This Standard of Requirements is working in conjunction with document to **EHSP-207 H&S Machine and Equipment Standard of Requirements for Vendors.** Both documents should be used in conjunction when purchasing or modifying machinery or equipment within Tiercon Corp and Coplas Inc.

Table of Contents and Master revision List

1.0 Scope

Tiercon Plastics Equipment Design and Build Specification:

(Hereinafter may be called the “Specification”)

The scope of this document is to provide general specifications for the design and fabrication of industrial equipment. Tiercon has implemented the “Tiercon Equipment Design and Build Specification” as a communication tool to ensure that equipment shall be built for maximum safety, performance and maintainability. This specification shall represent a baseline, which may assist Tiercon employees in policing the design, fabrication and purchase of industrial equipment. This specification is also intended for use by our Suppliers, to communicate clearly, Tiercon’s expectations in quality for industrial equipment.

We do not wish to limit the creativity of our suppliers or their suggestions relating to new technology and improved methods of accomplishing our goals. We wish to instill an open line of communication with our suppliers and request that our employees are involved in decisions that may conflict with these specifications.

The “Tiercon Equipment Design and Build Specification” is intended to promote.

- Safety
- Environmental Awareness and Improvements
- Component Consolidation
- Minimum Purchase and Operational Costs
- Focused Supplier Support
- Conservation of Energy
- Implementation of New Technology
- Long Term Planning and Development
- Equipment Capability and Repeatability
- Supplier Responsibility
- Equipment Maintainability
- Quality of Equipment, Tooling and Fixtures supplied

2.0 General

2.01 All equipment quotations must include reference to the latest revision of the Specification.

2.02 The "Specification Acknowledgement Form" must be agreed upon and completed prior to acceptance of a purchase order or commencement of any work.

2.03 The acceptance of the purchase order whether written or verbal shall also deem acceptance of the Specification unless indicated by the supplier in writing on the "Specification Acknowledgement Form" and endorsed by the originator.

2.04 Suppliers of Tooling, Assembly Equipment and Fixtures must be registered to a minimum Quality Management System Requirements Standard ISO9001:2000

2.05 We wish to work with suppliers that operate in a manner that will help us to attain the Tiercon vision, "To be the preferred supplier of injection molded products".

2.06 We shall conduct business with preferred suppliers who believe in and demonstrate the following:

- Safety - following the "Occupational Health and Safety Act and Regulations for Industrial establishments", Ontario, Canada as well as rules and regulations under the "Ministry of Environment and Energy" (MOEE). USA regulation apply in the case of CoPlas ie. Following the "Occupational Safety and Health Administration – OSHA"
- Integrity
- Teamwork
- Speed
- Innovation
- Performance
- Open communication
- Lawful and ethical business practice following all laws of Ontario, Canada
- Quality

2.07 Documented communication from our vendors, in the form of timing charts and problem solving checklists are expected at least every 2 weeks. A project gant chart shall be submitted with the quotation and be revised upon acceptance of the contract. Project progress reports, in gant chart form, shall be updated and submitted at the request of Tiercon. Changes in the scope of the project may require the timing chart to be revised. Any changes to original milestones and completion dates must be agreed upon by all parties involved.

2.08 A penalty clause may be part of the contract for late delivery of equipment. A bonus clause may also be part of a contract for early delivery. Tiercon reserves the right to take action against poor quality tools and/or slippage in timing. This may take the form of a tool transfer and/or financial recourse against the supplier.

2.09 Tiercon requires equipment and tooling to meet all design and process criteria. In addition, set up, change over, maintenance and troubleshooting must be achieved safely and efficiently. All fixtures will be "quick change" with no or minimal parts which have to be exchanged during changeover. Changeovers are a design criteria when changeovers are inevitable.

2.10 The equipment shall be designed around a Total Productive Maintenance (TPM) program. Easy access to lubrication points, valves, sensors, gear boxes, motors, etc. must be considered prior to any fabrication and assembly of equipment.

2.11 The use of statistics by suppliers to control their own process is desirable. In addition, it is a requirement of every supplier of every piece of equipment to prove to Tiercon that the equipment and tooling is statistically capable and repeatable of meeting all specifications and requirements.

2.12 Equipment shall be delivered with documentation and training.

2.13 All electrical components shall be CSA/UL and Electrical Panels have to have the Ontario Hydro/ESA approval and conform to OSHA standards.

2.14 All energies required (e.g. water, compressed air, gas, hydro, etc.) must be notified to Tiercon at the earliest point of the project. One single drop for air, water and power for each individually controlled machine.

2.15 A footprint of the machine to display energy drop locations (e.g. power, air and water) should be made available at the earliest point of the project.

2.16 All temperature, level, flow, pressure, proximity and limit switches and valves shall be labeled with brass tags displaying stamped letters representing component description, address, station number etc.

2.17 All electrical boxes and enclosures to be labeled with Lamacoid labels - black letters on white.

2.18 All safety items shall be labeled with Lamacoid labels - black letters on yellow.

2.19 This document may be used by itself in whole, or with additional documents in the form of, purchase orders, meeting minutes, Tiercon part design drawings, statistical specifications, plant layout, government documents, etc.

