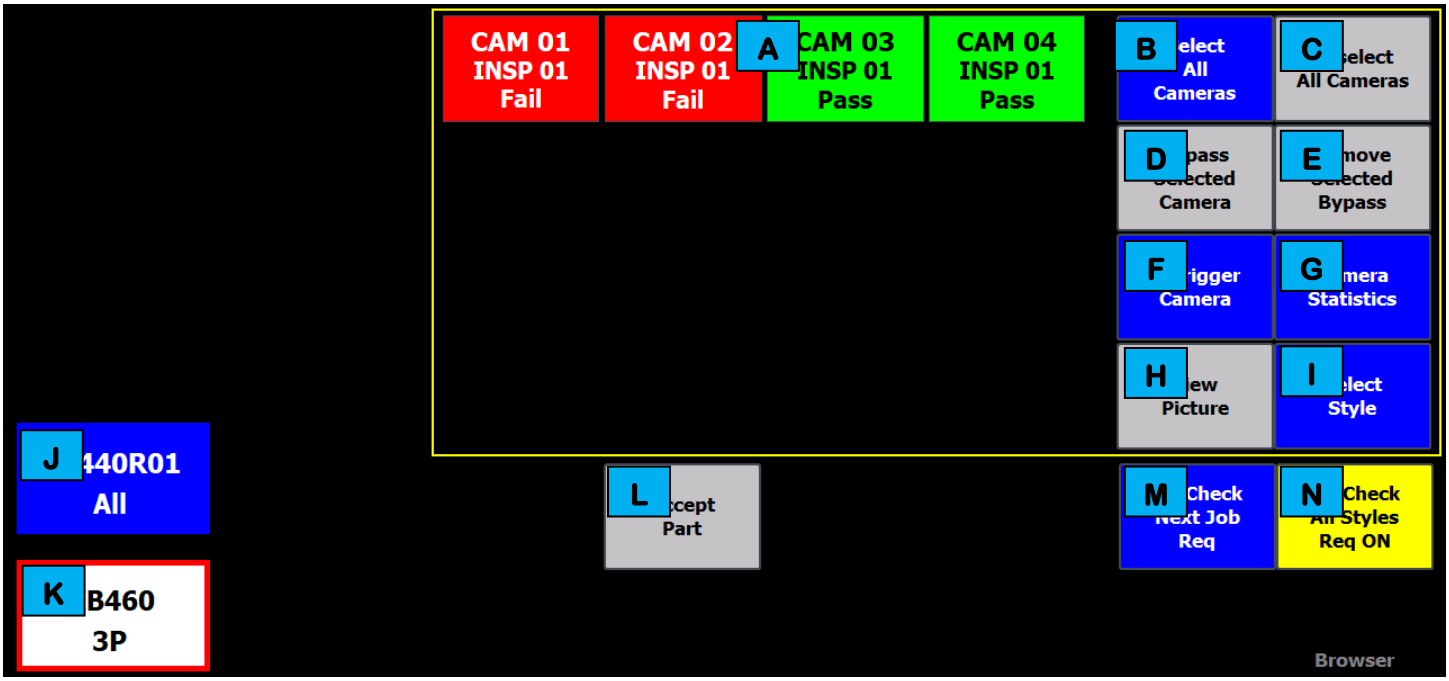


Figure 4-35. An illustration of an example TIM/Press screen.

The TIM/Press screen features several areas of information and control, used as follows.

- **A** Displays the cameras in the system and the status of their last inspection
- **B** Selects all cameras in the system
- **C** De-selects all cameras in the system
- **D** Allows the system to bypass the selected camera
- **E** Removes bypass permission from the selected camera
- **F** Triggers the selected camera
- **G** Displays statistics and information on the selected camera
- **H** Displays the last photo taken by the selected camera
- **I** This button allows you to select the different styles needed for the job
- **J** Able to change the view between which view is being used
- **K** This were the selected station with style listed
- **L** Overrides the fail status of the selected camera
- **M** This checks to see if fail is still there and allows you to request the next job.
- **N** This checks for fails of all the styles.

4.2.34. Press Screen

Touching the **PRESS** button on the Select screen navigates directly to a screen (see ***Figure 4-36***) that displays information about the presses and allows for some manual control.

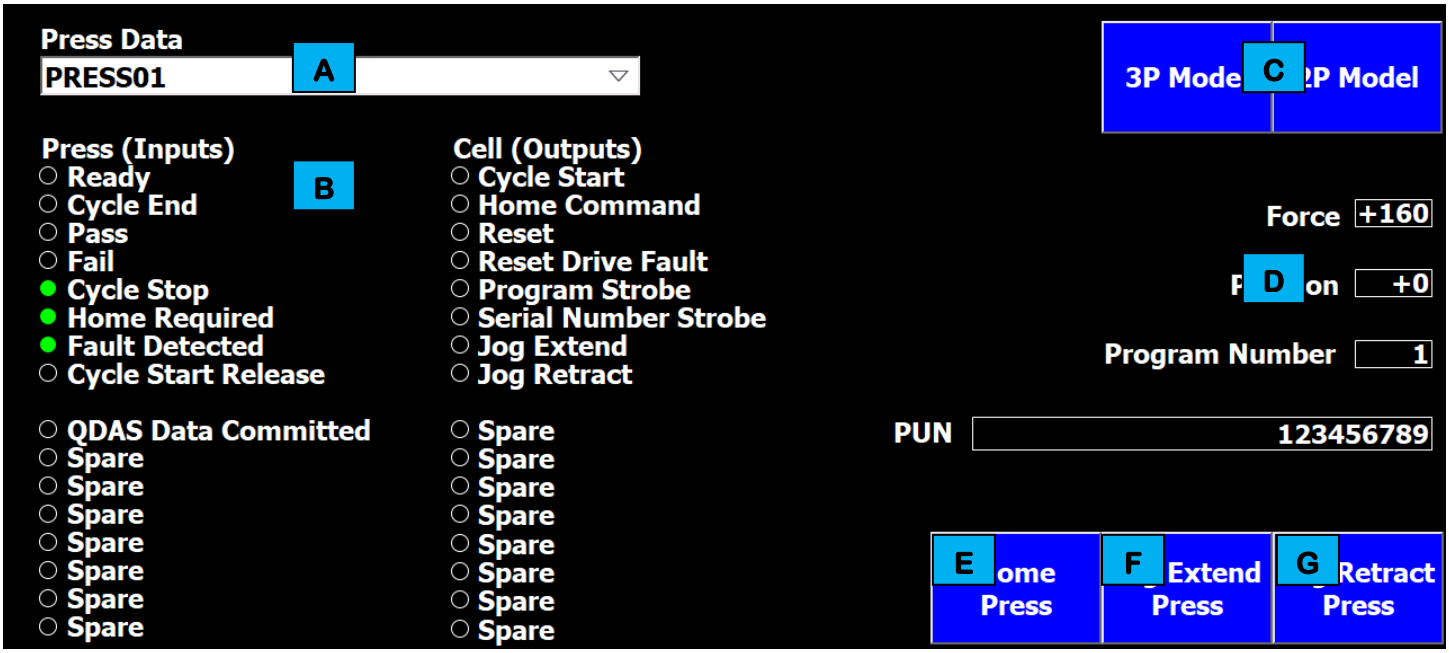


Figure 4-36. An illustration of an example Press screen.

The Press screen features several areas of information and control, used as follows.

- **A** This dropdown allows for the desired press to be selected
- **B** This section displays the status of the press' inputs and outputs
- **C** These buttons allow for cycling between press models
- **D** This area displays information about the press
- **E** This button homes the press
- **F** This button jogs the press into an extended position
- **G** This button jogs the press into a retracted position

4.2.35. Dispense Expiration Screen

Touching the **DISPENSE EXPIRATION** button on the Select screen navigates directly to a screen (see *Figure 4-37*) that displays information about the status of the materials in the system's dispensers.

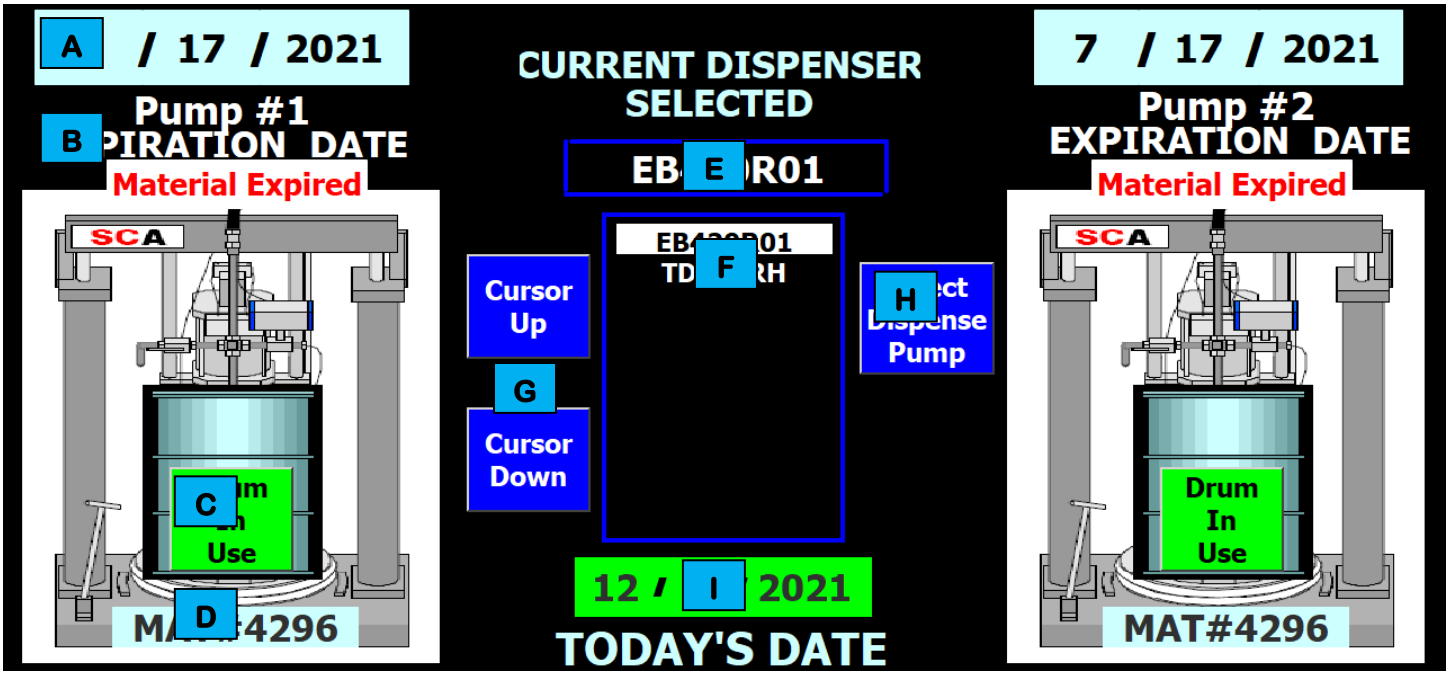


Figure 4-37. An illustration of an example Dispense Expiration screen.

The Dispense Expiration screen features several areas of information and control, used as follows.

- **A** The expiration date of the material in the pump
- **B** The pump label and material status
- **C** The status of the pump's drum
- **D** The specific identifier of the material in the pump
- **E** The pump currently selected
- **F** Displays the available pumps
- **G** Moves the selector up and down the list in **F**
- **H** Selects the pump highlighted in **F**
- **I** Today's date

4.3. COMMON OPERATING PROCEDURES

Only trained operators are to operate the line. Operators use this section to operate the line daily. This section describes the procedures for inspecting, starting, running, stopping, shutting down, emergency stopping, and recovering from faults on the line.

4.3.1. Inspecting the Line

The following checklist outlines actions that, when completed, help to ensure the proper and safe operation of the equipment. This checklist should be used prior to startup of each cell, such as at the beginning of the day or a shift. Complete the following checks to ensure proper cell operation:

- Ensure that all cell operators have been thoroughly trained and instructed in safety procedures and in cell operation. Do not allow untrained personnel to operate the cell.
- Ensure the cell air supply shutoff valve (Lockout Point A-1) is on.
- Ensure the PDP main disconnect switch (Lockout Point E-1) is in the on position.
- Ensure that all mechanisms are clear for cell operation.
- Ensure that all necessary safety guards and doors are closed.
- Ensure that all safety mechanisms are in proper working order.
- Ensure that all mechanical devices have had proper preventive maintenance and are properly cleaned.
- Ensure that no one is working on, or near, cell devices.

4.3.2. Starting an Automatic Cycle

Use the following procedure to start a cell in auto mode. After completing this procedure, the cell will be started and cycling. To start an auto cycle in one of the cells:

1. Ensure all enclosure disconnects are not disabled and that control power is present. Ensure the cell pneumatic equipment is enabled and up to pressure.
2. A reset is required of all equipment. If the equipment is appropriately located, the RESET button on the HMI terminal will be flashing blue. If the button is not flashing, the equipment is not appropriately located. Check the equipment status on the touch screens.
3. When the equipment is appropriately located and the RESET button is flashing blue, press the RESET button. After the equipment resets the blue button indicator illuminates steady.
4. Turn the AUTO/MANUAL key switch on the HMI terminal to the MANUAL position. Navigate to the Scroll List screen, select ***** START OF LIST ***** in the Function List, and press the DO button to drive all equipment to the load positions.
5. Return the AUTO/MANUAL key switch to the AUTO position.
6. If any faults are displayed at the top of the screen, touch the **FAULT RESET** button in the screen header to reset each fault.
7. Check the indicator in the AUTO INITIATE button. All mode selector switches on the system must be set to auto before the cycle can be started. If the green indicator in the button is dark or is rapidly flashing, one or more stations are not ready for auto. Use the alarm messages to identify why the cell and stations within the cell may not be ready for auto.
8. When the AUTO INITIATE button indicator is flashing steadily (not rapidly), press and hold the button. The alarm horn sounds three times and the cell initiates auto mode. Release the button after the alarm horn ceases. The indicator illuminates steady.

4.3.3. Stopping a Cycle

There are two methods for stopping the cycle at the cell: cycle stopping, and emergency stopping.

4.3.3.1. Cycle Stop

Cycle stopping is the normal and preferred means of stopping the cell. To safely stop the cell, navigate to the Mode screen and select one of the End of Cycle options. The cell completes the current cycle and then comes to a stop.

4.3.3.2. Emergency Stop

Push a red mushroom EMERGENCY STOP button in to immediately interrupt control power in the cell.

WARNING!

Press an EMERGENCY STOP ***button to immediately stop movement of all mechanisms. Ensure that all movement has stopped before entering the cell. Follow procedures taught in your GM-UAW Lockout class. Severe injury or death may occur if this warning is not followed.***

4.3.4. Shutting Down

Use the following procedure to shut down a cell. Use this procedure any time a cell needs to be completely powered down, such as for maintenance. To completely shut down a cell:

NOTE

To shut down the entire Stacker Line, this procedure must be completed on each of the cells until no power remains in the line.

1. Safely stop the cell by navigating to the Mode screen and selecting one of the End of Cycle options. The cell completes its current cycle and then comes to a stop.
2. Turn the main disconnect switch (Lockout Point E-1) to the off position at the PDP main control panel. Verify that the CONTROL POWER ON indicator is dark at the main control panel and at the cell operator interface.
3. If necessary, push the air processing equipment air dump and turn the air shutoff valve (Lockout Point A-1) to the off position to remove pneumatic energy.
4. If maintenance is to be performed, refer to the Hazardous Energy Guidelines section in Chapter 5.

4.3.5. Recovering from an Emergency Stop

WARNING!

Press an EMERGENCY STOP ***button to immediately stop movement of all mechanisms. Ensure that all movement has stopped before entering the cell. Follow procedures taught in your GM-UAW Lockout class. Severe injury or death may occur if this warning is not followed.***

Complete the following steps to recover after an EMERGENCY STOP button has been pressed:

1. Visually confirm the status of the devices. If the equipment is in a recoverable position (no collisions will result upon movement), pull out the EMERGENCY STOP button that was depressed.
2. If any faults are displayed at the top of the screen, touch the **FAULT RESET** button in the screen header to reset each fault.
3. Check the indicator in the AUTO INITIATE button. If the green indicator in the button is dark or is rapidly flashing, one or more stations are not ready for auto. Use the alarm messages to identify why the cell and stations within the cell may not be ready for auto.

4. When the AUTO INITIATE button indicator is flashing steadily (not rapidly), press and hold the button. The alarm horn sounds three times and the cell initiates auto mode.
5. Release the button after the alarm horn ceases. The indicator illuminates steady.

4.3.6. Recovering from a Fault

A fault occurs anytime there is an interruption in the automatic cycle. There are various conditions that can result in fault, such as: the failure of a sensor, a part blockage or jam, or any number of other situations.

When a fault occurs, the cell cycle is stopped, and the operator is alerted to the situation. The HMI provides a detailed fault message with the associated fault number and I/O (when applicable). In some situations, the fault message also provides recovery information.

For most faults, recovery is to remove any jam, reset the system, and resume automatic operations. Refer to Chapter 6 for more specific information.

4.3.7. Opening and Closing an Entrance Gate

Each cell is surrounded by guarding to protect operators from moving equipment. Entrance gates are placed in areas where access inside the cell guarding may be necessary. Each entrance gate has an Entrance Gate Box, located beside the gate, that is used to interface with the cell safety circuit to properly open and close an entrance gate.

Opening a Gate

To open a gate at a cell, complete the following steps:

1. At the gate control box, press the CYCLE HOLD button. Inside the button, an indicator light flashes to acknowledge the hold. The cell continues to operate until it reaches the end of the current cycle. Once the cycle has stopped, the indicator light illuminates solid.
2. Open the box door and turn the SELECTION switch to the appropriate position. Refer to ***4.1.2 Entrance Gate Box*** and your GM-UAW Lockout Training for more information.
3. Grasp the handle on the gate and slide the bar out of the interlock switch.
4. Control energy is removed from the safety circuit at the cell, preventing the movement of any equipment. Apply a personal safety lock to the entrance gate control box.
5. Verify the MPS is active. Follow the procedures taught in your GM- UAW Lockout Training class. Check for the green stack light to be illuminated. If the yellow stack light illuminates, enter with a pendant. If the green light or yellow light is not illuminated, the cell is not safe. Do not enter the cell. Follow full lockout procedures.
6. When the required tasks within the cell guarding are complete continue with the next procedure, Closing a Gate.

NOTE	***Each slide bar has a safety feature that allows the bar to be opened from the inside of the guarding, preventing any person from becoming locked inside.***

Closing a Gate

After the required tasks within the cell guarding are complete, ensure all personnel are outside of the guarding and then complete the following steps to close the gate:

1. Verify that no other personnel are inside the guarding and then close the gate. Pull the slide bar so that it engages the interlock switch.
2. If used, remove the pendant and insert the pendant plug.
3. Remove the personal lock from the entrance gate control box.
4. Press the RESET button. The gate reset indicator illuminates blue.
5. Turn the SELECTION switch to pos1.
6. If the mode selector switch at the HMI is still in automatic, look for the green RESUME AUTOMATIC button to be flashing. Press and hold the RESUME AUTOMATIC button for three seconds until the cell horn stops sounding. Release the button. Once automatic mode has resumed, an indicator light illuminates solid inside the button.