2.20 Failure to meet this specification without written approval by Tiercon may result in the supplier being financially responsible for all corrections.

2.21 It is the supplier's responsibility to identify additional improvements that may increase the performance of any piece of equipment. Tiercon may offer reward and recognition if the improvements prove positive.

3.0 Drawings, Confidentiality and Design Review

3.1 Drawings

3.1.1 All drawings supplied by Tiercon are confidential and property of Tiercon. Drawings are NOT to be copied unless approved by Tiercon. All drawings supplied must be returned to Tiercon at project completion or as requested by a Tiercon employee.

3.2 Confidentiality

3.2.1 The supplier shall be required to sign a Confidentiality Agreement prior to any drawings release by Tiercon. This document acts as a binding contract and legal agreement pertaining to all “Confidential Information”.

3.2.2 It is standard operating procedure for Tiercon to enter into Confidentiality Agreements with its suppliers. The supplier must be prepared to sign this agreement if requested.

3.2.3 When Confidentiality Agreements are signed, all design proposals, drawings, programs etc. become the property of Tiercon regardless of their physical location.

3.2.4 At the written request of Tiercon, equipment shall be designed and fabricated in camera. (Def. in camera; private, behind and enclosure, in secrecy)

3.3 Design Review

Definition of design approval: This approval is only an acknowledgement by Tiercon to the supplier that the general equipment concept is within the purchase order requirements and that all sections of the Specification have been followed. This approval does not wave the responsibility of the supplier to make the equipment function as per the specification criteria established in this document and in additional documents such as the purchase order.

3.3.1 A design review by Tiercon shall be conducted at the detailed design stage. At this time, initial compliance to the Purchase Order, the project team will address the specification, safety concerns and ergonomic issues. (Supplier and Tiercon representatives). At this point, Tiercon may provide approvals to continue.

3.3.2 Further reviews will be determined as needed by the Tiercon Project Manager. (Project/Process Engineer)

3.3.3 Supplier Responsibility: The supplier shall be responsible to ensure that the design is functional to all parameters documented in the Purchase Order, the Specification and any relative part drawings or layouts. If the supplier develops difficulties with any portion of the contract, it is the suppliers’ responsibility to inform Tiercon, in writing, of this difficulty.

4.0 Equipment Quotation

4.1 All equipment quotations must conform to the latest revision of the "Tiercon Equipment Design and Build Specification".

4.2 Quotations must include a written breakdown of the following:

- Cycle of operation
- Cycle time (seconds/cycle)
- Cycle time (gross parts/hour)
- Cycle time (net parts/hour at 88% efficiency)
- Key mechanical components to be used
- Key electrical components to be used
- Key hydraulic components to be used
- Estimated overall dimensions
- Concept drawings
- Floor plan drawings
- Energy required (air, hydro rating, water, etc.)
- Delivery time in weeks.
- Quick changeover tooling/components/mechanical aids/dies carts/etc.

4.3 Quotation financials must include a written breakdown of the following:

- Price of design portion for equipment
- Price of material portion of equipment
- Price of labour portion for equipment
- Price to ship equipment to Stoney Creek, Ontario.
- Total price of equipment in Canadian dollars (excluding G.S.T. &P.S.T.)

4.4 Quotation payment terms to be Net 7 days after customer payment.

4.5 Quotation delivery times must hold for a period of 1 month.

4.6 Quotation delivery terms shall be negotiated at time of purchase order - pending size of project, supplier responsibilities and Tiercon's requirements.

4.7 Penalty clauses for late delivery shall be negotiated prior to issuance of a Purchase Order.

4.8 A delivery schedule in gant chart form to be submitted at time of quotation. This schedule shall be revised at time of purchase order. The schedule will be the key tool for both parties to achieve specified milestones and avoid project pitfalls. Tiercon shall monitor this schedule for any delays to the project. This tool promotes open communication and project updates.

4.9 If for any reason a request for quotation is declined, Tiercon requires that the request for quotation package be returned immediately.

5.0 Mechanical Specifications

5.01 All equipment designs must be approved by The Tiercon Technical Representatives prior to build commencement. This approval is only an acknowledgement by Tiercon to the supplier that the general equipment concept is within the purchase order requirements and that all sections of the Specification have been followed. This approval does not wave the responsibility of the supplier to make the equipment function as per the specification criteria established in this document and in additional documents such as the purchase order.

5.0.2 Equipment shall be designed for safety, ergonomics, maintainability and tool free changeovers.

5.0.2.1 All manual, semi-automated, or automated, mobile / stationary “scissor style” lift tables, carts, operator stations, or production equipment must include a “skirt” / “bellows” or similar protective device(s) on all open/exposed sides/areas. See “EXAMPLE” below.

5.0.3 Equipment shall be designed, fabricated, wired, programmed and debugged prior to delivery to Tiercon.

5.1 Fasteners

5.1.1 Fasteners that would be removed, loosened or adjusted during a changeover should be a consistent size to facilitate the changeover and maintenance.

5.1.2 All screw products to be imperial size threads when possible.

5.1.3 All screw products should meet ANSI B18.3 DIN and BS standards. The lot should be traceable even without the shipping container.

5.1.4 All hex head screw products should be Grade 5 or better. (Unbrake or H.K only)

5.1.5 All socket head screw products should conform to Grade 9 standards.

5.1.6 All threaded rod (Ready Rod) should be Grade 5 or better.

5.1.7 All dowel pins shall conform to ANSI standards for Hardened Ground Machine Dowel Pins. All dowel pins shall be a pull type. The effective length must not be less than 75% of the overall length of the pin.

- General rule: use dowel pins of the same size (diameter) as the screws used in fastening the work.
- General rule: the length of the dowel pin should be about one and one half to two times the diameter in each part to be doweled.

5.1.8 Cotter pins and clevis pins shall conform to ANSI standards.

5.1.9 When possible, ANSI standard helical spring lock washers should be used with screw products to protect against loosening.

5.1.10 When possible, for changeover items, use tool less fasteners such as thumb screws, hand wheels, ball plungers, T nuts, etc.

5.1.11 When possible, for any adjustable set-up components, use “Siki” calibrated adjustment devices. Consult the Tiercon Engineer for changeover design approvals.

5.2 Structural Welding

5.2.1 Any structural welding must conform to ANSI/AWS welding codes under their latest revisions.

5.2.2 All pressure vessels shall be equipped with a suitable safety relief valve that can be manually tested. All pressure vessels must be provided with the appropriate nameplates showing CRN’s, OIN#’s, etc. Documentation including the Certificate of Inspection must be provided. Absolutely, no welding or modifications shall be conducted on a certified pressure vessel. (Must meet TSSA requirements)

5.2.3 Design drawings shall display weld locations using the ANSI symbol designation.

5.2.4 All welded machine frames must be stress relieved after welding.

5.2.5 Machining of frame pads must be performed after frame stress relieving.

5.3 Bearings

5.3.1 All bearings must have seals, shields or wipers.

5.3.2 Pillow block mounted bearings must have grease nipples installed.

5.3.3 Pillow block mounted radial bearings must use a compression collet or eccentric lock collar to secure the bearing to the shaft. Using a set screw and collar is not acceptable.

5.4 Drivers

5.4.1 All sliding, pivoting or rotating surfaces must have some form of bearing application for wear resistance and maintainability.

5.4.2 Motors driving reducers should be mounted horizontally wherever possible. Motors mounted vertically above the reducer are acceptable. A motor mounted vertically below the reducer is not acceptable.

5.4.3 All drive systems shall be guarded accordingly.

5.5 Lubrication

5.5.1 All machines to have centralized wear lubrication points.

5.5.2 All lubrication distribution tubing to be steel unless flexible connection is required, where hydraulic grade hose will be used.

5.5.3 Where auto lubrication is not used - all lubrication points must be piped to a common or centralized header. Lubrication of a machine must be accomplished without removal of guards.

5.5.4 Lubrication materials shall be specified by the bearing or applications designer. Consult Tiercon for common lubricants used in the facility.

5.6 Manual Assembly Table

5.6.1 2” sq. tube frame, ¼ - ½” with steel top (optional ¾ laminate), 34” high table base, 53” high O/H light frame, fork pockets (24”ctr Tiercon 352, 32”ctr Tiercon Oshawa), 4” setback of base frame bottom front tube (toe kick), backboard/peg board for Work Instructions, operator fan (JAN FAN model JF-12F).

5.6.2 12” height adjustment (Suspa MLS-0007, ErgoSwiss or Dynalift 4M-DIA-12-S), 4” casters.

5.6.3 “Frame in Frame” adjustability for ensure table stability if height adjustments fail, table will not collapse. See below for sample.

5.6.4 4’ T5 dual fluorescent fixture (Deluce DLVP254HO) or 4’ LED fixture (Lithonia FMLWL 48 review colour temp), 4’ T8 dual fluorescent fixture for adpro applications (Viscor IND2 with wire guards) (Symban F32T8/BL lamp), electrical outlet and light switch, BX cable from light to switch.

5.7 Tools for assembly tables

5.7.1 A variety of manual, electrical, electro-mechanical tools can be used on the assembly tables. The approved list of tools is provided in table 18.1 Mechanical components.

5.7.2 For re-using existing tools, cables, controllers, etc., or purchasing used ones consult with tooling engineer and plant maintenance.

5.8 Manual Press

5.8.1 Capable of 45psi for adhesive tape wetout or enough to insert clip.

5.8.2 Hand wheel to be used to obtain correct force but handle cannot fall freely or return to home position freely to protect the operator onto operator. ***Review with plant to ensure the proper selected item is approved.***

5.8.3 Use of a counterbalance is recommended to reduce operator effort.

5.8.4 Guard rack if exposed.

5.9 Manual Degate

5.9.1 Cutting blade to be guarded at home position and labeled as “SHARP”

5.9.2 Pinch points must be guarded

5.10 Equipment Lighting – General.

5.10.1 Any and all 3-sided enclosed equipment must include interior lighting sufficient to allow clear visibility of interior components. More than one light source may be required. **Minimum requirement 10foot candles.**

6.0 Electrical Controls Specification

6.1 General

6.1.1 Plant 1: Tiercon voltage is 575 V AC 3 phase nominal 60 Hz.
Plant 2: CoPlas voltage is 480 V AC 3 phase nominal 60 Hz.