4.3.8. Loading (or Unloading) Components

Parts and components can be loaded onto conveyor systems throughout the line. The following section details how to introduce these components.

4.3.8.1. Cell Load (EB020) Dunnage Loading/Unloading

When dunnage needs loaded or unloaded at the cell, an operator grasps and pulls the pull cord at end of the desired conveyor. Once the pull cord has been activated, the system is notified of dunnage being loaded or unloaded. The operator then loads dunnage with full trays to the input side of the conveyor or unloads dunnage full of empty trays from the output side of the conveyor.

4.3.8.2. Cell Stacker (EB300) Dunnage Loading/Unloading

When dunnage needs loaded or unloaded at the cell, an operator grasps and pulls the pull cord at end of the desired conveyor. Once the pull cord has been activated, the system is notified of dunnage being loaded or unloaded. The operator then loads dunnage with full trays to the input side of the conveyor or unloads dunnage full of empty trays from the output side of the conveyor.

4.3.8.3. Module Assembly (EB400) Dunnage Loading/Unloading

When dunnage needs loaded or unloaded at the cell, an operator grasps and pulls the pull cord at end of the desired conveyor. Once the pull cord has been activated, the system is notified of dunnage being loaded or unloaded. The operator then loads dunnage with full trays to the input side of the conveyor or unloads dunnage full of empty trays from the output side of the conveyor.

4.3.9. Removing Rejects

Parts or components can be rejected from the Stacker line due to failure to meet parameters or conditions. The following details how to remove these components.

4.3.9.1. Cell Processing (EB080) Remove Rejects

If a pallet has a cell that has been rejected, the pallet is stopped at EB080 and mechanisms pick the rejected cell from the pallet, move the cell over a reject conveyor, rotate the cell, and place the cell into the reject conveyor. The reject conveyor then transports the rejected cell to an Operator to remove the rejected module.

4.3.9.2. Cell Stacker (EB300) Remove Rejects

If a battery cell is rejected, the Cell Stacking Robot places the rejected cell onto the Reject Conveyor. The Reject Conveyor then transports the rejected cell out of the cell for an Operator to remove the rejected cell.

If a Thermal Barrier is rejected, the Thermal Barrier Robot places the rejected Thermal Barrier into a reject bin. An Operator must bring the cell to a complete stop, enter the cell and remove the Thermal Barriers from the reject bin periodically.

Once a side plate has been rejected, either from the Bar Code Reader or Adhesive Dispense Vision Check, that side plate is transferred to a lift mechanism that lowers the side plate to a conveyor so that it can be taken out of the cell safely.

The Soft Stack Reject cart takes rejected cell stacks either from the sub stack dial, or z height inspection failures. The cart can then be pulled out and emptied and then put back into position.

4.3.9.3. Module Assembly (EB400) Remove Rejects

If a Cooling Plate is rejected, one of the Dispense Robots places the rejected Cooling Plate onto the TIM Reject Conveyor. The TIM Reject Conveyor Transports the rejected Cooling Plate out of the cell for an Operator to remove the rejected Cooling Plates periodically.

If a Module Assembly failed during the press cycle and is rejected, the Press Unload Robot places the rejected Module Assembly into the Soft Stack Reject cart for an Operator to remove the rejected Module Assemblies periodically.

4.3.10. Reintroducing Parts

Certain parts or components can be reintroduced at various locations on the Stacker line with some conditions. The following section details how to reintroduce these components.

4.3.10.1. Cell Load (EB020) Part Reintroduction

If a part pulled off the Cell Processing equipment (EB080) is determined to be good and needs to be loaded to the equipment again, an operator can open the EB020 guard door (following the proper procedure) and place the part(s) onto the Cell Positioning Table. The operator then closes the door (following the proper procedure) and then initiates auto mode on the HMI.

4.4. MODES OF OPERATION

Each cell has several modes of operation, explained in detail in the paragraphs that follow.

4.4.1. Auto Mode

Auto mode is the standard operating mode for a cell. While in auto mode, the cell processor directs and monitors the operation of the associated equipment.

When there is an interruption in the cycle (such as the occurrence of a fault), auto mode is not typically dropped. If recovery is possible without manual operator intervention, the automatic cycle resumes upon recovery. If the fault was severe, such as a utility loss or a communication fault, one or more of the stations within the cell may have lost automatic mode. Once the fault has been corrected, refer to ***4.3.2 Starting an Automatic Cycle*** to restore operation.

The AUTO/MANUAL key switch on the cell operator interface toggles the cell mode.

4.4.2. Manual Mode

Manual mode provides the ability to individually move mechanisms using the operator interface. Manual mode can be used for fault recovery, troubleshooting, setup, and for numerous other reasons.

There are three sections that follow: entering manual mode, example manual motion, and example manual cycling. Complete the steps as necessary for the desired manual operations.

4.4.2.1. Entering Manual Mode

The following steps detail the operations required to operate the machine in manual mode.

1. Turn the AUTO/MANUAL key switch to the MANUAL position on the operator interface terminal.
2. On the operator interface touch screen, touch the **SELECT** button in the screen header.
3. After the Select screen displays, touch the **SCROLL LIST** button.
4. Utilize the Scroll List screen and the DO button on the operator interface terminal for manual operations.

4.4.2.2. Example Manual Motion

In this example, a Lift Transfer Unit (LTU) needs to be lowered. Complete the steps that follow to manually lower the LTU. Use this procedure as a guide to manually move devices.

1. Complete the procedure in ***4.4.2.1 Entering Manual Mode***.
2. Touch the **PAGE DOWN** button repeatedly until `Lower LTU` is displayed.
3. Touch the **CURSOR UP** or **CURSOR DOWN** button as needed to select `Lower LTU`. A yellow box highlights the selected action.
4. Press the DO button on the operator interface terminal.
5. If no other manual actions are needed, touch the **SELECT** button at the top of the screen. Return the AUTO/MANUAL key switch to AUTO and follow the procedure in ***4.3.2 Starting an Automatic Cycle***.
6. If additional manual actions are needed, repeat Steps 2 through 5 for the action and option.

4.4.2.3. Example Manual Cycling

The steps that follow detail the operations required to perform an example cycle manually. Use this procedure as a guide for manually cycling a cell.

1. Complete the procedure in ***4.4.2.1 Entering Manual Mode***.
2. With ***** `START OF LIST` ***** highlighted, use the Scroll List Function List **CURSOR UP** or **CURSOR DOWN** button until `Turn Auto Cursor On` is displayed and selected with the yellow box.
3. Touch the **SELECT** button on the screen. The cell is now prepared to step through the complete cycle manually.
4. Press the DO button on the operator interface terminal. The Scroll List cursor automatically advances to the next step. Each press of the DO button completes each step of the sequence.

4.4.3. Tryout Mode

Tryout mode is provided to allow the cell mechanisms to cycle without running any parts. Tryout mode is used for setup and recovery to verify the cell process is operational. Complete the following steps to toggle cell operation to tryout mode.

1. Remove all parts from the cell. Tryout mode is not available if sensors detect parts in the cell.
2. On the operator interface touch screen, touch the **SELECT** button in the screen header.
3. After the Select screen displays, touch the **MODE** button.

4. After the Mode screen displays, touch the **TRYOUT MODE ON** button.
5. Put the operator interface AUTO/MANUAL key switch in the AUTO position and initiate automatic mode. Refer to the procedure in ***4.3.2 Starting an Automatic Cycle***.
6. To cancel tryout mode, stop the cell using **END OF CYCLE HOLD** (refer to ***4.4.5 End of Cycle Hold Mode***), move the operator interface AUTO/MANUAL key switch to the MANUAL position, and touch the **TRYOUT MODE ON** button again.

4.4.4. Runout Mode

Runout mode is provided to allow a cell to complete the assembly of the remaining product without beginning production of anything new. Runout mode is used to empty the cell of product. Complete the following steps to toggle the cell operation to runout mode.

1. On the operator interface touch screen, touch the **SELECT** button in the screen header.
2. After the Select screen displays, touch the **MODE** button.
3. After the Mode screen displays, touch the **RUNOUT MODE ON** button.
4. To cancel runout mode, touch the **RUNOUT MODE ON** button again.

4.4.5. End of Cycle Hold Mode

End of Cycle Hold mode is provided to bring a cell to a controlled stop and to the end of the current cycle. Complete the following steps to toggle the cell operation to end of cycle hold mode.

1. On the operator interface touch screen, touch the **SELECT** button in the screen header.
2. After the Select screen displays, touch the **MODE** button.
3. After the Mode screen displays, touch the **END OF CYCLE HOLD** button.
4. To cancel End of Cycle Hold mode, touch the **END OF CYCLE OFF** button.

4.5. SYSTEM BACKUP

All connected systems (i.e., PDPs, HMIs, Robot Controllers, and Laser Controllers) Within the Stacker system will be interlinked with GM's system for backup and recovery and will automatically backup data according to GM specifications and requirements.

5. MAINTENANCE

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5.1. GENERAL SERVICE GUIDELINES

Review the necessary sections of this User Manual and any relevant third-party device manufacturer literature before attempting to service the system. In addition to the general safety rules at the beginning of this Operation and Maintenance Manual, use the following guidelines when cleaning, servicing, or adjusting system mechanisms:

- Entering or servicing the controls enclosure while it is still electrically or pneumatically activated is extremely hazardous.

WARNING!

Press an EMERGENCY STOP button to immediately stop movement of all mechanisms. Ensure that all movement has stopped before entering the cell for maintenance. Severe injury or death may occur if this warning is not followed.

- Do not perform service work alone. Do not attempt internal service or adjustment unless another person capable of rendering first aid is present.
- Do not substitute parts or modify equipment. Due to the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the product.
- Shut off electrical power and air pressure to the cell before servicing it, unless otherwise specified.
- Follow the general safety rules found at the beginning of this manual.

- Before troubleshooting or servicing the cell, make sure to have up-to-date drawings.
- Never enter or reach into an enclosure without the presence of another person capable of rendering aid.
- Do not wear metal items such as rings, metal necklaces, watches, and jewelry. They are electrical hazards. Wear medical alert jewelry with caution.
- Wear approved safety glasses.
- Use insulated tools when working with electrical equipment.
- When the repair is complete, check that all fittings and connections are tight.
- Use approved fuse pullers when changing fuses (or remove electrical power).
- Never use jumper wires or fuse substitutes to replace fuses.
- For continued fire protection, replace the line fuses only with fuses of the same voltage and current rating and type. Do not use repaired fuses or short-circuited fuse holders.
- Be prepared for proper handling of electrical fires by always keeping dry powder or carbon dioxide extinguishers handy.
- Do not use compressed air to clean cell devices. Use only clean cloths or a vacuum cleaner. Compressed air causes dirt and lubricants to become airborne, potentially contaminating sensitive tooling and products under assembly.
- Do not apply lubricants in a spray form. Apply lubricants by brush, oil can, cloth, or grease gun.

5.2. HAZARDOUS ENERGY GUIDELINES

This section describes the energy in the cell, its potential dangers, and the proper precautions that must be observed when working on the cell.

The system utilizes both pneumatic and electrical energy to provide automated motion. Both energy sources pose the potential for serious injury or death through contact, either directly or indirectly. Any time mechanical, electrical, or pneumatic adjustments are required, whenever preventive maintenance is to be performed, or at any other time where unsafe conditions may be present, always remove hazardous energy from the cell.

Electrical circuits carry relatively high voltages within the cell. Electrical hazards may result from damaged or broken wires and open electrical boxes or control panels. In the event of these or other kinds of electrical hazards, stop the equipment and disable power at the MAIN DISCONNECT switch. Do not enable power to the cell until an electrical technician has corrected the problem.

Pneumatic circuits carry relatively high pressures within the cell. Crushing or pinching injuries may be incurred from devices actuated by this compressed air. Compressed air injected into the bloodstream through a skin puncture may also cause severe injuries, as can debris propelled by uncontrolled compressed air. When working on devices in the pneumatic circuit (including the hoses and connectors), place the air processing equipment shutoff valve in the off position and vent the pneumatic circuit by pressing an EMERGENCY STOP button.

5.3. LOCKOUT/TAGOUT

Any time maintenance is to be performed on the cell, all cell energy sources must be locked out and tagged. The next section details the procedure to use when locking out and tagging the energy sources. This section describes the proper locks and tags that should be used.

Lock Considerations – When performing a lockout tagout procedure, proper locks should be installed. A good lock should:

- Be provided by the employer to ensure standardization and eliminate the use of inferior locks
- Be made by a reputable manufacturer
- Be standardized with all other locks used for lockouts (same size, shape, and color)
- Withstand heat, cold, and humidity
- Be strong enough that it cannot be removed with heavy force
- Not be a combination lock, must have a key
- Have only one key, held by one person
- Not be able to be opened by any other means than by key

Tag Considerations – When performing a lockout tagout procedure, proper tags should be attached to the locks. A good tag should:

- Feature a clear warning
- Be easy to read (both legible and clearly worded)
- Contain the identification mark of the individual who installed the tag
- Be durable and able to withstand extreme temperatures, fumes, and caustic chemicals
- Be secure enough to withstand accidental removal (not tear off)
- Be secured with something like a nylon cable tie that is self-locking, can be attached by hand, can resist release with less than 50-pounds of pressure, and cannot be reused

NOTE

A tag can never be substituted for a lock. A tag is a visual warning but does not provide vital physical protection.

5.3.1. Lock, Tag, and Try Procedure

Any time maintenance is to be performed on the cell, the following steps must be completed to ensure the safety of all personnel. For the most up-to-date information regarding lockout, always refer to the energy control lockout placard on the front of the cell PDP main control panel. In general, complete the following steps to lockout the primary energy sources in a cell:

1. Safely stop the cell by navigating to the Mode screen and selecting one of the **END OF CYCLE** options. The cell completes its current cycle and then comes to a stop.
2. Turn the main disconnect switch (Lockout Point E-1) to the off position at the PDP main control panel. Verify that the POWER ON indicator is dark at the main control panel and at the cell operator interface.
3. Install a lock and tag to the switch detailing the time and date of the lockout, the reason for the lockout, and the person responsible for the lockout.
4. Push in on and turn the air processing equipment shutoff valve (Lockout Point A-1) to the off position to disconnect the cell pneumatic supply. Install a lock and tag detailing the time and date of the lockout, the reason for the lockout, and the person responsible for the lockout.
5. Make sure to lockout any other primary energy control sources identified on the cell lockout placard before performing any maintenance activities.

6. Check the cell operator interface for indicator illumination. If any indicators are illuminated, electrical energy is still present.
7. At the air processing equipment, check the pressure gage and ensure no residual pressure is present.
8. With the cell safely locked out, tagged out, and verified, maintenance can begin. When maintenance is complete, close all guard doors and remove the locks and tags. Refer to Chapter 4 for startup information.

5.3.2. Additional Safety Recommendations

The following actions will contribute to the safety of all personnel:

- A lockout/tagout center should be established under the control of one individual
- All locks and tags should be of the same type and stored and distributed by the individual responsible for the lockout/tagout center
- Technicians should retrieve locks and tags from the responsible person and then should install them on the system themselves
- When service spans a shift change, the new technician should install new locks and tags before the previous technician removes the previous locks and tags
- After removing locks and tags, return them to the lockout/tagout center

5.4. PREVENTIVE MAINTENANCE

Preventive maintenance must be performed at established intervals to keep the Stacker Line equipment operating at peak performance. Follow your company preventive maintenance program when performing these activities. In addition to the maintenance activities already established by your company for commonly used equipment, ATS has provided preventive maintenance instructions specific to components critical to the equipment operation. The documents provided are as follows:

Job Plan File Name	Device	Task Description	Task Frequency
ALLEN-BRADLEY_VLP-B0753E_JOB_PLANS	Conveyor IDC	Clean motor housing and gear box of any dirt or debris	
		Inspect Motor housing and seals for Damage or excessive wear are detected, replace unit	
		Replace shaft seal	
Allen- Bradley	C2C Dispense	Clean and inspect Complete bulk melter	Daily
		Clean and inspect Power Cable for external damage	Daily
		Clean and inspect Air Hoses	Daily
		Clean fan screens, clean or replace Filter for electrical cabinet ventilation	Daily
		Clean fan cover for Motor/gear box	Daily
		Performance check on Pressure restrictor valve	6 months
		Change lubricant on Motor/ Gear box	15000 hours (2-3 years)
		Replace the buffer battery on Processor Board	3 years
ATS_ASSEMBLY PRESS_7.1_REV1	Assembly Press	Lube linear rail cars	6 Months
		Inspect vacuum cups	3 Months
ATS_BOSCH CONVEYOR_7.1_REV1	Bosch Conveyor	Clean motor	Weekly
		Inspect roller chain	Monthly
		Inspect toothed belt	Weekly
		Clean LTU belts	Monthly
		Inspect LTU idler rollers	Monthly
		Inspect LTU belts	Monthly
ATS_CELL FLIP_MAA94705S_JOB_PLANS	Cell Flip	Inspect timing belt tension	Monthly
		Lube linear rail cars	6 Months
ATS_CELL SWAP RACK_7.1_REV1	Cell Swap Rack	Inspect vacuum cups	3 Months
		Lube linear rail cars	6 Months
ATS_DORNER FLATBELT CONVEYORS	Dorner Conveyors	Inspect belt	6 Months
ATS_LABEL PRINT AND APPLY_7.1_REV1	Label Printer	Lube linear rail cars	6 Months
		Clean print head and platen roller	Daily
		Inspect air filter	Daily
		Inspect tamp pad and web guide rollers	Daily
		Inspect for loose screws or rollers	Daily
		Clean peeler bar, rollers, and tamp pad	Weekly
		Check for air leaks	Weekly
		Clean outside of applicator and product detect lens	Weekly
		Inspect extended peel edge noses	Weekly
		Inspect dancer arm spring tension and unwind break belt	Monthly
		Inspect rollers for free rotation and play	Monthly
		Inspect rewind slip clutch	Monthly
		Replace air inlet filter	Monthly
		Inspect vacuum pump	6 Months
		Inspect pulleys, belts, and rewind clutch	6 Months
		Vacuum inside and outside of applicator	6 Months
ATS_LASER TRIM_7.1_REV1	Laser Trim	Changeout copper beryllium tooling	Daily
		Clean copper beryllium tooling	Daily