6.1.2 Control voltage is 24 Volts DC.

6.1.3 110 voltage AC 60 Hz is available for general facilities, office, motors under 1/2 HP, computers.

6.1.4 Electrical Wires Colour Code:

6.1.4.1	Machine neutral, or common from the secondary of the control transformer:	White
6.1.4.2	Protective Ground, PG	Green-Yellow
6.1.4.3	Line, 1 PH	Red or Black (if high current)
6.1.4.4	Remote AC Interlock	Yellow with Red Stripe

6.1.4.5	Remote DC Interlock	Yellow with Blue Stripe
6.1.4.6	Remote Interlock, two controllers/ two pieces of equipment:	Yellow.
6.1.4.7	Line, 3 PH, L1	Red
6.1.4.8	Line, 3 PH, L2	Black
6.1.4.9	Line, 3 PH, L3	Blue
6.1.4.10	DC	Blue
6.1.4.11	DC Common	Blue & White stripped
6.1.4.12	Jumper wires in panels	Purple
6.1.4.13	Control wire insulation	Red, except:
6.1.4.13.1	Wire in flexible rubber covered cord.	
6.1.4.13.2	DC power voltage	Blue
6.1.4.13.3	Power wires, (motors, heaters, etc.) (except SEW2 which may be White)	Black,

6.1.5 All electrical design and wiring shall be done in strict accordance to the current CSA and ESA. In the case of CoPlas local electrical code must be followed.

6.1.6 All components must be CSA/UL approved. If CSA/UL approval is not evident on the exterior of the component, manufacturer's literature must be provided that indicates compliance. In the case of CoPlas UL approved applies and CSA can be superseded.

6.1.7 All electrical panels must have ESA, Electrical Safety Authority approval, and it is the supplier's responsibility to obtain PHSR, Pre-start and Safety Review, before a machine is shipped. In the case of CoPlas "All electrical panels must have ESA, Electrical Safety Authority approval" does not apply.

6.1.8 A divider plate is required between high voltage side and control voltage side.

6.2 Design/Construction

6.2.1 A machine will have one source of power only. If an interlock is connected from a machine with a different source of power, then dry relay contacts must be used.

6.2.2 Electrical enclosures must have NEMA 12 rating. No part of an electrical enclosure will be more than 7 feet 6 inches above floor level. Doors must incorporate a rolling latch mechanism such as the Allen-Bradley 1494F-L4 rather than using clamps. Doors 40 inches high or more must use a 3-point latch. All operation doors are to be interlocked.

6.2.3 Fuses must have an interrupt rating of at least 200,000 Amperes. Motor starters shall be fused with dual element; time delay fuses Class J or Class CC, or approved properly sized breakers. The contractor must supply properly sized fuses. Class CC time delay fuses are to be used for protection of control transformers where possible. All fuses and fuse holders should have the rejection feature.

6.2.4 A spare duplex receptacle and a programmer port should be provided on the electrical enclosure wall that contains a programmable device, or on HMI panel with Tiercon Automation Engineer approval. This receptacle should be fused to handle a programmer or computer or other backup devices.

6.2.5 AC motors should be 3 PH 575 VAC 60 Hz TEFC (Totally Enclosed Fan Cooled). The Tiercon Automation Engineer approval is required to use 110/230 VAC motors. Motors above 10 horsepower must be supplied with power factor correction capacitors. Motors must be selected for efficient energy consumption.

6.2.6 At least 30% spare terminal blocks will be provided in the electrical panel and at least 30% spare space will be reserved, for future developments.

6.2.7 At least 30% spare PLC I/O or 16 I/O, whichever is greater, is required for future additions to the controls circuit. These spare I/O shall be wired to the terminal blocks and marked as spares in the electrical schematic.

6.2.8 No more than two wires may be placed under one terminal block screw; duplicate terminal blocks using a suitable jumper strip shall be used to avoid more than two wires. Motor power wires may be connected directly to the starter rather than using terminal blocks. Terminal blocks shall be labelled with manufacturer original labels, and an industrial printer to write the labels should be used.

6.2.9 Timers, Control Relays, Power Supplies, are to be mounted on 35mm DIN rail, using standard square sockets (square base relay, not tube base relay). Relays should have an indicator light when it is energized.

6.2.10 All wires and terminals must be permanently labeled both ends with wire numbers. The locations for control relays, fuses, timers and starters must be labeled using Lamacoid labels. Motors, solenoid valves, limit switches, photoelectric and other sensors and actuators must be marked or tagged on or near the sensor.
The control system neutral conductor should be designated as wire number “DCCOM”.

6.2.11 Large control panels such as 36" by 60" or larger will be free standing, not fixed to the machine.

6.2.12 Operator control station is to be separate from main control circuits.

6.2.13 Surge protection must be used to protect control circuits.

6.2.14 Conduit will be liquid tight, run overhead, not on the floor, or a square wire trough may be used.

6.2.15 Conduits shall not be physically filled more than 70%.

6.2.16 All conduits will carry a minimum quantity of 4 or 10% extra wires, whichever is greater. Except: valves, these to have a minimum of 3 wires even if a single solenoid valve is used.