Job Plan File Name	Device	Task Description	Task Frequency
ATS_LINEAR RAIL EOAT_7.1_REV1	Linear Rail EOAT	Inspect vacuum cups	3 Months
ATS_MAA94702_7.1_REV1	MAA94702	Lube linear rail cars	6 Months
		Inspect vacuum cups	3 Months
		Inspect cable management	6 months
ATS_MAA94704_7.1_REV1	MAA94704	Inspect pump grease level	6 Months
		Inspect toggle press seal	Yearly
		Clean fill fittings	Daily
		Clean pump and reservoir	Daily
		Inspect harnesses	Monthly
		Clean tab guide tooling	Daily
ATS_OMNI DUNNAGE CONVEYORS_7.1_REV1	Omni Conveyors	Inspect chain tension	Monthly
		Inspect bearing seals	Monthly
		Grease vertical guide tubes	Monthly
		Grease chain drive roller bearings	13 Weeks
		Clean pallet trafficking sensors and reflectors	Yearly
		Inspect Air Spring	60 Days
ATS_STACK TURNTABLE_7.1_REV1	Stack Turntable	Check index drive oil level	Monthly
		Change oil	6 Months
		Lube all grease fittings	Monthly
		Inspect index drive mounting bolts	Yearly
		Inspect cam followers	8000 Hours
ATS_TAB BEND_7.1_REV1	Tab Bend	Lube linear rail cars	6 Months
ATS_TAB FORM_7.1_REV1	Tab Form	Lube linear rail cars	6 Months
ATS_VACUUM EOAT AND LINEAR RAIL_7.1_REV1	Vacuum EOAT and Linear Rail	Lube linear rail cars	6 Months
		Inspect vacuum cups	3 Months
ATS_VACUUM EOAT_7.1_REV1	Vacuum EOAT	Inspect vacuum cups	3 Months
ATS_VACUUM TOOLING_7.1_REV1	Vacuum Tooling	Inspect vacuum cups	3 Months

5.5. LUBRICATION POINTS

Proper lubrication is required to keep some of the Stacker Line equipment operating at peak performance. ATS has provided lubrication charts for equipment requiring lubrication. The following charts have been provided in a single Word document:

Chart Name
EB020 Cell Load (2 pages)
EB040 Cell Processing (3 pages)
EB300 Cell Stacking (3 pages)
EB400 Module Assembly (4 pages)

5.6. MAINTENANCE TASK INSTRUCTION SHEETS

The Stacker Line equipment requires periodic maintenance to keep the equipment operating at peak performance. ATS has provided Task Instruction Sheets as guides to completing these maintenance activities. The following Task Instruction Sheets have been provided:

Task Instruction Number	Task Description
1	Replace Tooling Components
2	SuperTrak – Teach Conveyor Positions
5	Keyence Micrometer – Replace and Clean Camera
5	Matrox Camera – Replace or Adjust Camera
6	Reject Station – Adjust Unloader Position
7	Reject Station – Replace Reject Conveyor Belt
8	Reject Station – Replace Reject Conveyor Motor-Drive
9	Replace Pneumatic Components
10	Adjust Positive Stops
11	Flipover Station – Replace Belts on Roll Over
12	Flipover Station – Adjust Position of Pickup or Setdown
12	Dunnage Conveyor Replace-Adjust Lift Sensors
15	Adjust Cylinder Flow Controls
17	Dunnage Conveyor Chain-Gearbox Replacement
18	Dunnage Conveyor Transfer Lift Bladder Replacement
21	Dunnage Conveyor Motor Replacement
22	Dunnage Conveyor Roller Cleaning
23	Dunnage Conveyor Pallet Jam Clearing
24	SuperTrak – Clean Pallet
27	Sick Light Curtain Adjustment and Replacement
32	Adjust Switches on Robot End Effector
39	Reintroduce Parts to the Load-Unload Cell
41	Promess Press – Press and Motor Replacement
42	Promess Press – Belt Replacement
60	Stack Dial – Repair Gearbox Drives
64	Laser Enclosure – Wall and Door Repair
65	Laser Enclosure – Perform Light Tight Inspection with Spotlight
66	Laser – Replace and Clean Cover Slide
67	Laser – Replace Cutting Head Nozzle
68	Riedel Chiller – Flush and Treat Water System
69	Riedel Chiller – Air Filter Cleaning and Replacement

Task Instruction Number	Task Description
72	Laser General – Troubleshoot Equipment
73	Laser General – General Sweep and Workplace Organization
77	CTM Printer – Replace Printer Spool
79	Torit Dust Collector Motor and Fan Replacement
80	Torit Dust Collector Filter Replacement
81	Torit Dust Collector Pressure Valve Replacement
84	Torit Dust Collector Differential Pressure Switch Replacement
85	Torit Dust Collector Verifying Monthly Pressure Drop
86	Torit Dust Collector Bin Emptying

5.7. THIRD-PARTY EQUIPMENT MANUALS

The Stacker Line equipment is comprised of many integrated third-party components. Many of these components have their own documentation. The following table identifies the documentation associated with these third-party components. The electronic files have been provided separate from this manual.

5.7.1. EB020 Cell Load Manual References

Tool	Component	Manufacturer	Document File Name(s)
EB010T01 Conveyor Equipment	Conveyor	Omni	Omni - (Firestone) Recommended Maintenance and Air Spring Inspection.pdf Omni - Chain Driven Live Roller Conveyor Straight and Curve Technical Handbook.pdf Omni - Chain Lubrication Instructions.pdf Omni - Chain Transfer Inspection and Lubrication Instructions.pdf Omni - General Safety Instructions Technical Handbook.pdf Omni - Notes on Chain Transfer Reducer Removal and Replacement.pdf
EB010T01 Conveyor Equipment	Light Curtain	Sick	Sick - deTec4 Prime Safety Light Curtain Operating Instructions.pdf
EB010R01 Cell Handling Robot	Robot	Fanuc	Fanuc - Robot R-2000iC Mechanical Unit Operator's Manual.pdf
EB010R01 Cell Handling Robot	Camera	Fanuc	Fanuc - iRVision 2D Camera Application Operator's Manual.pdf
EB020R01 Tray Handling Robot	Robot	Fanuc	Fanuc - Robot R-2000iC Mechanical Unit Operator's Manual.pdf
EB020R01 Tray Handling Robot	Camera	Fanuc	Fanuc - iRVision 2D Camera Application Operator's Manual.pdf

5.7.2. EB040 Cell Processing Manual References

Tool	Component	Manufacturer	Document File Name(s)
SuperTrak Conveyor	SuperTrak	ATS	ATS - SuperTrak GEN3 Modular Conveyor Operation and Maintenance Manual.pdf
EB040 Barcode Reader	GTR Camera	Matrox	Matrox Iris GTR Install and Technical Manual.pdf
EB050/EB060/EB070 OCV	Gripper	SMC	SMC - Operation Manual Compact Air Gripper.pdf
EB050/EB060/EB070 OCV	Multimeter	Keithley	Keithley - Model 2700 Multimeter-Switch System User's Manual.pdf Keithley - Model 2701 Ethernet-Based DMM-Data Acquisition User's Manual.pdf
EB080T01 Reject Conveyor	Conveyor	Dorner	Dorner - 3200 Series Flat Belt LPZ Conveyors Installation, Maintenance & Parts Manual.pdf
EB090 Tab Knurling	Press	BTM	BTM - Set-Up and Maintenance Guide.pdf
EB110 Pre-Bend Cell Flip	Gripper	SMC	SMC - Operation Manual MHZ2 Series Gripper.pdf
EB130/EB135 Laser Trim	Camera	Axis Communications	Axis Communications - Axis M5525-E PTZ Network Camera User Manual.pdf
EB130/EB135 Laser Trim	Flame Detector	Minimax	Minimax - Operating Instructions Flame Detector UniVario FMX5000 IR.pdf
EB130/EB135 Laser Trim	Chiller	Dimplex	Dimplex – Riedel Chiller Operating Instructions.pdf
EB130/EB135 Laser Trim	Laser Equipment	Trumpf	Trumpf – Operator’s Manual TruDisk 1000-8002.pdf
EB130/EB135 Laser Trim	Fume Extractor	Donaldson	Donaldson Torit - Downflo LS Installation, Operation and Maintenance Manual.pdf
EB137 Trim Verification	Laser Micrometer	Keyence	Keyence - IG Series User's Manual.pdf
EB280 Post-Bend Cell Flip	Gripper	SMC	SMC - Operation Manual MHZ2 Series Gripper.pdf

5.7.3. EB300 Cell Stacking Manual References

Tool	Component	Manufacturer	Document File Name(s)
EB320R01 Cell Stacking Robot	Robot	Fanuc	Fanuc - Robot M-10iA Mechanical Unit Operator's Manual.pdf
EB320T01 Reject Conveyor	Conveyor	Dorner	Dorner - 3200 Series Flat Belt LPZ Conveyors Installation, Maintenance & Parts Manual.pdf
EB330R01 Dunnage Robot	Robot	Fanuc	Fanuc - Robot R-2000iC Mechanical Unit Operator's Manual.pdf
EB330R01 Dunnage Robot	Camera	Fanuc	Fanuc - iRVision 2D Camera Application Operator's Manual.pdf
EB330R01 Dunnage Robot	Robot Transport Unit	Fanuc	Fanuc - Generation VI - Robot Transport Unit (RTU) Mechanical Assembly, Operation and Maintenance Manual.pdf

Tool	Component	Manufacturer	Document File Name(s)
EB330T01/T02/T03 Conveyor Equipment	Conveyor	Omni	Omni - (Firestone) Recommended Maintenance and Air Spring Inspection.pdf Omni - Chain Driven Live Roller Conveyor Straight and Curve Technical Handbook.pdf Omni - Chain Lubrication Instructions.pdf Omni - Chain Transfer Inspection And Lubrication Instructions.pdf Omni - General Safety Instructions Technical Handbook.pdf Omni - Notes on Chain Transfer Reducer Removal and Replacement.pdf
EB330T01/T02/T03 Conveyor Equipment	Light Curtain	Sick	Sick - deTec4 Prime Safety Light Curtain Operating Instructions.pdf
EB340R01 Thermal Barrier Robot	Robot	Fanuc	Fanuc - Robot M-10iA Mechanical Unit Operator's Manual.pdf
EB350R01 Side Plate/Mid-Beam Load Robot	Robot	Fanuc	Fanuc - Robot M-10iA Mechanical Unit Operator's Manual.pdf
EB360 Stack Dial	Dial Indexer	Camco	Camco - Service Manual RDM Series Index Drives.pdf
EB370R01 Press Load Robot	Robot	Fanuc	Fanuc - Robot R-2000iC Mechanical Unit Operator's Manual.pdf
Thermal Barrier Bar Code and Reject	GTR Camera	Matrox	Matrox Iris GTR Install and Technical Manual.pdf

5.7.4. EB400 Module Assembly Manual References

Tool	Component	Manufacturer	Document File Name(s)
EB400R01 Dunnage Robot	Robot	Fanuc	Fanuc - Robot R-2000iC Mechanical Unit Operator's Manual.pdf
EB400R01 Dunnage Robot	Camera	Fanuc	Fanuc - iRVision 2D Camera Application Operator's Manual.pdf
EB400R01 Dunnage Robot	Robot Transport Unit	Fanuc	Fanuc - Generation VI - Robot Transport Unit (RTU) Mechanical Assembly, Operation and Maintenance Manual.pdf
EB400T01/T02/T03 Conveyor Equipment	Conveyor	Omni	Omni - (Firestone) Recommended Maintenance and Air Spring Inspection.pdf Omni - Chain Driven Live Roller Conveyor Straight and Curve Technical Handbook.pdf Omni - Chain Lubrication Instructions.pdf Omni - Chain Transfer Inspection and Lubrication Instructions.pdf Omni - General Safety Instructions Technical Handbook.pdf Omni - Notes on Chain Transfer Reducer Removal and Replacement.pdf
EB400T01/T02/T03 Conveyor Equipment	Light Curtain	Sick	Sick - deTec4 Prime Safety Light Curtain Operating Instructions.pdf
EB420R01 Dispense 1 Robot	Robot	Fanuc	Fanuc - Robot R-2000iC Mechanical Unit Operator's Manual.pdf
EB440R01 Dispense 2 Robot	Robot	Fanuc	Fanuc - Robot R-2000iC Mechanical Unit Operator's Manual.pdf
EB450R01 Press Unload Robot	Robot	Fanuc	Fanuc - Robot M-20iA Mechanical Unit Operator's Manual.pdf
EB450T01 TIM Reject Conveyor	Conveyor	Dorner	Dorner - 2200 Series Center Drive Conveyors Installation, Maintenance & Parts Manual.pdf
EB460 Assembly Press	Servo Press	Promess	Promess - MotionPRO Technical Manual Rev 1_16.pdf Promess - MotionPRO User's Manual Appendix Rev 1_2.pdf Promess - MotionPRO User's Manual Rev 1_11.pdf
EB460 Assembly Press	Load Cell	Honeywell	Honeywell - SC Instrumentation Model SC500.pdf
EB460 Assembly Press	GTR Camera	Matrox	Matrox Iris GTR Install and Technical Manual.pdf
EB470 Label Print and Apply	Printer Applicator	CTM Labeling	CTM Labeling Systems - 3600a Printer Application Maintenance and Service Manual.pdf
EB480T01 Conveyance	Conveyor	Bosch	Bosch - Belt Section BS 2.pdf Bosch - BS 2C-…, BS 2R-… Belt Sections Assembly Instructions.pdf Bosch - HQ 2U Lift Transverse Unit Assembly Instructions.pdf Bosch - PE 2X Positioning Unit Assembly Instructions.pdf
EB500 BOM Check	GTR Camera	Matrox	Matrox Iris GTR Install and Technical Manual.pdf

6. TROUBLESHOOTING

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6.1. GENERAL TROUBLESHOOTING

6.1.1. Part Faults

Part faults occur when the system is out of parts, a reject bin or waste bin is full, or a part is jammed. The following table provides a list of part faults and resolutions.

Fault	Recovery
The system is out of production parts.	Replenish the production parts.
A reject bin is full.	Remove the rejected parts.
A waste bin is full.	Remove the waste.
A device is jammed, or a part is jammed in the device.	Remove the jammed part. ***Refer to 6.1.1.1 Remove a Jammed Part***.

6.1.1.1. Remove a Jammed Part

To remove a jammed part, complete the following steps:

WARNING!

To prevent injury or death, turn electrical power and pneumatic pressure OFF before manually removing jammed parts. Be aware of stored energy sources (such as trapped air pressure, vertical gravity movement, or hot surfaces) that exist in the system after lockout and tagout. Only trained and qualified Technicians should complete this procedure.

CAUTION!

To prevent damage to devices, do not pry jammed parts from a device.

1. Attempt to step or home the faulted device.
2. On the HMI, navigate to the Service screen and touch the **PREPARE FOR STOP** button. The cell completes the current cycle and then comes to a stop.
3. Turn the AUTO/MANUAL key switch to the MANUAL position on the operator interface terminal.
4. On the operator interface touch screen, touch the **SELECT** button in the screen header.
5. After the Select screen displays, touch the **SCROLL LIST** button.
6. Utilize the Scroll List screen and the DO button on the operator interface terminal for manual operations to reverse the device movement and relieve pressure on the part.
7. Open the guard door nearest the faulted device.
8. Carefully remove any parts that are jammed in the device.
9. If necessary, manually move pneumatic devices or servo-actuated devices. Always return devices back to the position they were originally in after moving them.
10. Close the guard door.
11. Turn the AUTO/MANUAL key switch to the AUTO position on the operator interface terminal.
12. Touch the **FAULT RESET** button in the screen header to reset the fault.
13. Check the indicator in the AUTO INITIATE button. If the green indicator in the button is dark or is rapidly flashing, one or more stations are not ready for auto. Use the alarm messages to identify why the cell and stations within the cell may not be ready for auto.
14. When the AUTO INITIATE button indicator is flashing steadily (not rapidly), press and hold the button. The alarm horn sounds three times and the cell initiates auto mode.
15. Release the button after the alarm horn ceases. The indicator illuminates steady.

6.1.2. Moving Device Faults

Moving device faults occur when a device does not complete an expected action and the sensor reports the unexpected condition to the processor. The following table provides a list of moving device faults and resolutions.

Fault	Recovery
A sensor reports an unexpected condition.	• Check the operation of the sensor for signs of abnormal operation. If the sensor is functioning correctly and is secure, inspect the stop in relation to the sensor. Refer to ***6.1.3. Sensor Faults***. • Check the hard stop alignment and inspect for damage. This can prevent the stop from triggering the sensor. Adjust or replace as required. • Check the air pressure. • Check the solenoid valves.
Pneumatic pressure supply is too high, too low, or turned off.	Check the air pressure.
A part is jammed in the tooling.	Remove the jammed part. ***Refer to 6.1.1.1 Remove a Jammed Part***.
The gripper is malfunctioning.	Check the gripper for an obstruction or other issue.
A device is damaged.	Repair or replace the damaged device.

6.1.3. Sensor Faults

6.1.3.1. Sensor Type Tests

WARNING!

To prevent injury or death, turn electrical power and pneumatic pressure OFF before working with sensor faults. Be aware of stored energy sources (such as trapped air pressure, vertical gravity movement, or hot surfaces) that exist in the system after lockout and tagout. Only trained and qualified Technicians should complete this procedure.

Sensors monitor the presence and position of parts and tooling. Accurate positioning of sensors is critical to system performance. For more information about sensor locations and functions, refer to the ATS Electrical Drawings and Mechanical Drawings. The following table describes the tests for the sensor function.

Sensor Type	Test
Proximity sensor	Verify the sensor is operational. Pass a flag through the sensing range while observing the LED indicator on the sensor body. If the sensor is functioning correctly, the LED indicator changes state as a flag passes through the sensing range.
Through-beam sensor	Verify the sensor is operational. Pass a flag through the sensing range while observing the LED indicator on the sensor body. If the sensor is functioning correctly, the LED indicator changes state as a flag passes through the sensing range.
Hall effect sensor	Verify the sensor is operational. Manually move the affected device and observe the LED indicator on the sensor body. If the sensor is functioning correctly, the LED indicator changes state as the device moves through calibrated positions.

6.1.3.2. Sensor Fault Troubleshooting

The following table describes sensor faults and possible resolutions.

Device	Fault	Recovery
Sensor	Part is in the wrong location.	Remove the jammed part. *Refer to 6.1.1.1 Remove a Jammed Part*.
	Sensor cable is loose or disconnected.	Secure the cable to the sensor body or input block.
	Sensor is obstructed.	Remove the obstruction.
	Sensor face is dirty.	Clean the sensor.
	Sensor is out of alignment.	Adjust the sensor. Move the sensor to a position where the object is in the field of view. If necessary, adjust the sensor sensitivity.
PLC	Communication error.	• If the sensor is connected to a field device input module (that is, a module that is located in a remote location from the PLC and communicates by means of a network), check the I/O network communication status. In most cases, a communications problem results in many faults being reported. If all network communication is okay, then attempt sensor replacement. • If the sensor is connected directly to the PLC, locate the sensor input address label (on the sensor or cable) and locate that input address LED on the PLC card. If the LED is lit, check that the PLC is in RUN mode. If the LED is not lit, check the sensor cable connections. If sensor cable connections are okay, replace the sensor.

6.1.4. Pneumatic Faults

The following table provides a list of pneumatic faults and resolutions.

Device	Fault	Recovery
Regulator	Air supply regulator pressure is low.	• Make sure the facility air supply is turned ON. • Inspect the air pressure regulator to make sure it is turned ON and is set to the correct pressure. • Check that the air lines are secure and not worn or damaged. • Check for a blockage in the lines. • Check that the regulator is functioning properly. • Check for a malfunctioning solenoid.
Air Pressure	Pressure is not sufficient.	• Check for an incorrect regulator setting, or malfunctioning solenoid. • Adjust the air pressure.
Solenoid	Solenoid is malfunctioning.	Test the solenoid. Refer to *6.1.6 Solenoid Faults*.

6.1.5. Air Cylinder Faults

The following table provides a list of air cylinder faults and resolutions.