6.2.17 All junction boxes, including push button boxes, must have at least one DC positive wire from the main panel.

6.2.18 Low-level data handling wires must be in a separate conduit, except DC.

6.2.19 Motor wires must be in a separate conduit.

6.2.20 All I/O wires may be carried in the same conduit.

6.2.21 All flexible and non-metallic conduit must carry a separate ground wire.

6.2.22 Conduits between the control panel and the machine must not be on the floor.

6.2.23 All limits (this includes pressure switches and flow switches) must have an identification number stamped or legibly engraved on the machine adjacent to the limit. (Brass tags, plastic tags, laminated tags).

6.2.24 All valves, including pressure reducing valves, must have an identification (brass tags, plastic tags, and laminated tags) containing a number stamped or legibly engraved on the valve or machine adjacent to
the valve. This may be the output address number and operation description.

6.2.25 All push buttons and selector switches must have individual nameplates fastened with the mounting nut. Theses are to have black letters on a white background.

6.2.26 Control wires in a panel will be contained in wire ways of the slotted open construction type. These wire ways must not be physically filled more than 70%. Wires are not to be tied with wire ties inside the wire ways.

6.2.27 There is to be 1 1/2 inches between the wire ways (in the panel) and any relays or terminals blocks the wires are connected to.

6.2.28 The disconnect switch, control transformer, motor starters and power supplies are to be located in the top section of the control enclosure. Do not locate the control relay(s), terminal strips, control voltage fuses or programmable controllers in this area.

6.2.29 Control wires will be 16AWG stranded “machine tool wire” (MTW or TEW, 600V, 90 degrees Celsius) except:

- **6.2.29.1** Power wires (motors, heaters, etc.) which will be sized to the requirements of the device.
- **6.2.29.2** Wires to limits (proximity’s) and valves may be of the flexible rubber covered cord if liquid tight wire clamps are used on the ends.
- **6.2.29.3** Wires in high temperature applications such as heaters and furnaces shall be type SEW2 or equivalent.

6.2.30 All solenoids must have separate fuses with blown fuse indicator.

6.2.31 The machine may only be powered up in the “hand setup” or “manual” mode using a push button not the switch for auto selection; if using an HMI button machine should start in “no mode”, followed by the operator input in choosing “manual mode” or “auto mode”.

6.2.32 When switching from the manual to the automatic mode, there will not be any movement of the machine.

6.2.33 In case of a power failure, there shall be no mechanical movement of the machine. Fluid or air power cylinders will require double solenoid valves.

6.2.34 All independent motions in the machine must be able to be moved by the operator for setup purpose by an operator interface. This motion must be done safely, meaning safe to the operator as well as to the machine.

6.2.35 Equipment must sequence by sensor control, not timer control.

6.2.36 Two hand controls:

6.2.36.1 Push button must be individually guarded such that a flat object cannot operate them; in addition provisions will be done in programming to avoid this. There must be 24" between buttons.

6.2.36.2 Anti-repeat, anti-tie down circuits must not be defeatable by the operator.

6.2.36.3 Soft touch or capacitive proximity type two hand controls may be used (these are preferred as they are much more ergonomically friendly).

6.2.37 Limits and sensors:

6.2.37.1 Each limit to have its own input address.

6.2.37.2 All limits and sensors to be operated in such a way, if failing to fail safe. This usually precludes using it in the “normally open” mode.

6.2.37.3 All proximity sensors must have a wrap around LED for indication that the sensor has been “made”

6.2.37.4 All sensors shall be PNP (Sourcing)

6.2.38 Access to moving parts of the machine will be prevented by fixed guards or electrically interlocked service doors or panels.
Where access to hazardous areas of the machine is required between cycles in automatic mode, (such as loading parts), the area shall be guarded during machine cycle by light curtains or guarded doors with safety bar leading edges. Interruption of either device during machine cycle will immediately cause all rotating devices to stop and all axes to return to home position providing such action does not create additional hazards. Automatic modes shall switch to manual.

6.2.39 The Safety Relays or the Safety PLC controls the voltage to the outputs only. Power to the processor, input modules and lights will not be included in this wiring.

6.2.40 All motor starters will be controlled by an output of the programmable controller.

6.2.41 Each motor starter must be interlocked with the overload relay contact. Each overload relay must be wired to a separate input of the programmable controller to indicate status (tripped or set).

6.2.42 Fluid or air logic should not to be used to sequence the machine. Flow controls on fluid power units are to control the speed of the unit only.

6.2.43 24 VDC will be used for operating pneumatic valves, pilot lights, proximity sensors, limit switches and other position sensing devices.

6.2.44 110 volts A.C. may be used for operating the PLC and the HMI, but 24 VDC is recommended.

6.2.45 Room must be provided for expansion, either empty slots in the I/O rack, or room in the panel to add extra rack or expansion modules.

6.3 Robot Interface – Logic Sequence

6.3.1 The PLC shall provide a **minimum of two** signals to the robot but shall have the capability of providing up to a **maximum of four**.

a. Bring robot down.
b. Send robot up.
c. Reserved for future use.
d. Reserved for future use.

6.3.2 The PLC/Robot dialogue will interact in the following manner.

a. When the auxiliary equipment requires a part to be placed in the nest or remove a part from the nest: PLC to Robot – **Call robot down**.
b. When the robot has placed the part in the nest: Robot to PLC - **Robot is down**.
c. When the auxiliary equipment has completed its function or requires the robot to back off: PLC to Robot – **Call robot up**.
d. When the robot has removed the part or has backed off: Robot to PLC – **Robot is up**.

6.3.3 The auxiliary equipment shall have the capability to run in either *Manual Mode* or *Robot Mode*.

a. *Robot Mode* will not allow manual cycle.
b. The auxiliary equipment will run in *Robot Mode* when the PLC sees a Robot Mode input. This signal will come from a hardwired jumper located in the Robot/Aux. Equipment interface plug.

6.4 Robot Interface – Hardware

6.4.1 The hardware interface shall consist of one each of the following.

a. # 42.50.24.00 HTS Surface Mounted Housing
b. # 43.12.24.40 HTS Male (24 pin) Insert
c. # 04.42.68.24.00 HTS Protective Cover

6.4.2 The insert shall be oriented so that Pin 1 is located at the top.

6.4.3 Pin Connections

a. Pin 1 - +24 VDC from robot panel.
b. Pin 2 - Pin 1 voltage switched back to robot via dry contact relay controlled by PLC. *Call robot down*.
c. Pin 3 - Pin 1 voltage switched back to robot via dry contact relay controlled by PLC. *Call robot up*.
d. Pin 4 - Pin 1 voltage switched back to robot via dry contact relay controlled by PLC. *Future use*.
e. Pin 5 - Pin 1 voltage switched back to robot via dry contact relay controlled by PLC. *Future use*.
f. Pin 12 - +24 VDC from PLC common supply.
g. Pin 24 - To PLC input commanding *Robot Mode* operation. (Pin 12 is shorted to Pin 24 at the robot side of the interface plug.)
h. Pin 13 - 0 VDC common from the robot panel.
i. Pin 14 - Robot output to energize relay, providing PLC input for

Robot is down.

j. Pin 15 - Robot output to energize relay, providing PLC input for *Robot is up*.
k. Pin 16 - Robot output to energize relay, providing PLC input for *Future use*.
l. Pin 17 - Robot output to energize relay, providing PLC input for *Future use*.

6.5 SOFTWARE

6.5.1 PLC Programming Language: Allen Bradley

6.5.2 IP Addresses, Subnet and Gateway allocated as per Tiercon rules:
There are IP addresses and Gateways specific for each Tiercon plant, which should be applied only to

the PLC and HMI. If there are more devices on the Ethernet (valve banks, I/Os, servo amplifiers, nut runners, ..) then the PLC and HMI will have the IP addresses in the Tiercon plant IP addresses range and all the other devices will be connected to the second Ethernet card having the IP address 192.168.10.2, and the devices connected to it having the IP address 192.168.10.3, and incrementing with 1 the last digit. CoPlas IP addresses will be assigned by plant IT/Plant Controls Technician.

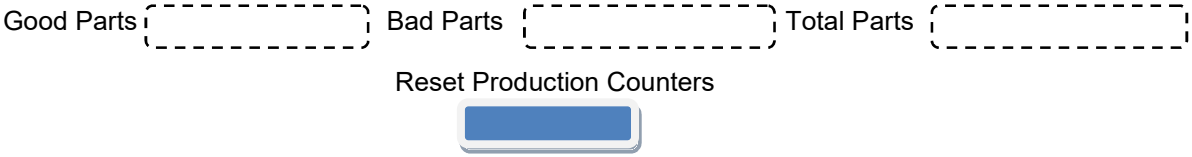
6.5.3 HMI MINIMUM SCREENS STRUCTURE (more screens will be added depending of the machine specific)
HMI must have screen saver after 10 minutes of non-activity.
The HMI screens should not have any object (button …) which is not related to the machine or not functional.
Each screen must have, on the bottom, buttons to navigate to any other screen.
Each screen must have Date, Time, and user (Operator, Supervisor, Engineering or Administrator) displayed on the upper right corner.
Note regarding the users: Operator – no password, Supervisor –password, Engineering, next higher level – password, and Admin, highest level – password.

6.5.3.1 Main Screen (Run Screen)

This screen has a part imported image having the part in place sensors and other meaningful sensors positioned
on the part picture in the right position, displayed as round LEDs.
Messages for Operator displayed on the upper part, and guiding operator/reflecting all cycle steps, for example:
"Load Parts and Clear Light Curtain", "Press Opto-touch Button", "First Bolt Torqued", "Second Bolt Torqued", and so on, depending of machine type.
The alarms will be also displayed on the upper part of the screen.

6.5.3.2 Shift Production Info Screen

This screen will contain the three shifts, bad/good/and shift total parts counters, and a RESET COUNTERS button, which could reset counters to zero.