Device	Fault	Recovery
Sensor	Sensor cable is loose or not connected.	• Secure the cables to the sensor body. • Check sensor alignment. • Check for sensor obstruction.
	Sensor is misaligned.	• Adjust the sensor. • Check for loose or disconnected sensor cables or sensor obstruction.

	Sensor is obstructed.	Remove the obstruction.
Air Pressure	Air supply regulator pressure is low.	• Check that the air lines are secure and not worn or damaged. • Check for a blockage in the lines. • Check that the facility air supply is ON and functioning properly. • Check that the regulator is functioning properly. • Check for a malfunctioning solenoid.
	Pressure is not sufficient.	• Adjust the air pressure. • Check for an incorrect regulator setting or malfunctioning solenoid.
	Solenoid is malfunctioning.	Test the solenoid. Refer to ***6.1.6 Solenoid Faults***.
Cylinder or Air Slide	Component is obstructed.	Remove the obstruction.
	Component is malfunctioning.	Replace the component.

6.1.6. Solenoid Faults

WARNING!

Manually activating solenoids causes pneumatic devices to move. To prevent injury, stay clear of moving equipment.

CAUTION!

Manually activating solenoids causes pneumatic devices to move. Equipment damage may result if the moving device contacts other devices, assembly pieces, or supporting structures.

If the system reports a solenoid fault:

- Press and hold the solenoid button. If the solenoid is operating correctly, the air valve spool shifts freely. If the valve is not operating properly, the spool does not shift freely. Replace, or disassemble and clean the valve, and then reassemble.
- If available, check the solenoid valve indicator light. If the light does not illuminate when the output signal is ON, it may be faulty. Temporarily replace the solenoid or test the solenoid.

The following table describes solenoid faults and possible resolutions.

Fault	Possible Cause	Recovery
Valve blows to exhaust when not actuated.	Inlet poppet is not sealing.	• Cycle the valve several times and check if valve air flow flushes the particles out. • Disassemble the valve and check the poppet seat for damage. If there is damage, replace the entire valve body assembly. • Disassemble the valve, clean thoroughly, lubricate lightly, and reassemble.
	Seals are damaged.	• Inspect the seals and replace any that are defective. • Lubricate the seals lightly and reassemble the valve.

Fault	Possible Cause	Recovery
	Valve-to-base gasket is damaged.	Rarely does a gasket become defective during normal operation. Do not attempt to continue use with a damaged gasket. Replace immediately.
	Water or oil contamination exists.	• Disassemble the valve. Clean, lightly lubricated, and reassemble. • Check that the supply air is dry, and that the air filter is drained frequently.
Solenoid fails to actuate the valve, but a manual override does actuate the valve.	Pilot cover is loose.	Tighten the cover and check for normal operation.
	Solenoid is damaged.	• Check the coil for electrical continuity. Replace the solenoid if the coil is open. • Check the coil for varnish deposits.
	Solenoid voltage is not adequate.	Use the following steps: 1. Exhaust the air supply to the valve. 2. Attach a voltmeter to the solenoid electrical supply. 3. Actuate the solenoid. If the voltage falls below the allowable operating range, the electrical supply is inadequate.
Solenoid fails to actuate the valve and a manual override also fails to actuate the valve.	Seals are damaged.	• Inspect the seals and replace any that are defective. • Lubricate the seals lightly and reassemble the valve.
	Valve has varnish deposits.	Remove the varnish deposits with a water-soluble detergent or solvent. Do not scrape the varnish off. Avoid chlorinated solvents and abrasive materials.
	Pilot or signal pressure is low.	Increase pilot pressure to the valve.
	Water or oil contamination exists.	• Disassemble the valve. Clean, lightly lubricated, and reassemble. • Check that the supply air is dry, and that the air filter is drained frequently.
Air flow is normal only in actuated position.	Spring return is broken.	Replace the broken return spring.
Solenoid buzzes.	Solenoid is damaged.	• Check the coil for electrical continuity. Replace the solenoid if the coil is open. • Check the coil for varnish deposits.
	Solenoid voltage is not adequate.	Use the following steps: 1. Exhaust the air supply to the valve. 2. Attach a voltmeter to the solenoid electrical supply. 3. Actuate the solenoid. If the voltage falls below the allowable operating range, the electrical supply is inadequate.
	Valve has varnish deposits.	Remove the varnish deposits with a water-soluble detergent or solvent. Do not scrape the varnish off. Avoid chlorinated solvents and abrasive materials.
Solenoid burns out prematurely.	Valve has varnish deposits.	Remove the varnish deposits with a water-soluble detergent or solvent. Do not scrape the varnish off. Avoid chlorinated solvents and abrasive materials.

Fault	Possible Cause	Recovery
	Incorrect voltage at solenoid.	Exhaust the air supply to the valve.
Pilot section blows to exhaust.	Pilot cover is loose.	Tighten the cover and check for normal operation.
	Pilot poppet is not sealing.	• Inspect the poppet and seat for foreign particles or damage. • Replace the pilot insert if the poppet or upper seat is damaged. • Replace the entire pilot housing if the lower seat is damaged. Blow out the pilot air passages to remove any loose dirt particles before installing a new insert. Reassemble.
Poppet chatters.	Air pressure is low.	• Check the air pressure supply. If the pressure falls more than 10% during actuation of the valve, the air supply may be inadequate. • Inspect the system for undersized supply lines, sharp bends in the piping, restrictive fittings, a clogged filter element, or a defective pressure regulator.
	Pilot or signal pressure is low.	Increase pilot pressure to the valve.
	Silencer is damaged.	• Remove silencer to observe if valve performance is improved. • Clean the silencer.
Valve action is sluggish.	Damaged seals on spool valve.	• Inspect and replace defective seals. • Lightly lubricate the seals.
	Valve has varnish deposits.	Remove the varnish deposits with a water-soluble detergent or solvent. Do not scrape the varnish off. Avoid chlorinated solvents and abrasive materials.
	Air pressure is low.	• Check the air pressure supply. If the pressure falls more than 10% during actuation of the valve, the air supply may be inadequate. • Inspect the system for undersized supply lines, sharp bends in the piping, restrictive fittings, a clogged filter element, or a defective pressure regulator.
	Pilot or signal pressure is low.	Increase pilot pressure to the valve.
	Silencer is damaged.	• Remove silencer to observe if valve performance is improved. • Clean the silencer.
	Water or oil contamination exists.	• Disassemble the valve. Clean, lightly lubricated, and reassemble. • Check that the supply air is dry, and that the air filter is drained frequently.

6.1.7. Gripper Faults

The following table describes gripper faults and possible resolutions.

Device	Fault	Recovery
Sensor	Sensor cable is loose or disconnected.	Secure the cable to the sensor body.
	Sensor is misaligned.	Check the operation of the sensor for signs of abnormal operation. If the sensor is functioning correctly and is secure, inspect the stop in relation to the sensor. Refer to ***6.1.3 Sensor Faults***.
	Sensor is obstructed.	Remove the obstruction. ***Refer to 6.1.1.1 Remove a Jammed Part***.
Air pressure	Air pressure is low.	• Check that the facility air supply is ON and functioning properly. • Check that the air lines are secure and not worn or damaged. • Check for a blockage in the lines. • Check that the regulator is functioning properly. • Check for a malfunctioning solenoid.
	Solenoid is malfunctioning.	Refer to ***6.1.6 Solenoid Faults***.
Gripper or Rotary Actuator	Component is obstructed.	Remove the obstruction. Refer to ***6.1.1.1 Remove a Jammed Part***.
	Component is malfunctioning or is not set up correctly.	• Adjust or replace the component. • Check the air pressure. • Check the solenoid valves. Refer to ***6.1.6 Solenoid Faults***. • Check the hard stop alignment and inspect for damage. This can prevent the stop from triggering the sensor. Adjust or replace as required.
Cylinder or Air Slide	Component is malfunctioning.	• Check for an obstructed cylinder. Remove the obstruction if required. Remove the obstruction. Refer to ***6.1.1.1 Remove a Jammed Part***. • Replace the component.

6.1.8. Air Pressure Faults

The following table describes air pressure faults and possible resolutions.

Device	Fault	Recovery
Air flow	Air pressure is low.	• Check that the facility air supply is ON and functioning properly. • Check that the air lines are secure and not worn or damaged. • Check for a blockage in the lines. • Check that the regulator is functioning properly. • Check for a malfunctioning solenoid.
Solenoid	Solenoid is malfunctioning.	Refer to ***6.1.6 Solenoid Faults***.

6.1.9. Conveyor Faults

The following table describes conveyor faults and possible resolutions.

Device	Fault	Recovery
Fuse	Fuse has failed.	Replace the blown fuse.
Motor	Overload relay has been tripped.	Reset and then restart the motor.
	Motor is receiving power, but it is not running.	Replace the motor.
Gearbox	Motor is running but the conveyor is not.	Replace the gearbox.
Conveying device	Conveying device is obstructed.	Remove the obstruction. Refer to ***6.1.1.1 Remove a Jammed Part***.
	Parts were manually moved out of position during maintenance.	Acknowledge the fault and manually send the conveying device to the next position to reset.
	Timing belt is not functioning properly.	Replace the timing belt.
	Pulleys are not running freely without excessive drag.	Replace the pulleys.
	Servo motor is not functioning properly.	Replace the servo motor.

6.1.10. Servo Motor Faults

The following table describes servo motor faults and possible resolutions.

Fault	Recovery
Servo axis has positive or negative overtravel.	• If possible, open the guard door and manually push the servo away from the travel limit (possible on most axes that do not have a mechanical brake). Jogging off a software over-travel limit may require limits to be temporarily disabled. • Jog the servo in a positive or negative direction using the Servo/VFD screen.
Servo axis is not referenced (homed).	Manually remove any interfering parts, and then home the servo.
Servo emergency all stop triggered.	• Reset the servo. • Verify that the servo power is ON.
Servo axis reset did not complete, or the servo drive DC bus voltage is low.	• Acknowledge the fault, and then reset the servo. Retry the servo. • Verify that the servo power is ON and that the servo is enabled. Retry the servo. • Check the AC fuses. • Check for a communication problem.
Any other fault.	Verify that the servo power is ON and that the servo is enabled. Retry the servo.

6.1.11. Vision Faults

The following table describes vision faults and possible resolutions.

Device	Fault	Recovery
Software	Calibration is required.	Complete the necessary calibration procedure.
Camera	Camera is offline.	Check the power supply.
	Trigger did not finish.	Check the I/O.
	Message did not finish.	Check the Ethernet cable to make sure it is not unplugged or kinked.
Lighting	Lighting is faulty.	Adjust the light settings. Check the power supply. Check that the filter is in position.

6.1.12. Processor Faults

Whenever a fatal processor fault occurs:

- The cell stops completely.
- All indicator lights turn OFF.
- The cell cannot be restarted.

A processor fault may result from power loss to the processor or from a software problem.

To determine the cause of the fault:

1. Open the electrical enclosure door and inspect the status indicator lights on the processor power supply module.
2. Connect a computer terminal to the programmable controller and check for fault codes.
3. Refer to the programmable controller OEM literature for assistance in determining the cause of the fault and appropriate corrective action.
4. Contact ATS if additional assistance is required.

6.2. COMMON FAULTS TROUBLESHOOTING

Specific troubleshooting procedures for common fault types are documented in the GM NOK Checklists. Please refer to these checklists for recovery information.

7. ASSEMBLY AND DISASSEMBLY

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7.1. EB010R01 CELL HANDLING ROBOT END OF ARM TOOLING

To replace the end of arm tooling (see callout **A** in *Figure 7-1*) on the Cell Handling Robot, complete the following steps:

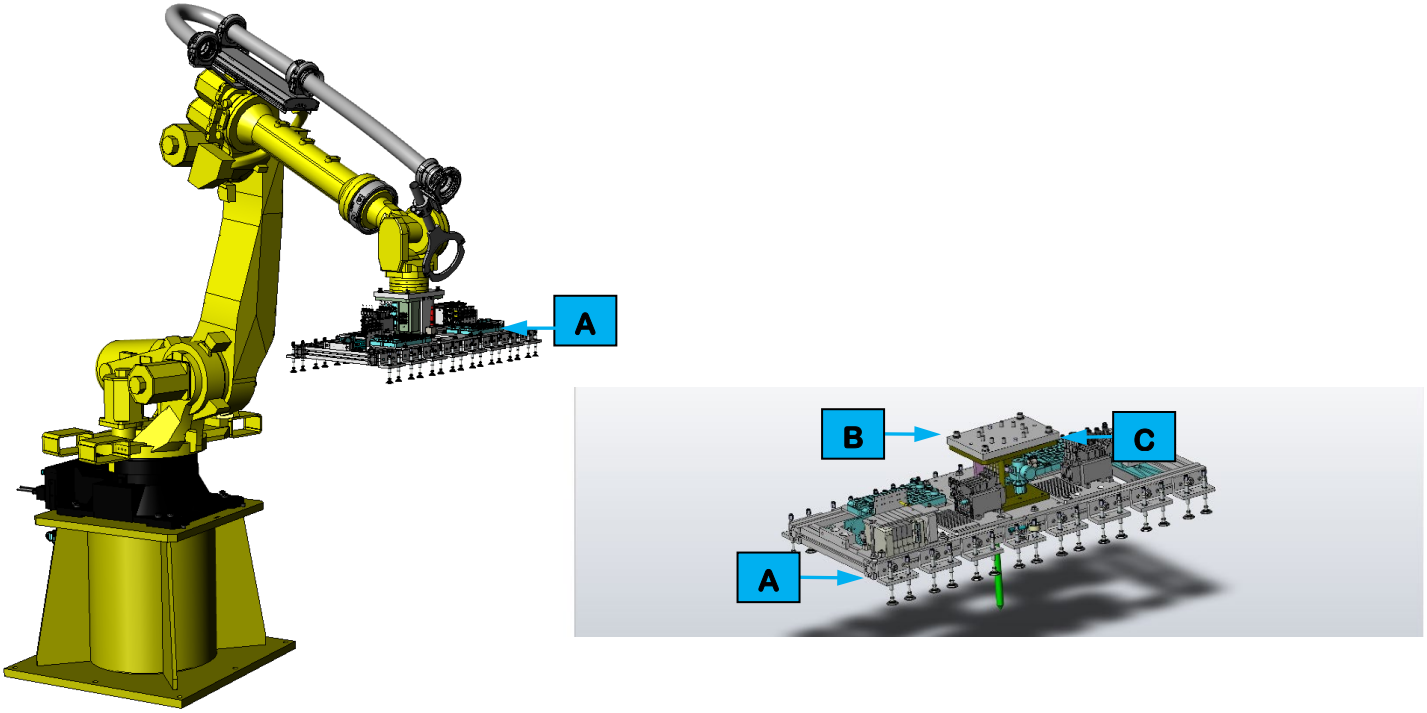

Figure 7-1. Illustrations of the Cell Handling Robot end of arm tooling.

1. Safely stop the cell by navigating to the Service screen and touching the **PREPARE FOR STOP** button. The cell completes its current cycle and then comes to a stop.
2. Turn the MAIN DISCONNECT switch (Lockout Point E-1) to the off position at the PDP main control panel.
3. Open the cell guard door.
4. Disconnect all air and electrical connections from the robot to the end of arm tooling (see callout **A** in *Figure 7-1*).
5. While supporting the end of arm tooling, remove the 10 bolts securing the end of arm welded post (see callout **B** in *Figure 7-1*) to the robot attachment plate (see callout **C** in *Figure 7-1*).
6. Remove the end of arm tooling from the robot.
7. After adjusting or replacing any necessary tooling, install the end of arm tooling to the robot by tightening the bolts the secure the welded post to the robot attachment plate.
8. Connect all air and electrical connections from the robot to the end of arm tooling.
9. Close the cell guard door.

7.2. EB020R01 TRAY HANDLING ROBOT END OF ARM TOOLING

To replace the end of arm tooling (see callout **A** in *Figure 7-2*) on the Tray Handling Robot, complete the following steps:

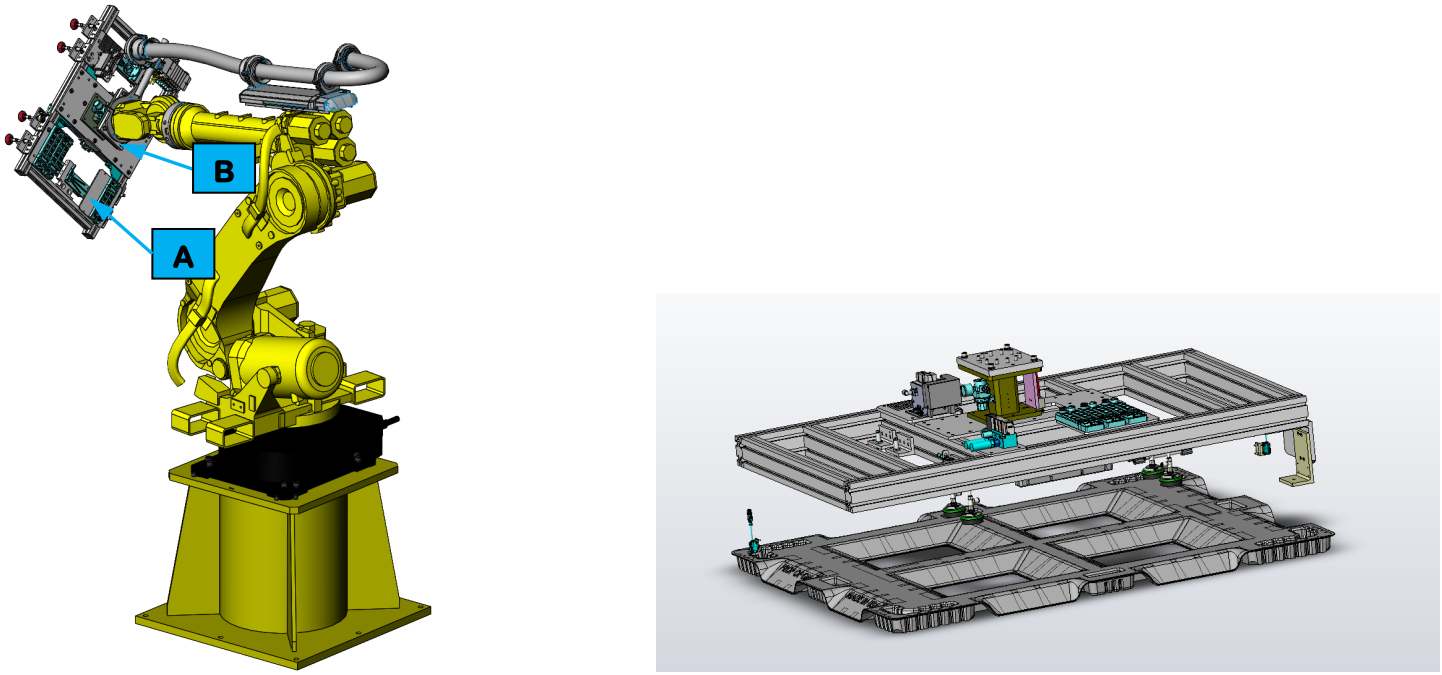

Figure 7-2. An illustration of the Tray Handling Robot end of arm tooling.

1. Safely stop the cell by navigating to the Service screen and touching the **PREPARE FOR STOP** button. The cell completes its current cycle and then comes to a stop.
2. Turn the MAIN DISCONNECT switch (Lockout Point E-1) to the off position at the PDP main control panel.
3. Open the cell guard door.
4. Disconnect all air and electrical connections from the robot to the end of arm tooling (see callout **A** in *Figure 7-2*).
5. While supporting the end of arm tooling, remove the 10 bolts securing the end of arm welded post (see callout **B** in *Figure 7-2*) to the robot attachment plate.
6. Remove the end of arm tooling from the robot.
7. After adjusting or replacing any necessary tooling, install the end of arm tooling to the robot by tightening the bolts the secure the welded post to the robot attachment plate.
8. Connect all air and electrical connections from the robot to the end of arm tooling.
9. Close the cell guard door.

7.3. EB040 SUPERTRAK PALLET FIXTURE

To remove the fixture from a SuperTrak pallet (see ***Figure 7-3***), complete the following steps:

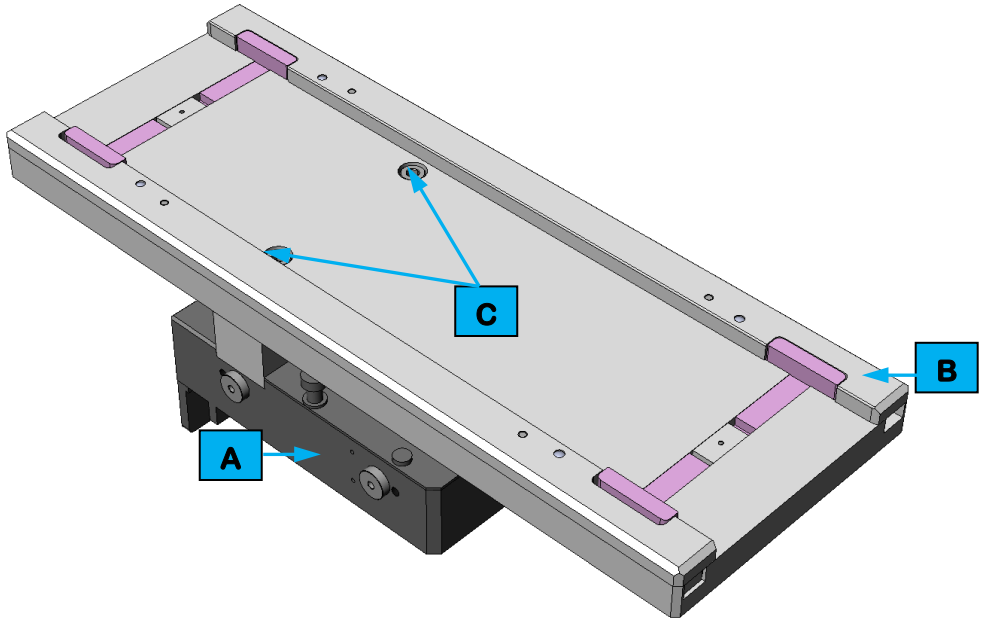

Figure 7-3. An illustration of a SuperTrak pallet and nest tooling.

1. Safely stop the cell by navigating to the Service screen and touching the **PREPARE FOR STOP** button. The cell completes its current cycle and then comes to a stop.
2. Turn the MAIN DISCONNECT switch (Lockout Point E-1) to the off position at the PDP main control panel.
3. Open the cell guard door(s).
4. Remove the pallet (see callout **A** in ***Figure 7-3***) from the SuperTrak by completing the steps described on pages 168 and 169 of the ATS *Operation and Maintenance Manual SuperTrak GEN 3 Modular Conveyor*.
5. With the pallet removed from the SuperTrak, the fixture (see callout **B** in ***Figure 7-3***) can be removed by loosening and removing the two M8 socket head cap screws (see callout **C** in ***Figure 7-3***).
6. After making adjustments or replacing any necessary tooling, install the fixture to the pallet using the two M8 socket head cap screws.
7. Install the pallet to the SuperTrak conveyor by completing the steps described on pages 166 and 167 of the ATS *Operation and Maintenance Manual SuperTrak GEN 3 Modular Conveyor*.
8. Close the cell guard door(s).

7.4. EB320R01 CELL STACKING ROBOT END OF ARM TOOLING

To replace the end of arm tooling (see callout **A** in *Figure 7-4*) on the Cell Stacking Robot, complete the following steps:

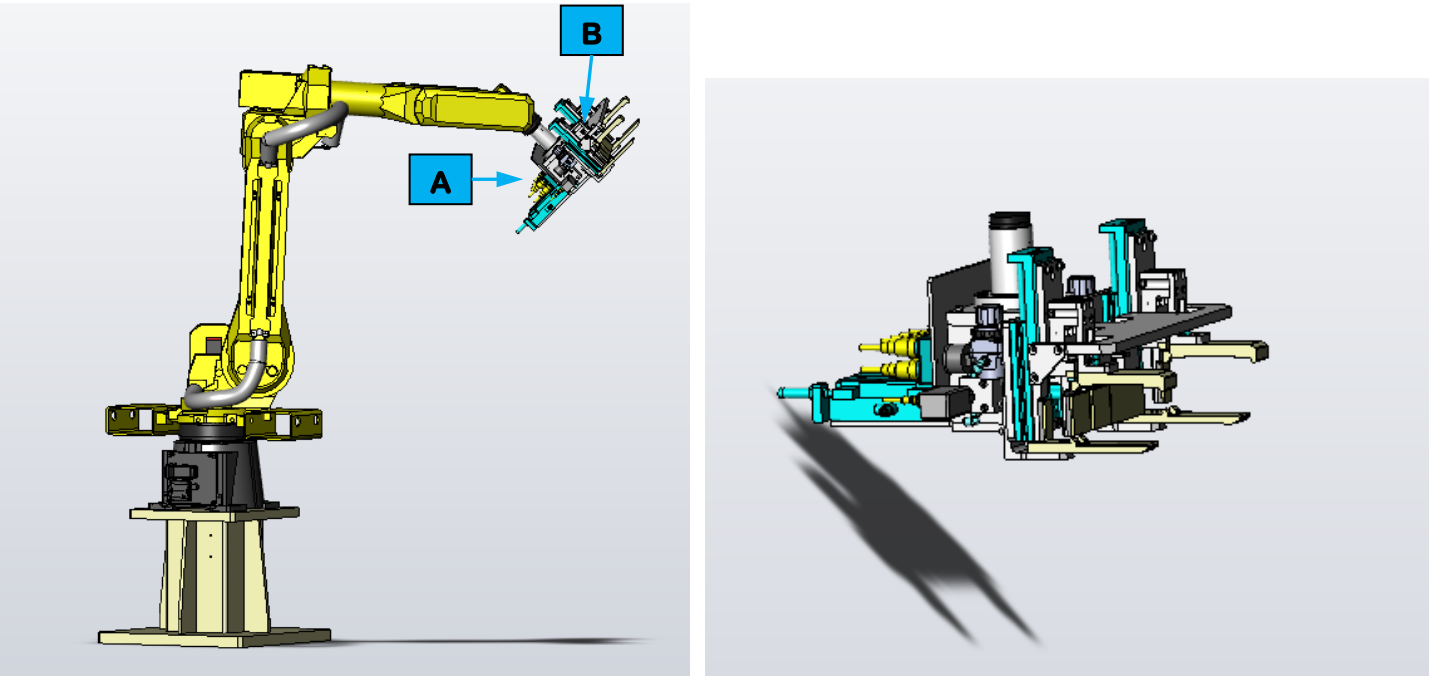

Figure 7-4. An illustration of the Cell Stacking Robot end of arm tooling.

1. Safely stop the cell by navigating to the Service screen and touching the **PREPARE FOR STOP** button. The cell completes its current cycle and then comes to a stop.
2. Turn the MAIN DISCONNECT switch (Lockout Point E-1) to the off position at the PDP main control panel.
3. Open the cell guard door.
4. Disconnect all air and electrical connections from the robot to the end of arm tooling (see callout **A** in *Figure 7-4*).
5. While supporting the end of arm tooling, remove the 6 bolts securing the end of arm welded post (see callout **B** in *Figure 7-4*) to the robot attachment plate.
6. Remove the end of arm tooling from the robot.
7. After adjusting or replacing any necessary tooling, install the end of arm tooling to the robot by tightening the bolts the secure the welded post to the robot attachment plate.
8. Connect all air and electrical connections from the robot to the end of arm tooling.
9. Close the cell guard door.

7.5. EB330R01 DUNNAGE ROBOT END OF ARM TOOLING

To replace the end of arm tooling (see callout **A** in *Figure 7-5*) on the Dunnage Robot, complete the following steps:

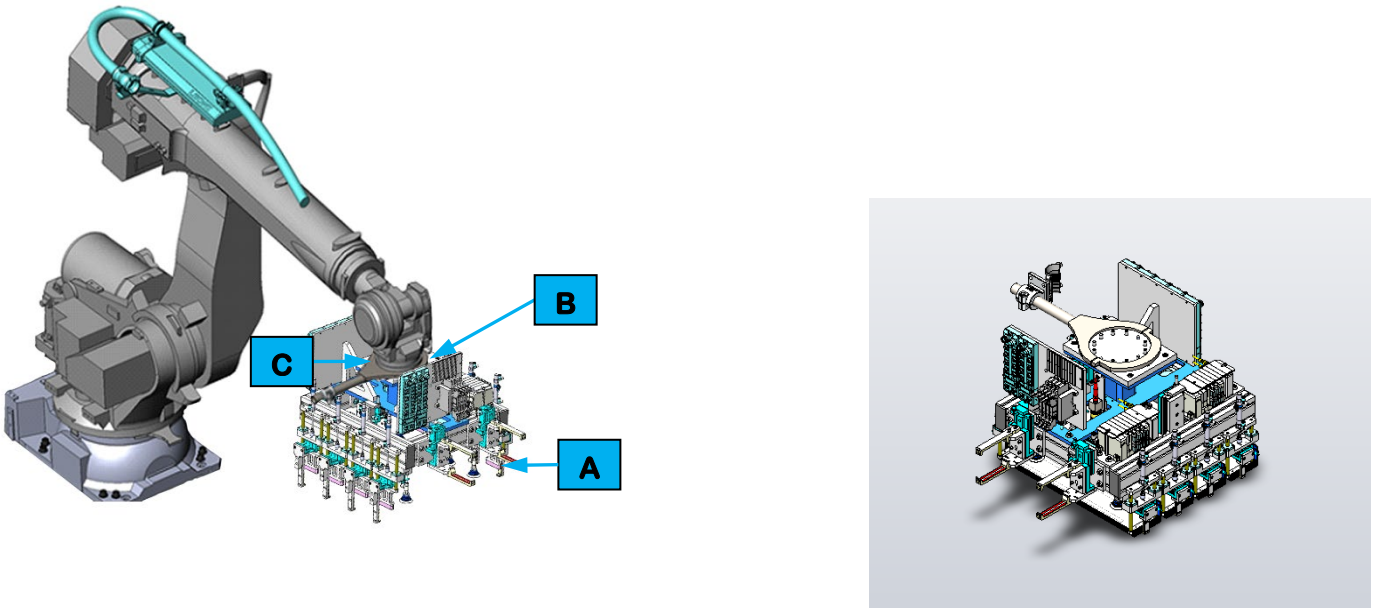

Figure 7-5. An illustration of the Dunnage Robot end of arm tooling.

1. Safely stop the cell by navigating to the Service screen and touching the **PREPARE FOR STOP** button. The cell completes its current cycle and then comes to a stop.
2. Turn the MAIN DISCONNECT switch (Lockout Point E-1) to the off position at the PDP main control panel.
3. Open the cell guard door.
4. Disconnect all air and electrical connections from the robot to the end of arm tooling (see callout **A** in *Figure 7-5*).
5. While supporting the end of arm tooling, remove the 10 bolts securing the end of arm welded post (see callout **B** in *Figure 7-5*) to the robot attachment plate (see callout **C** in *Figure 7-5*).
6. Remove the end of arm tooling from the robot.
7. After adjusting or replacing any necessary tooling, install the end of arm tooling to the robot by tightening the bolts the secure the welded post to the robot attachment plate.
8. Connect all air and electrical connections from the robot to the end of arm tooling.
9. Close the cell guard door.

7.6. EB340R01 THERMAL BARRIER ROBOT END OF ARM TOOLING

To replace the end of arm tooling (see callout **A** in *Figure 7-6*) on the Thermal Barrier Robot, complete the following steps:

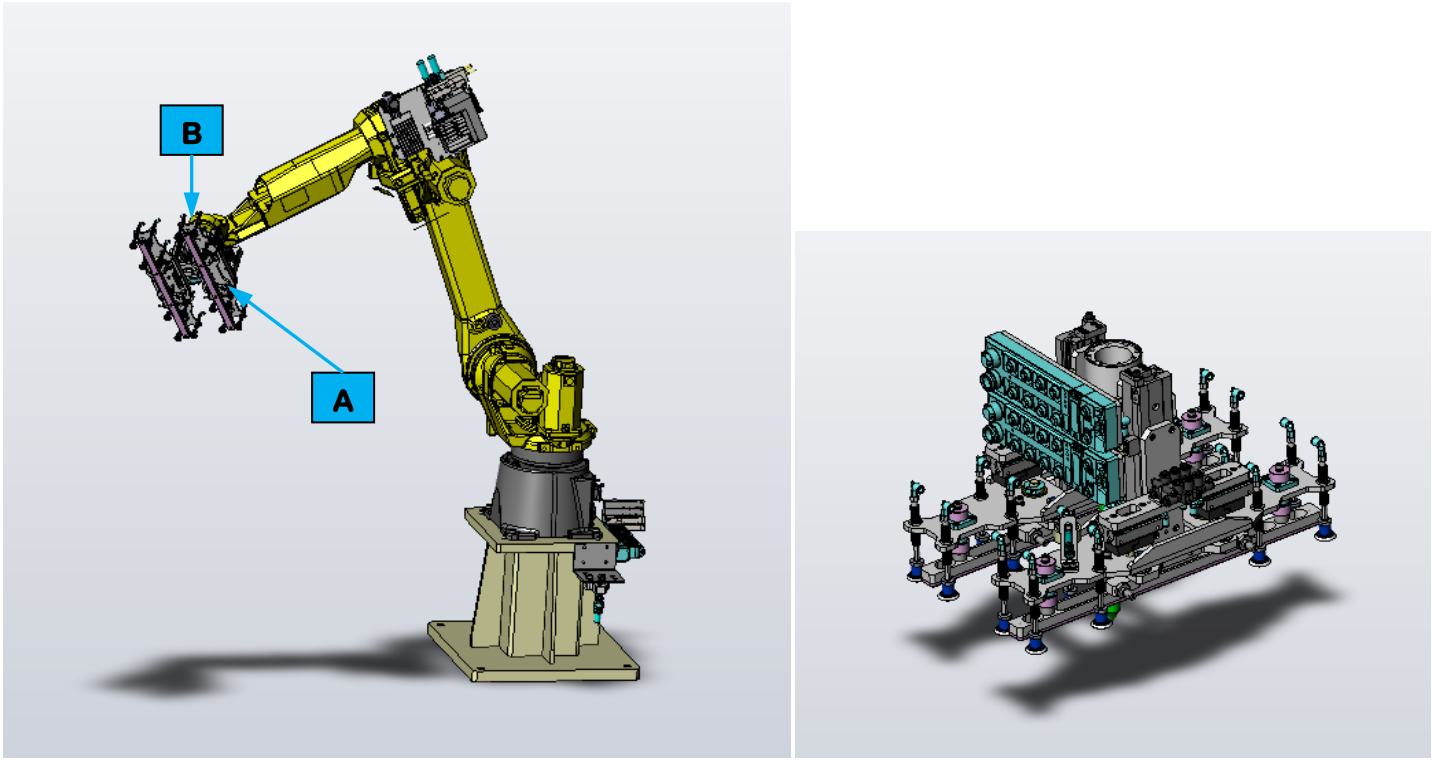

Figure 7-6. An illustration of the Thermal Barrier Robot end of arm tooling.

1. Safely stop the cell by navigating to the Service screen and touching the **PREPARE FOR STOP** button. The cell completes its current cycle and then comes to a stop.
2. Turn the MAIN DISCONNECT switch (Lockout Point E-1) to the off position at the PDP main control panel.
3. Open the cell guard door.
4. Disconnect all air and electrical connections from the robot to the end of arm tooling (see callout **A** in *Figure 7-6*).
5. While supporting the end of arm tooling, remove the 8 bolts securing the end of arm welded post (see callout **B** in *Figure 7-6*) to the robot attachment plate.
6. Remove the end of arm tooling from the robot.
7. After adjusting or replacing any necessary tooling, install the end of arm tooling to the robot by tightening the bolts the secure the welded post to the robot attachment plate.
8. Connect all air and electrical connections from the robot to the end of arm tooling.
9. Close the cell guard door.

7.7. EB350R01 SIDE PLATE/MID-BEAM ROBOT END OF ARM TOOLING

To replace the end of arm tooling (see callout **A** in *Figure 7-7*) on the Side Plate/Mid-Beam Robot, complete the following steps:

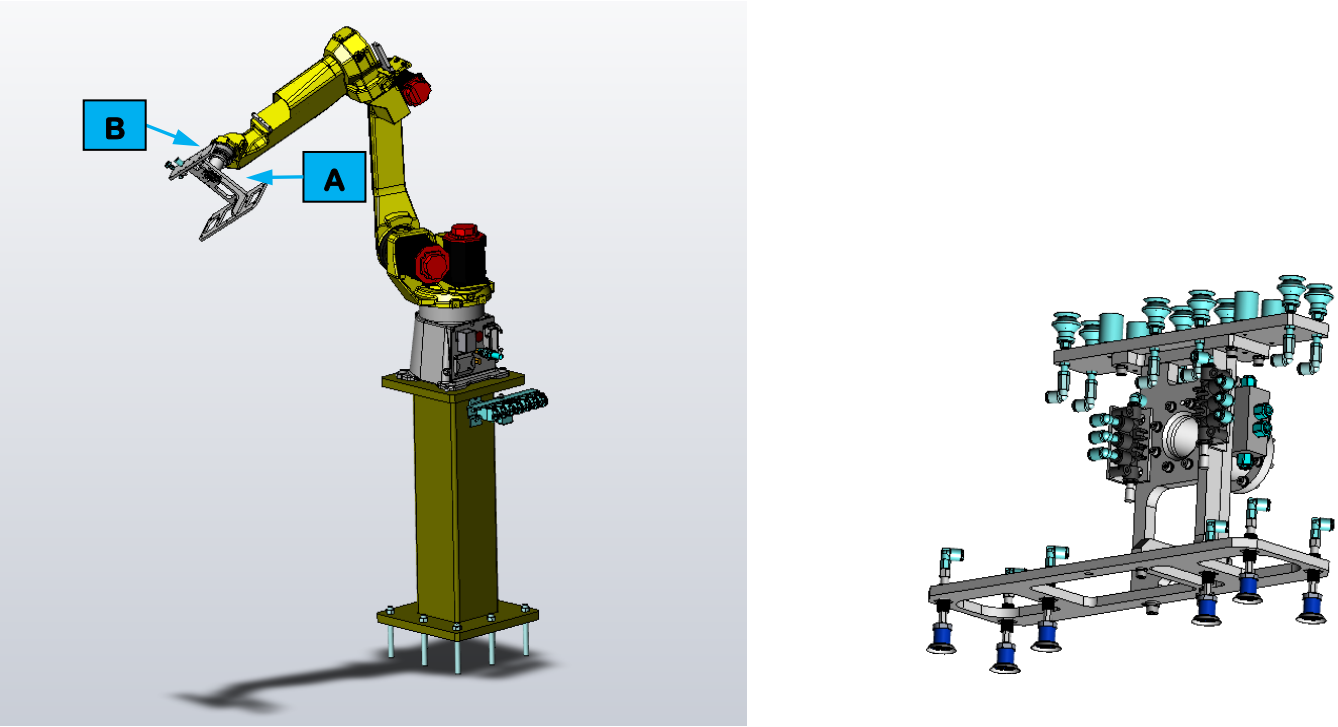

Figure 7-7. An illustration of the Side Plate/Mid-Beam Robot end of arm tooling.