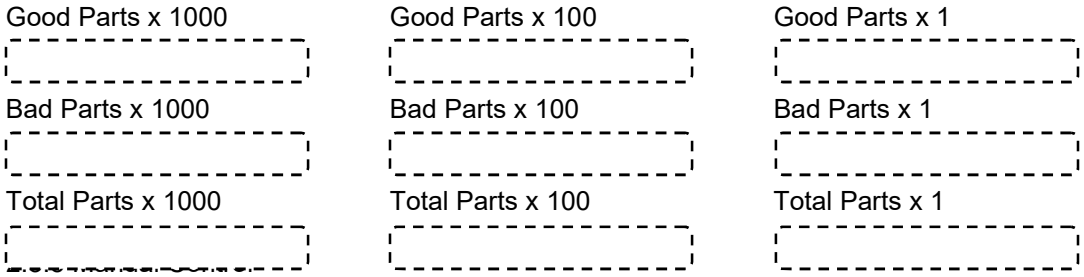


Note: Make sure do not exceed the max. variable type value, otherwise the PLC will have a major error.

6.5.3.3 Sequence Screen — LEDs will display the sequence attained by the machine.

6.5.3.4 Input Status Screen — Inputs status, displayed as round LEDs, green if input ON, red if input OFF.

6.5.3.5 Production Screen — This screen contains the total bad/good/and total parts counters.
Note: Make sure do not exceed the maximum value allowed for the variable type. Each counter has three windows containing fields for



6.5.3.6 Setup Screen — This screen is password protected

6.5.3.7 Input Bypass — Password protected; accessible from Setup Screen, bypass, individually, all process inputs. If input(s) bypassed, the Main Screen will display in red flashing colour “Input Bypassed”

6.5.3.8 Alarms History — Keeps the alarms history until operator/ maintenance reset history

6.5.4 Buttons — Highlighted with Green if pressed and Grey if not pressed

6.5.4.1 JOG (STOP CYCLE) — If pressed, the machine will finish the current cycle and stops

6.5.4.2 STOP — Soft stop with immediate effect

6.5.4.3 RUN — If pressed changes colour and displays RUNNING

6.5.4.4 MANUAL — Sets the machine in manual mode

6.5.4.5 AUTO — Sets the machine in auto mode

6.5.4.6 RESET — Same effect as RESET KEY; If pressed all the moving components retract orderly to home position, regardless if Auto or Manual mode.

6.5.5 PLC PROGRAMMING:

Power off timer: if the machine is not operated for 20 minutes, default, or at a certain number of minutes selected
from HMI than all outputs to be deactivated; the control power stays on all the time (PLC, HMI, Inputs)

6.5.5.1 INPUTS ROUTINE, & OUTPUTS ROUTINE: physical inputs and outputs will be assigned to

memory bits.

6.5.5.2 VARIABLES NAMES
The variable name must be descriptive conform the function / scope in the program (for example “bFixture_Advanced”) and to represent the variable type:

b - Boolean
id - Double Integer
i - Integer
f - Float
s - String
fb - Function Block, ex: fbExample.bPartOK, fbExample.sDate
udt - user defined variable, ex: udtConveyors, and InfeedCnv1 is data type udtConveyors.

6.5.5.3 Scenario to be agreed by both Tiercon and Machine Supplier if light curtain cut during the cycle or power off then the succession of actions to be considered:
- if machine is a degator then the machine should continue the cycle when the light curtain is clear, and The opto-touch button, Start Cycle, is activated.
- if the machine is a welding machine, or bolts are torqued, or any other assembly process which could lead to a bad part shipped to customer event then:
- if the cycle is active but the assembly process did not start (for example welding) then the operator, without a password, presses the Reset Button to home the machine.
- if the cycle is active and the process started, then the machine does not release the part, and:
  - if the production downtime is less five minutes then the amber beacon flashes with 0.5 Hz.
  - if the production downtime is over than five minutes then the red beacon flashes with 0.5 Hz, and an audible sound could be heard; the sound could be mute from HMI, in the password protected Setup Screen. Part to be released from station only by supervisor, using the Reset Key, or by pressing the Home Machine button in the password protected Setup Screen.

6.5.6. MANUFACTURING EXECUTION SYSTEM (MES):

6.5.6.1 Communication between system and MES:
The system must be capable to transmit required data to a separate MES system. The required data will be defined by Tiercon for each specific system on the G3 form.

6.5.6.2 Production display board:
Tiercon to supply specific information to MES supplier as requested on the separate production data form.

6.5.6.3 MES tags:
MES supplier must inform Tiercon and the system supplier about the required variables and the tags for the variables.

6.6 HARDWARE

6.6.1 PLC: Compact Guard Logix preferred; if complex machines ControlLogix may be used. At least 30% spare PLC I/O or 16 I/O, whichever is greater, is required for future additions to the controls circuit. This spare I/Os shall be wired to terminal blocks and marked as spares in the electrical schematic.

6.6.2 HMI: PanelView Plus 7 700 for simple machines, as for example degaters, or PanelView Plus 6 1000 for complex machines, as for example sonic welders.

6.6.3 AIR CONDITIONER/ FAN - If servo amplifier, computers and other electronic inside the electrical panel then AC has to be installed, otherwise FANS have to be installed; the choice has to be discussed with Tiercon.

6.6.4 AIR PRESSURE SWITCH - FESTO, with two set points and illuminated display, typical SDE1-D10-G2-W18-L-P1-M8-G, part # 192766, used with fitting T-shape part # 186158

6.6.5 BARCODE PRINTER - Intermec PM43 Mid-Range Direct Thermal-Thermal Transfer Industrial printer, Universal Firmware (IPL, Fingerprint, Direct Protocol) Ethernet/USB/Serial, with Label Taken Sensor. Optional Intermec Easy Coder PD42 Direct Thermal-Thermal Transfer Printer could be used with Tiercon approval. Complete Integration (hardware and software) into equipment/machine/automation/PLC with Tiercon Corp. approved label content. Content to include but not limited to: Date Stamp, Time Stamp, Part Number, Colour Description, BarCode, Customer specific details, with both alpha numeric characters and special character sets as required.