1. Safely stop the cell by navigating to the Service screen and touching the **PREPARE FOR STOP** button. The cell completes its current cycle and then comes to a stop.
2. Turn the MAIN DISCONNECT switch (Lockout Point E-1) to the off position at the PDP main control panel.
3. Open the cell guard door.
4. Disconnect all air and electrical connections from the robot to the end of arm tooling (see callout **A** in *Figure 7-7*).
5. While supporting the end of arm tooling, remove the 8 bolts securing the end of arm welded post (see callout **B** in *Figure 7-7*) to the robot attachment plate.
6. Remove the end of arm tooling from the robot.
7. After adjusting or replacing any necessary tooling, install the end of arm tooling to the robot by tightening the bolts the secure the welded post to the robot attachment plate.
8. Connect all air and electrical connections from the robot to the end of arm tooling.
9. Close the cell guard door.

7.8. EB360 STACK DIAL NEST

To replace a nest on the Stack Dial (see callout **A** in *Figure 7-8*), complete the following steps:

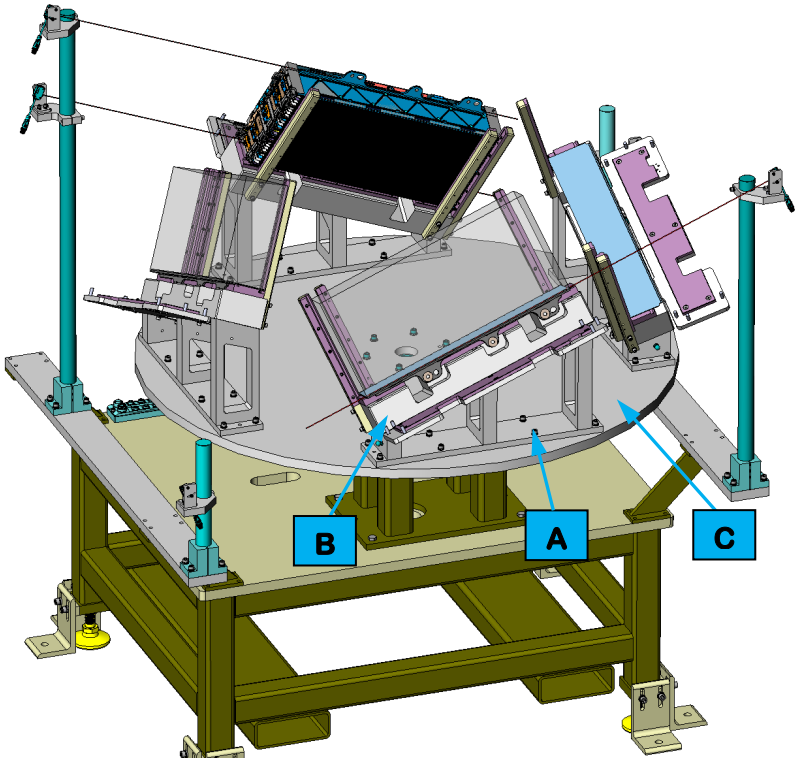

Figure 7-8. An illustration of the Stack Dial.

1. Safely stop the cell by navigating to the Service screen and touching the **PREPARE FOR STOP** button. The cell completes its current cycle and then comes to a stop.
2. Turn the MAIN DISCONNECT switch (Lockout Point E-1) to the off position at the PDP main control panel.
3. Open the cell guard door.
4. Remove the eight (8) bolts (see callout **A** in *Figure 7-8*) securing the dial nest (see callout **B** in *Figure 7-8*) to the dial plate (see callout **C** in *Figure 7-8*).
5. Remove the dial nest from the dial plate.
6. After adjusting or replacing any necessary tooling, install the dial nest to the dial plate by tightening the eight (8) bolts.
7. Close the cell guard door.

7.9. EB370R01 PRESS LOAD ROBOT END OF ARM TOOLING

To replace the end of arm tooling (see callout **A** in *Figure 7-9*) on the Press Load Robot, complete the following steps:

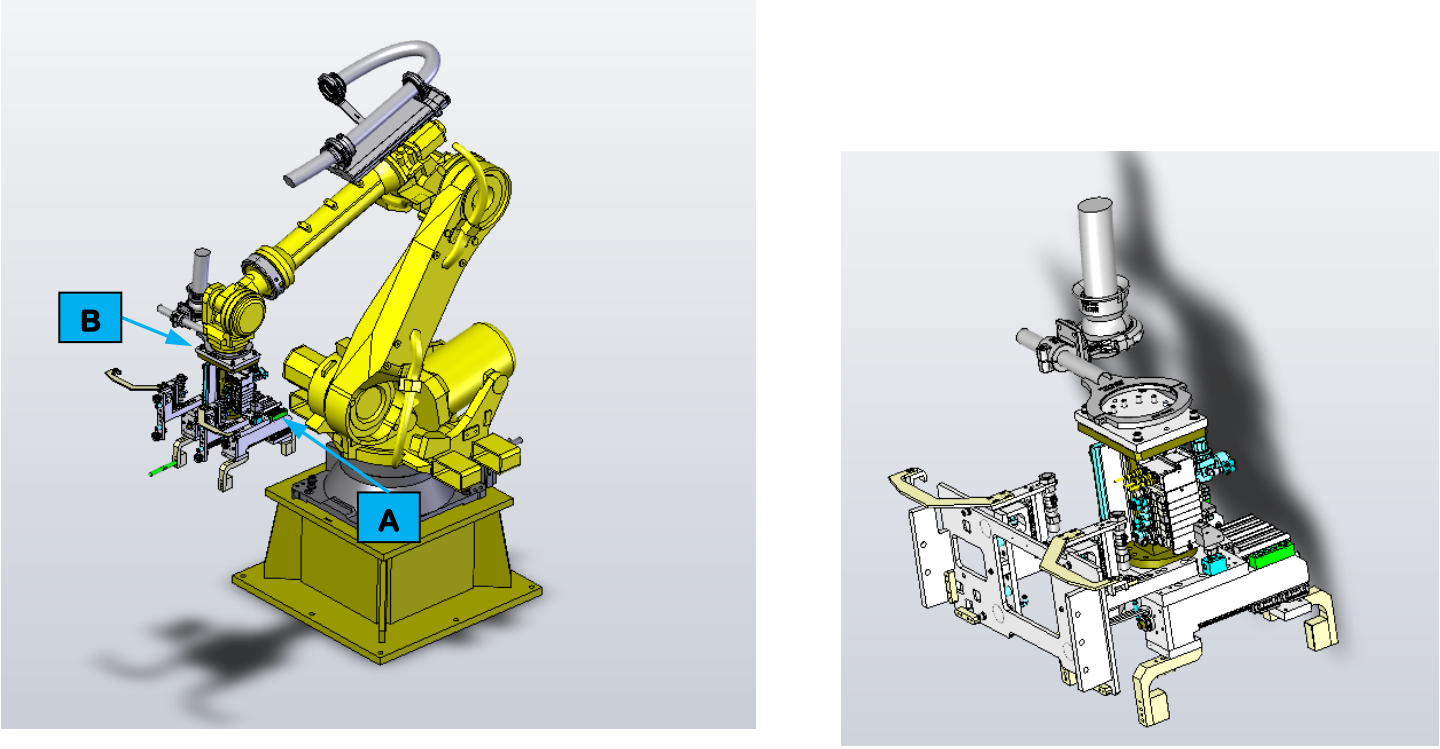

Figure 7-9. An illustration of the Press Load Robot end of arm tooling.

1. Safely stop the cell by navigating to the Service screen and touching the **PREPARE FOR STOP** button. The cell completes its current cycle and then comes to a stop.
2. Turn the MAIN DISCONNECT switch (Lockout Point E-1) to the off position at the PDP main control panel.
3. Open the cell guard door.
4. Disconnect all air and electrical connections from the robot to the end of arm tooling (see callout **A** in *Figure 7-9*).
5. While supporting the end of arm tooling, remove the 10 bolts securing the end of arm welded post (see callout **B** in *Figure 7-9*) to the robot attachment plate.
6. Remove the end of arm tooling from the robot.
7. After adjusting or replacing any necessary tooling, install the end of arm tooling to the robot by tightening the bolts the secure the welded post to the robot attachment plate.
8. Connect all air and electrical connections from the robot to the end of arm tooling.
9. Close the cell guard door.

7.10. EB400R01 DUNNAGE ROBOT END OF ARM TOOLING

To replace the end of arm tooling (see callout **A** in *Figure 7-10*) on the Dunnage Robot, complete the following steps:

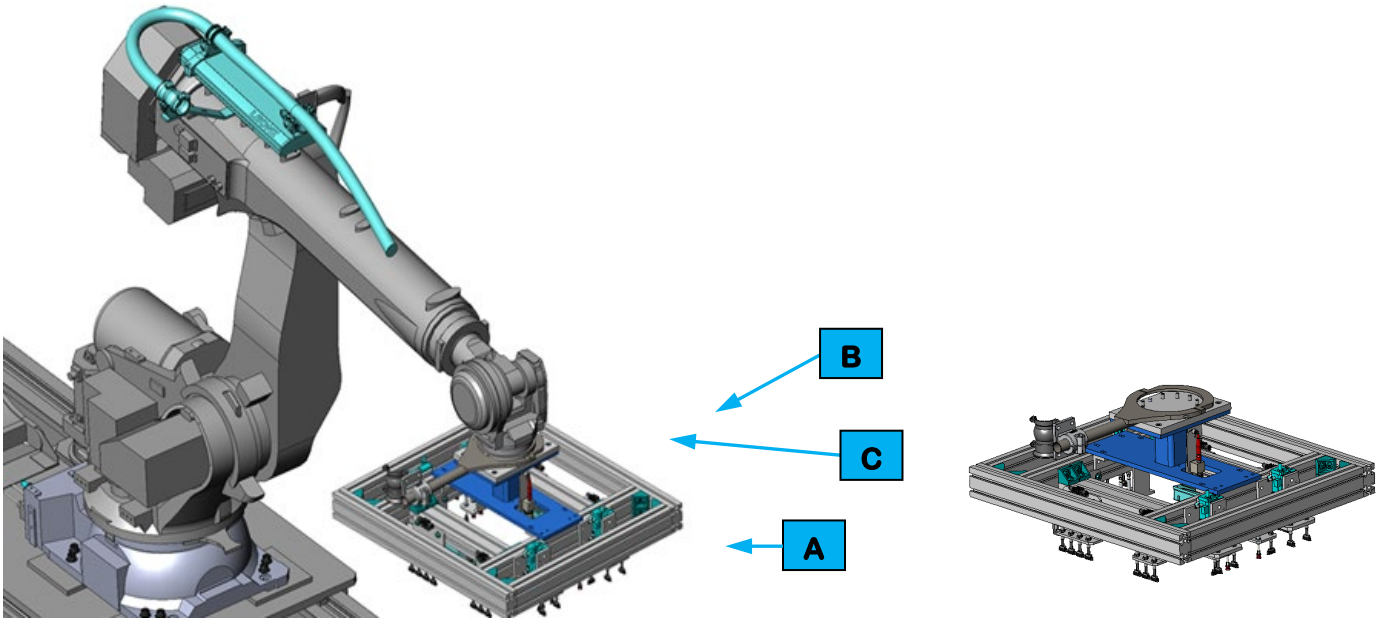

Figure 7-10. An illustration of the Dunnage Robot end of arm tooling.

1. Safely stop the cell by navigating to the Service screen and touching the **PREPARE FOR STOP** button. The cell completes its current cycle and then comes to a stop.
2. Turn the MAIN DISCONNECT switch (Lockout Point E-1) to the off position at the PDP main control panel.
3. Open the cell guard door.
4. Disconnect all air and electrical connections from the robot to the end of arm tooling (see callout **A** in *Figure 7-10*).
5. While supporting the end of arm tooling, remove the 10 bolts securing the end of arm welded post (see callout **B** in *Figure 7-10*) to the robot attachment plate (see callout **C** in *Figure 7-10*).
6. Remove the end of arm tooling from the robot.
7. After adjusting or replacing any necessary tooling, install the end of arm tooling to the robot by tightening the bolts the secure the welded post to the robot attachment plate.
8. Connect all air and electrical connections from the robot to the end of arm tooling.
9. Close the cell guard door.

7.11. EB420R01/EB440R01 DISPENSE ROBOT END OF ARM TOOLING

To replace the end of arm tooling (see callout **A** in *Figure 7-11*) on the Dispense Robots, complete the following steps:

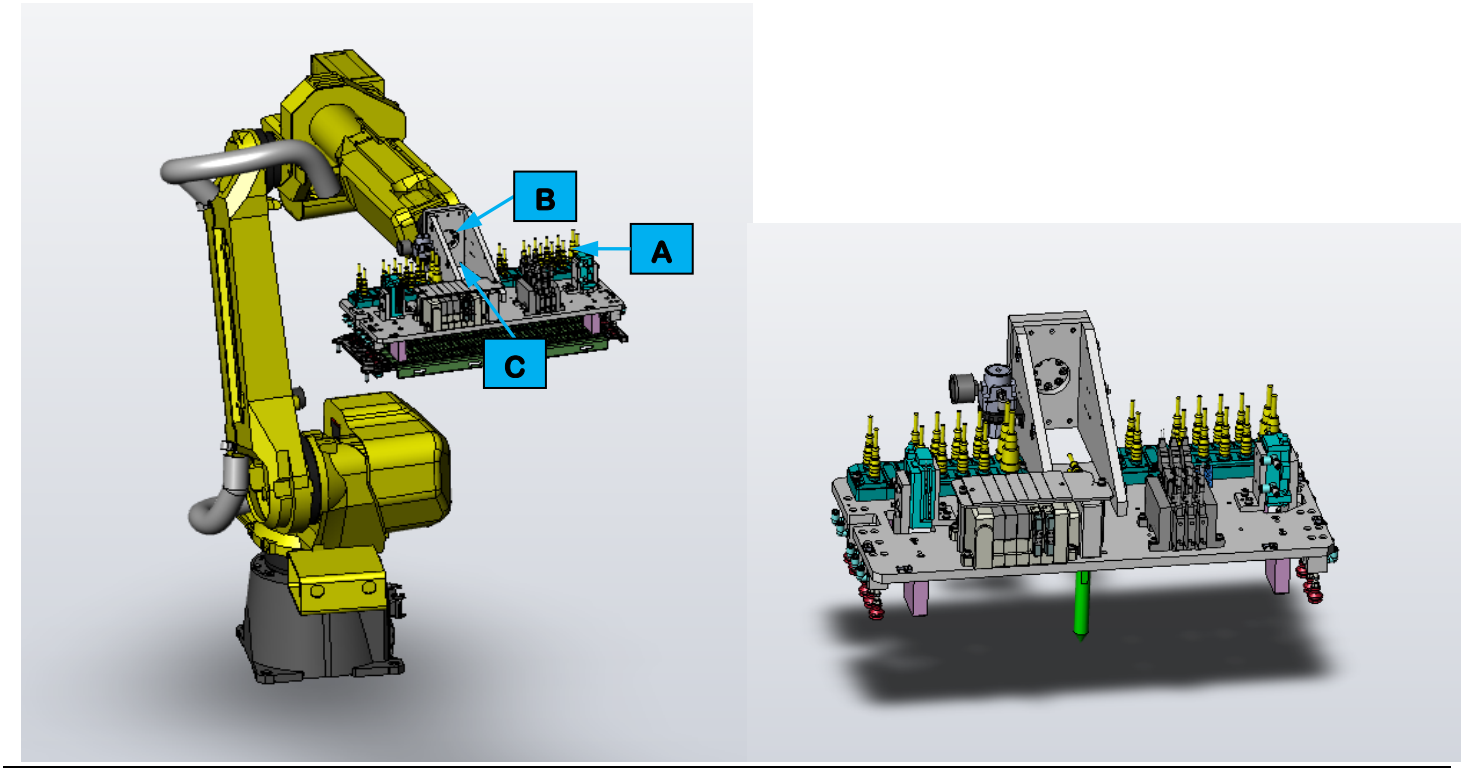

Figure 7-11. An illustration of the Dispense Robot end of arm tooling.

1. Safely stop the cell by navigating to the Service screen and touching the **PREPARE FOR STOP** button. The cell completes its current cycle and then comes to a stop.
2. Turn the MAIN DISCONNECT switch (Lockout Point E-1) to the off position at the PDP main control panel.
3. Open the cell guard door.
4. Disconnect all air and electrical connections from the robot to the end of arm tooling (see callout **A** in *Figure 7-11*).
5. While supporting the end of arm tooling, remove the 7 bolts securing the end of arm welded post (see callout **B** in *Figure 7-11*) to the robot attachment plate (see callout **C** in *Figure 7-11*).
6. Remove the end of arm tooling from the robot.
7. After adjusting or replacing any necessary tooling, install the end of arm tooling to the robot by tightening the bolts the secure the welded post to the robot attachment plate.
8. Connect all air and electrical connections from the robot to the end of arm tooling.
9. Close the cell guard door.

7.12. EB450R01 PRESS UNLOAD ROBOT END OF ARM TOOLING

To replace the end of arm tooling (see callout **A** in *Figure 7-12*) on the Press Unload Robot, complete the following steps:

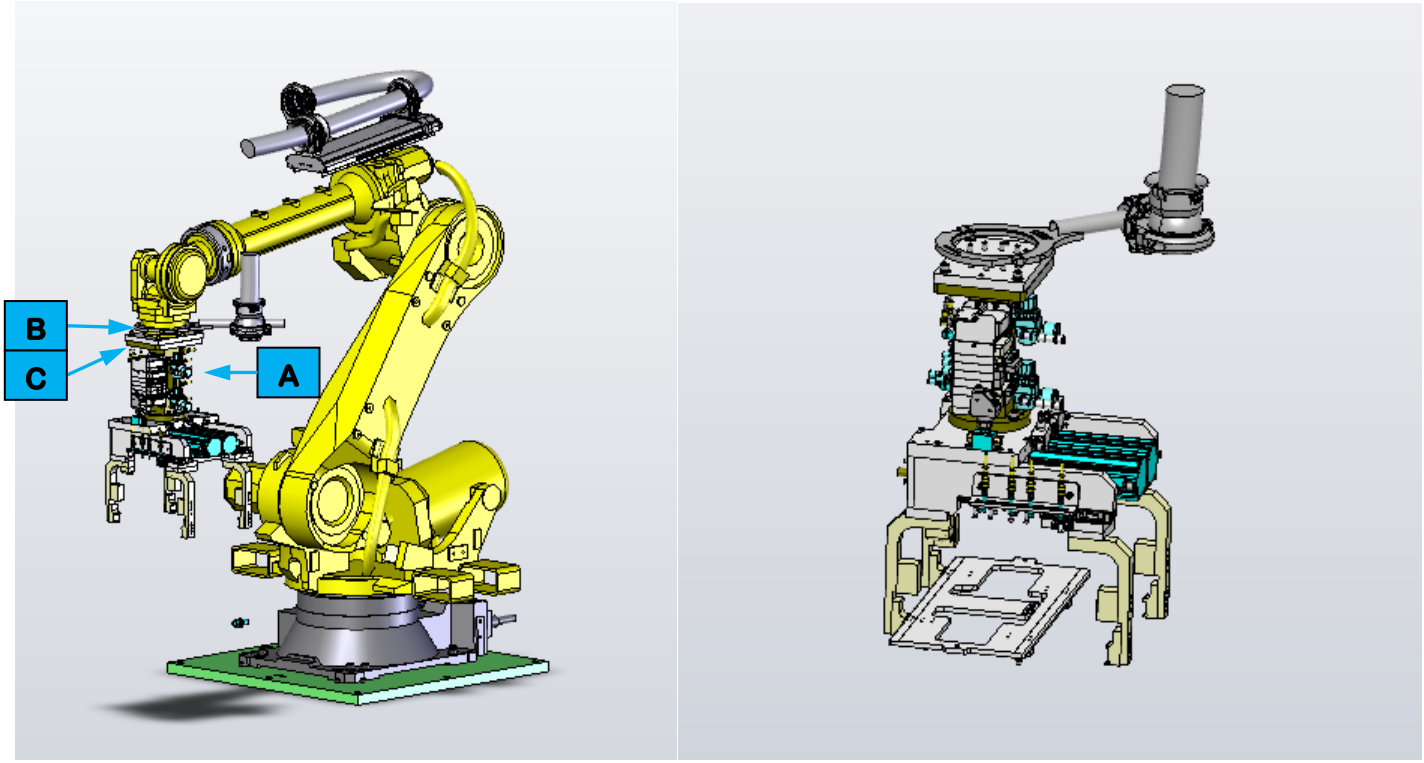

Figure 7-12. An illustration of the Press Unload Robot end of arm tooling.

1. Safely stop the cell by navigating to the Service screen and touching the **PREPARE FOR STOP** button. The cell completes its current cycle and then comes to a stop.
2. Turn the MAIN DISCONNECT switch (Lockout Point E-1) to the off position at the PDP main control panel.
3. Open the cell guard door.
4. Disconnect all air and electrical connections from the robot to the end of arm tooling (see callout **A** in *Figure 7-12*).
5. While supporting the end of arm tooling, remove the 10 bolts securing the end of arm welded post (see callout **B** in *Figure 7-12*) to the robot attachment plate (see callout **C** in *Figure 7-12*).
6. Remove the end of arm tooling from the robot.
7. After adjusting or replacing any necessary tooling, install the end of arm tooling to the robot by tightening the bolts the secure the welded post to the robot attachment plate.
8. Connect all air and electrical connections from the robot to the end of arm tooling.
9. Close the cell guard door.

8. INSTALLATION

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8.1. LONG TERM STORAGE

If the system is not installed immediately after delivery, it must be stored in a protected and dry location. It must be covered up appropriately to prevent moisture infiltration.

The system must not be stored out of doors. Shiny components are not protected with long-term preservation against climatic influences. Electrical cabinets and other electrical equipment are not rainproof.

If the shipping cover is removed the machine is not protected.

8.2. COMMISSIONING

This section outlines procedures for installing the Stacker Line. After the Factory Acceptance Test at the manufacturing facility, the system is broken up into major assemblies which are then vacuum sealed into an appropriate shipping material and secured inside custom-built wooden crating, then delivered to the GM facility. Care should be taken when unpacking system components.

In general, ATS personnel are ready to install, configure, and troubleshoot the installation of the Stacker Line. If this system is installed or moved without ATS assistance the following instructions are to be used as a guideline.

For a new install, it is recommended to install components as they are delivered from the manufacturer, as opposed to waiting for the full delivery. For example, as one cell tooling arrives, install before starting the remaining cells.

For the previously disassembled system, it is recommended to install according to the teardown map created in the removal section of this document. For example, ensure all of one cell components are present in the staging area before beginning the installation.

8.2.1. Required Personnel

All installations are to be conducted by trained and ATS-approved personnel. During installation, all personnel within the work area must be ATS-approved installation personnel, unless otherwise approved by the ATS project (or program) manager.

8.2.2. Installation Facility

The main requirement is a facility that meets the minimum space needs of the project, as shown in the engineering documents supplied by ATS. The facility must have a flat, reinforced concrete floor with a minimum thickness that complies with local building code. The facility must also be capable of delivering the required facility resources.

8.2.3. Installation Overview

Install the Stacker Line in the following general steps.

8.2.3.1. Draw Installation Locations on Facility Floor

On the facility floor, indicate with chalk markings or other marking system exactly where conveyors, electrical enclosures, and tooling are to be installed. Refer to engineering drawings supplied by ATS. Only authorized ATS personnel should perform this task.

8.2.3.2. Unpack Shipped Components

Carefully unpack all components shipped from the manufacturer, using heavy lifting equipment where necessary to remove components from the vacuum-sealed wooden crates. Check contents against the shipping documents. Place unpacked components for assembly in a suitable staging area as close as possible to the layout marked out on the facility floor.

8.2.3.3. Install Main Structure

Install the main structure for the cell.

8.2.3.4. Install Conveyor System

Where suitable, install the conveyor system to the cell.

8.2.3.5. Install Zone Tooling

Install all robots, feed systems, and other tooling system to the cell.

8.2.3.6. Install Electrical Enclosure and Pneumatic Controls

Install the electrical enclosure and pneumatic controls unit for the cell.

8.2.3.7. Connect the Facility Electrical Supply

When safe to do so, connect the facility electrical supply to the cell.

8.2.3.8. Connect Facility Air Supply

When safe to do so, connect the facility air supply to the cell.

8.2.3.9. Install All Safety Guarding

Where suitable install safety guarding to the cell.

8.2.3.10. Repeat for All Cells

Continue to install all cells of the Stacker Line until the Line is fully assembled.

8.3. LIFTING POINTS

WARNING!

To prevent severe injury or equipment damage, use only appropriate lifting equipment and use caution when lifting and handling equipment. Always follow local laws and regulations and third-party equipment guidelines.

8.3.1. Fanuc R-2000 iC Robot Lifting

Lift the Fanuc R-2000 iC robots using the fork tubes on the robot base.

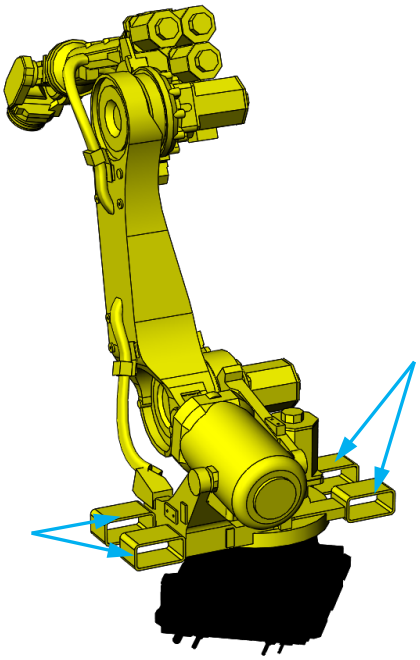


Figure 8-1. Fanuc R-2000 iC lifting points.

REFERENCE

For more information about lifting the robot, refer to the equipment supplier documentation (Fanuc Robot R-2000 iC Mechanical Unit Operator's Manual pg. 1-10).

8.3.2. Fanuc M-10 iA Robot Lifting

The Fanuc M-10 iA robots can be lifting with a crane using two eyebolts and two slings or can be lifted using a forklift by using the forklift attachment brackets. The proper lifting techniques are shown in ***Figure 8-2***.

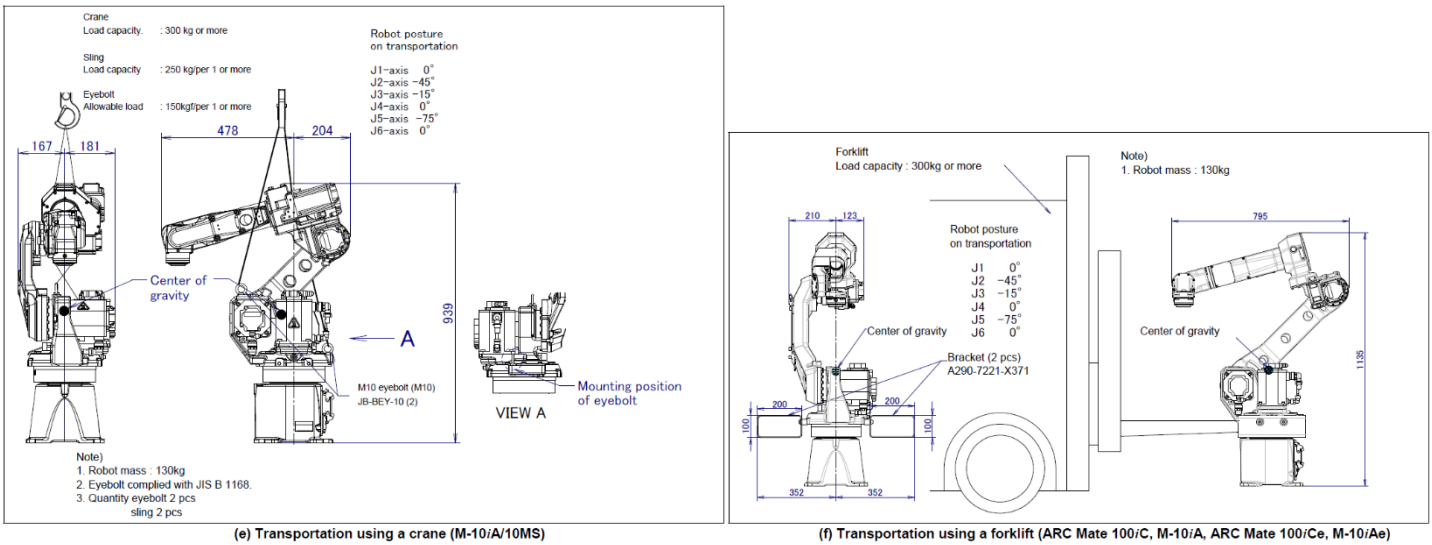


Figure 8-2. Fanuc M-10 iA lifting points.

REFERENCE

For more information about lifting the robot, refer to the equipment supplier documentation (Fanuc Robot M-10 iA Mechanical Unit Operator's Manual pg. 1-6).

8.3.3. Fanuc M-20 iA Robot Lifting

The Fanuc M-10 iA robots can be lifting with a crane using two eyebolts and two slings or can be lifted using a forklift by using the forklift attachment brackets. The proper lifting techniques are shown in ***Figure 8-3***.

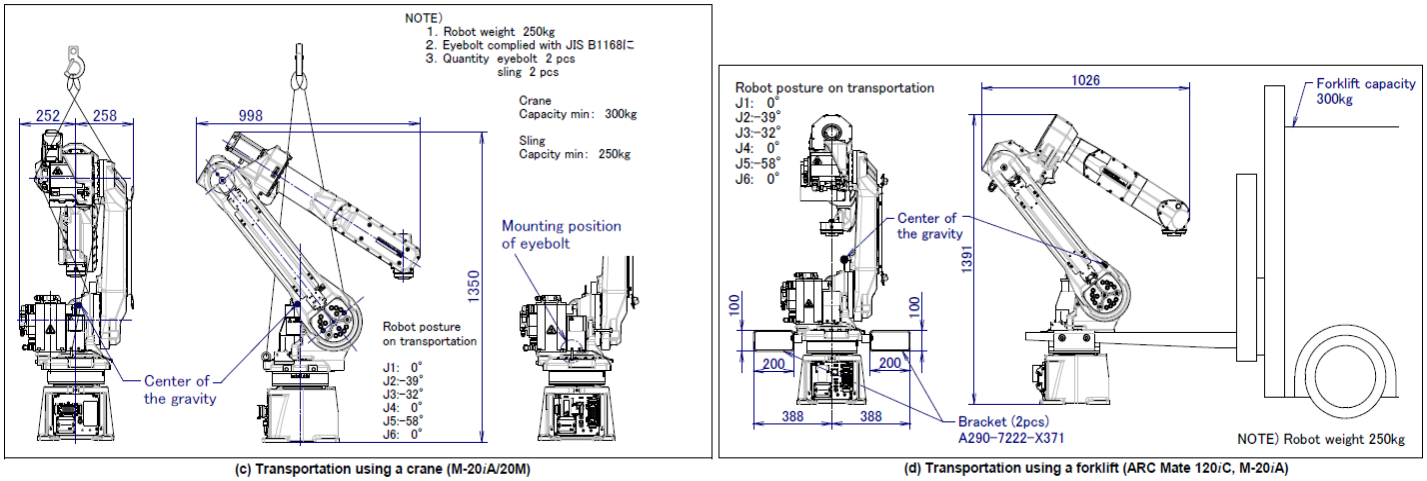


Figure 8-3. Fanuc M-20 iA lifting points.

REFERENCE

For more information about lifting the robot, refer to the equipment supplier documentation (Fanuc Robot M-20 iA Mechanical Unit Operator's Manual pg. 1-4).

8.3.4. PDP / Cabinet Lifting

Lift each PDP using the eyebolts on the top of the cabinet.

Figure 8-4. PDP lifting points.

8.3.5. Programming Terminal Lifting

Lift each programming terminal using the eyebolts on the top of the cabinet.

Figure 8-5. Programming terminal lifting points.

8.3.6. Fume Extractor Lifting

Lift each fume extractor using the four silver lifting points on the top of the device.

NOTE

There are two more lift points on the opposite side of the device.

REFERENCE

For more information about moving the fume extractor, refer to the equipment supplier documentation (Donaldson Torit Downflo LS Installation, Operation and Maintenance Manual pg. A4).

Figure 8-6. Fume extractor lifting points.

8.3.7. Chiller Cabinet Lifting

Lift each chiller using the eyebolts on the top of the cabinet.

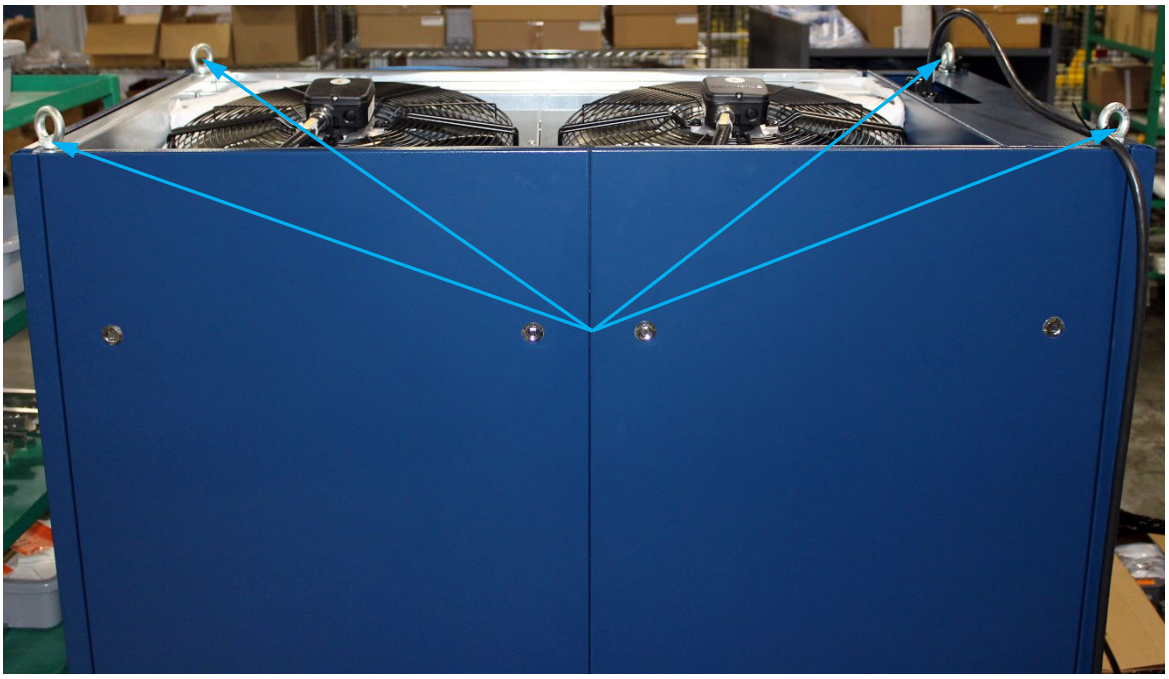


Figure 8-7. Chiller lifting points.

REFERENCE

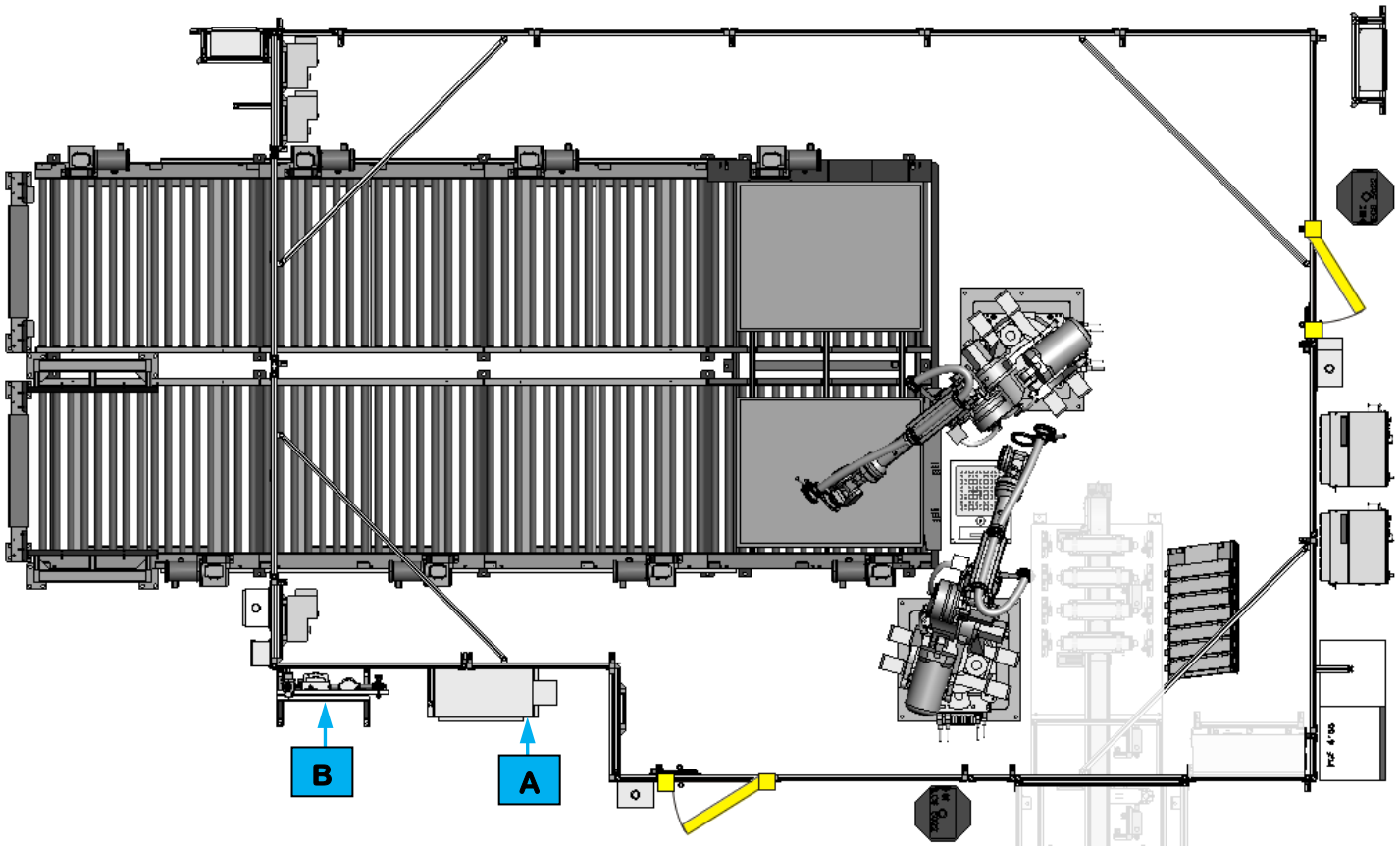
For more information about moving the chiller, refer to the equipment supplier documentation (Dimplex – Riedel Chiller Operating Instructions pg. 23-26).

8.4. EQUIPMENT WEIGHTS

Device	Weight (lbs.)	Weight (kg.)	Notes
Donaldson Torit Downflo LS	1,000	454	Based on Downflo Oval weights, LS weight info unavailable
Fanuc R2000 iC Robot	2,403	1,090	Without controller
Fanuc M-10 iA Robot	287	130	Without controller
Fanuc M-20 iA Robot	551	250	Without controller
Fanuc RTU	14,088	6,390	
Reidel Chiller	417	189	
SuperTrak Straight Section (1 Meter)	600	272	
SuperTrak 180° Section	545	247	
SuperTrak Control Panel Assembly	1,296	588	
Trumpf Trudisc 2000	1,267	575	

8.5. CONNECTION POINTS

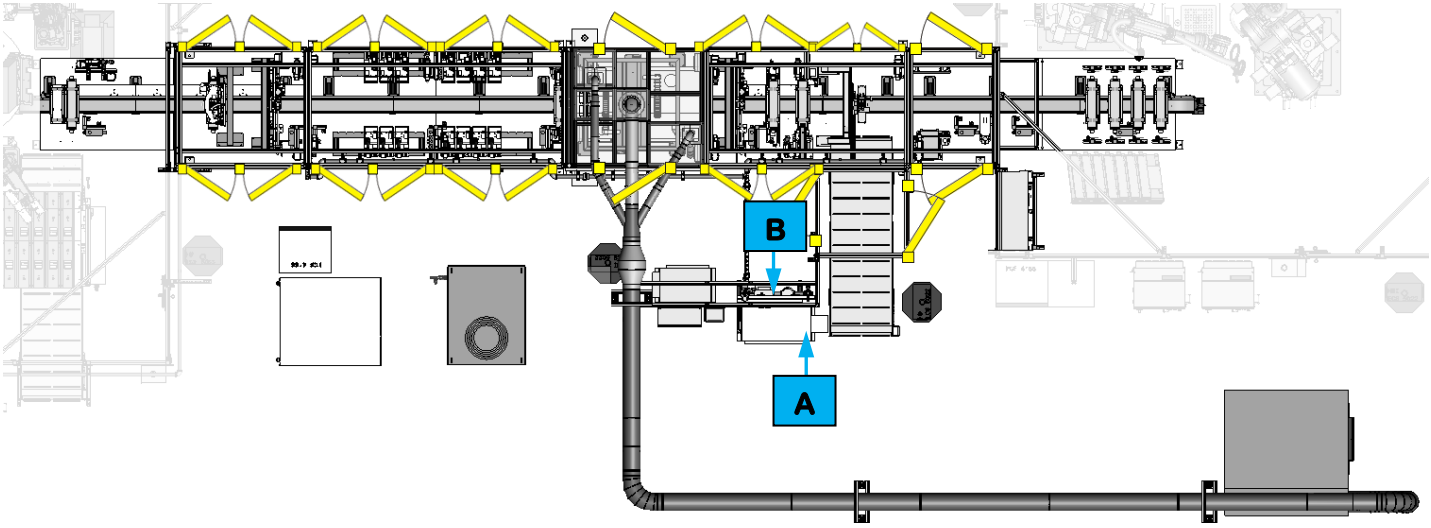
8.5.1. Cell Load Utility Connections



Connection Callouts in Figure 8-8		
A	Electrical Supply Connection	480 Volt 3 Phase 100 Amps
B	Air Supply Connection	65 PSI 55 Max. CFM

Figure 8-8. Cell Load utility connection points.

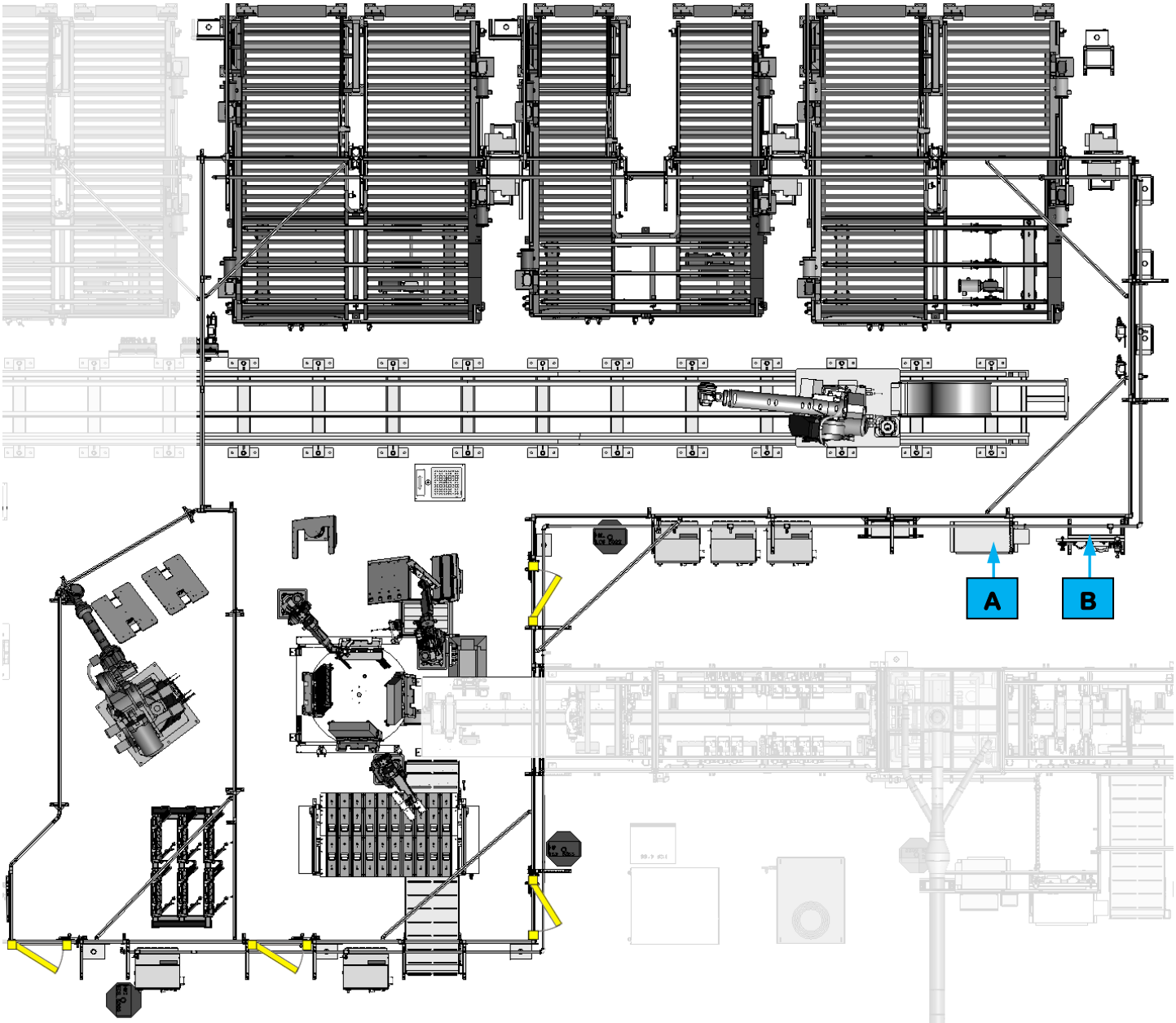
8.5.2. Cell Processing Utility Connections



Connection Callouts in Figure 8-9		
A	Electrical Supply Connection	480 Volt 3 Phase 200 Amps
B	Air Supply Connection	75 PSI 75 Max. CFM

Figure 8-9. Cell Processing utility connection points.

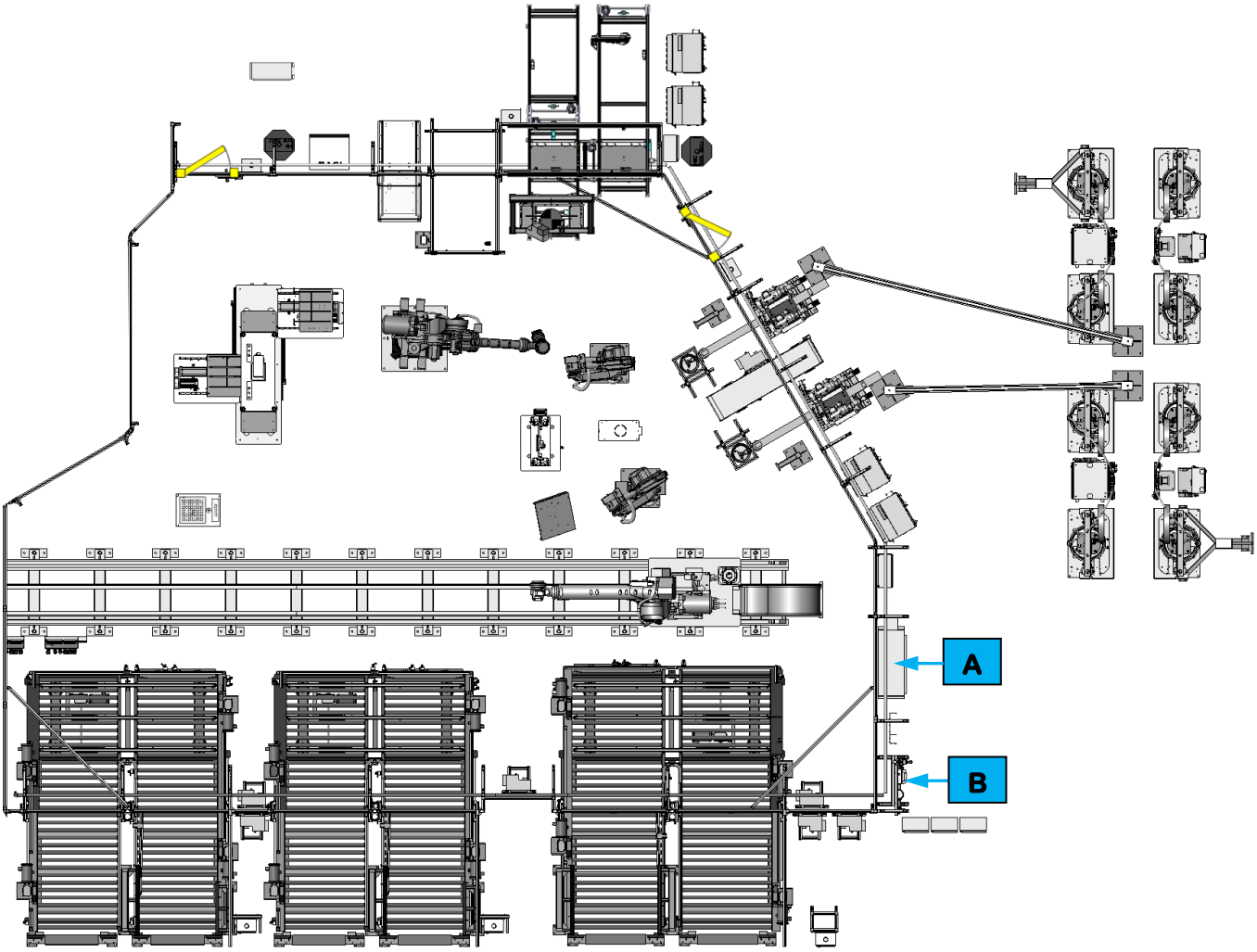
8.5.3. Cell Stacking Utility Connections



Connection Callouts in Figure 8-10		
A	Electrical Supply Connection	480 Volt 3 Phase 100 Amps
B	Air Supply Connection	65 PSI 60 Max. CFM

Figure 8-10. Cell Stacking utility connection points.

8.5.4. Module Assembly Utility Connections



Connection Callouts in Figure 8-11		
A	Electrical Supply Connection	480 Volt 3 Phase 200 Amps
B	Air Supply Connection	65 PSI 105 Max. CFM

Figure 8-11. Module Assembly utility connections.

8.6. UTILITIES

The Stacker System has the following utility requirements:

		Cell Load (EB020)	Cell Processing (EB040)	Cell Stacker (EB300)	Module Assembly (EB400)
Compressed Air Supply	Air Pressure (PSI)	65	75	65	65
	Max. CFM	55	75	60	105
	Supply Pipe Size	1.5″	1.5″	1.5″	1.5″
Electrical Supply	Equipment Volts	480	480	480	480
	Equipment Phase	3	3	3	3
	Main Disconnect Amps	100	200	100	200

8.7. DECOMMISSIONING

This section outlines procedures for disassembling for moving or removal of the Stacker Line.

In General, ATS personnel are ready to disassemble, reconfigure, and assist in moving the Stacker Line. If this system is disassembled or moved without ATS assistance the following instructions are to be used as a guideline.

8.7.1. Disassembly Planning

Before the disassembly process, a disassembly plan should be created. This plan should outline:

1. The General Manager of the disassembly operation and their team.
2. Local staging area for disassembled components (the "Teardown Map").
3. Moving and Shipping strategy.
4. Destination staging area for disassembled components.
5. Final reassembly location for assembling disassembled components.
6. A disposal plan, if necessary.

8.7.2. Disassembly Overview

The following steps are a high-level overview of the disassembly process.

8.7.2.1. Observe Safety Precautions

All personnel involved with the disassembly should review safety and potential safety hazards as described in Chapter 2-Safety. All hazardous energy sources must be isolated from the machine prior to disassembly.

8.7.2.2. Review to the Teardown Map

All personnel involved with the disassembly should fully understand the Teardown Map prior to the disassembly.

8.7.2.3. Label Each Item Clearly

All components, tooling, guarding, and devices should be labeled before disassembly to ensure correct reassembly, including labelling all wiring, air lines, and cabling.

8.7.2.4. Ensure System is Clear

Ensure the system is clear of all workpieces, including inside enclosures. Ensure all air lines have been vented, feeder lines cleared, and all products have been removed from the cells and equipment.

8.7.2.5. Disassemble and Remove Electrical Enclosure and Pneumatic Controls

Disconnect and remove the electrical enclosure and pneumatic controls unit from the cell.

8.7.2.6. Disassemble and Remove All Safety Guarding

Disassemble and remove safety guarding from the cell.

8.7.2.7. Disassemble and Remove Tooling

Disconnect and remove all robots, lift assists, feed systems, and other tooling systems from the cell.

8.7.2.8. Disassemble and Remove Conveyor Systems

Disconnect and remove all conveyor equipment from the cell.

8.7.2.9. Disassemble and Remove Main Structure

Disassemble and remove the main structure for the cell.

8.8. PACKING AND MOVING

It is recommended that you retain the original packaging of the system if there is an expectation of moving the system to another facility in the future. Follow these general steps to safely move the system:

1. Before packing or moving the system, ensure the system is clear of all parts, the system is drained of all fluids, and all electrical and air connections are disconnected (see ***Section 8.4 CONNECTION POINTS***)
2. Follow the disassembly procedure (see ***Section 8.6 DECOMMISSIONING***)
3. Load and secure the disassembled parts of the system into crates, skids, and packaging appropriate for moving the parts of the system.
4. Once the system has been moved, follow the assembly procedure (see ***Section 8.2 COMMISSIONING***).

Refer to the OEM manuals for specific moving requirements for system equipment not covered by this manual. Contact ATS with any questions on disassembling, moving, or reassembling the system.

8.9. DISPOSAL

If the entire Stacker Line is to be disposed of (i.e., at the end of the product's lifecycle) the disassembly process will follow the Disassembly Plan for the disposal contingency, with the addition of the following general, disposal guidelines:

1. All third-party components on the machine should be disposed of in accordance with relevant OEM product documentation.
2. All hazardous materials should be disabled or isolated to prevent accidental re-use in the wrong hands. Disposal of such hazardous materials should be done either through the original manufacturer or in accordance with local hazardous waste disposal rules.
3. Where possible and practical, disassembled components should be salvaged for re-use.
4. Careless disposal of any product that may pollute the environment should be avoided.
5. All remaining miscellaneous materials should be disposed of in accordance with local laws and regulations and any applicable national regulations.

9. PROCESS PARAMETERS

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9.1. EB020 CELL LOAD PARAMETERS

Battery Pack Variant	Process Step	Device	Parameter Setting	Parameter Value
BET/BEV	All	Main Air Prep	Air Pressure Regulator	65 PSI
		Air Shutoff	Air Pressure Switches	60 PSI

9.2. EB040 CELL PROCESSING PARAMETERS

Battery Pack Variant	Process Step	Device	Parameter Setting	Parameter Value
BET/BEV	All	Main Air Prep	Air Pressure Regulator	65 PSI
		Air Shutoff	Air Pressure Switches	60 PSI
BET/BEV	Laser Trim	Riedel Chiller	Thermostat	18°C/64.4°F
		Contact Tooling	Air Pressure Regulator	35 PSI

9.3. EB300 CELL STACKING PARAMETERS

Battery Pack Variant	Process Step	Device	Parameter Setting	Parameter Value
BET/BEV	All	Main Air Prep	Air Pressure Regulator	65 PSI
		Air Shutoff	Air Pressure Switches	60 PSI

9.4. EB400 MODULE ASSEMBLY PARAMETERS

Battery Pack Variant	Process Step	Device	Parameter Setting	Parameter Value
BET/BEV	All	Main Air Prep	Air Pressure Regulator	65 PSI
		Air Shutoff	Air Pressure Switches	60 PSI