6.6.6. COMPUTER INTERFACE/ AC PLUG COMBO PORT - to be installed on the main electrical panel side or on the HMI panel, whichever is closer to the operator.

6.7.7 DCCOM Blue with White stripe, and has to be connected to the ground. If more than one power supply then all the DCCOM are jumpered and only one of them is connected to the ground.

6.7.8 ENCLOSURES Rittal; 30% Spare Space in the Electrical Panel has to be provided for future development.

6.7.9 ETHERNET SWITCH – Located inside panel, has to have four spares ports, one to be used for company network and the other three for future development.

6.7.9.1 RJ45 CONNECTIONS Two external RJ45 connections required to allow network and plc connectivity.

6.7.10 EXHAUST VALVE: Mandatory, on the main air line and having the capacity to be locked out by maintenance when working on the machine, for safety reasons.

6.7.11 FERULES: All wires from gauge 12 and lower (AWG12, AWG14, AWG 16, AWG 18, AWG 20, AWG 22, and AWG 24) have to be terminated with ferules at the ends.

6.7.12 HMI PANEL should have:
- E-Stop illuminated button
- Reset Key
- Power on (Start Cycle) button with green light

6.7.13 INDUCTIVE DEVICES should have surge suppressors (relays coils, valves coils…).

6.7.14 INDUSTRIAL CONTROLS: Contactors, buttons, Lights – Allen Bradley

6.7.15 LABELS, CABLES, WIRES: Cables, cable wires, and individual wires should be labeled at both ends.

6.7.16 LABELS, LAMICOID: All components inside the electrical panel(s) have to have Lamacoid labels attached to the panel mounting plate.

6.7.17 LIGHT CURTAIN: Banner, all other brands only with Tiercon approval.

6.7.18 QUICK DISCONNECT: to be used when connecting machine systems.
HARTING CONNECTORS SCREW TERMINATION ONLY

6.7.19 RELAYS: Allen Bradley, 2nd choice Omron

6.7.20 SAFETY RELAYS: JOKAB, Banner, Allen Bradley. Allen Bradley positively guided contacts relays/ forced contacts relays/image contacts relays with gold plated contacts have to be used as the safety relays outputs/loads; typical is used 700S-CF440EJC, but 700-CFB310EJ, 700-CFB400EJ, and 700-CFB220EJ could be also used. For any variation Tiercon written approval is necessary.

6.7.21 SENSORS:

Inductive Proximity Sensors:	Balluff and Festo
Limit Switches:	Allen Bradley
Capacitive Proximity Sensors:	Balluff
Fiber Optic:	Keyence

All sensors should be quick disconnect.
For any variations Tiercon written approval is necessary.

6.7.22 SPIRALLY-CUT CABLE WRAPS and PLASTIC CONDUITS: All the wires 18 AWG or lower (AWG 18, AWG 20, AWG 22, AWG24) coming from cables, for example Light Curtains, Cameras, should be routed through spirally-cut cable wraps (plastic coils) or other conduits, one for each cable, which will protect the wires and will ease maintenance work.

6.7.23 SWITCHES, RELAYS, TERMINAL BLOCKS, LIGHTS AND POWER SUPPLIES:
Allen Bradley; for other solutions taken in consideration by machine Builder. Tiercon written consent is needed.

6.7.24 STACK LIGHT: Pole with large AB green-amber-red LED beacon and horn:
- 855T-BPM40 - Mounting Base 400 mm pole, Black Housing

- 855T-B24TL3 – 24 VDC Steady Green LED – machine is operating ok
- 855T-B24TL4 – 24 VDC Steady Red LED – machine error
- 855T-B24TL5 – 24 VDC Steady Amber LED – idle or out of cycle
- 855T-B24SA1 – 24 VDC Horn, with adjustable tone 64dB -103 dB

6.7.25 TERMINAL BLOCKS LABELS: Original terminal block manufacturer printed labels must be attached to each terminal block.

6.7.26 TERMINAL BLOCKS - Allen Bradley, Wieland, and should have screws, NOT spring contact.

6.7.27 VISION CAMERA Keyence

6.7.28 COLOUR CAMERA Keyence, TYPICAL IV Series where applicable. Recommendation: the colour sensor distance from the part <= 50 mm, and the angle between the colour sensor and the normal to the area of interest plane = 45 degrees.

6.7.29 VFD: Allen Bradley Power Flex, SEW Eurodrive; any other VFDs only with Tiercon approval.

6.7.30 Robots: Preferred robots to be used are Fanuc. Alternatively, ABB can be used

6.7.31 Barcode scanners: Barcode label scanners need to be installed perpendicular to the labels, and as close as possible. Preferred scanners are listed in 18.2.

6.8 PHSR

Machine builder has to do a safety risk assessment at the design concept stage, after the project is awarded, and review this assessment with Tiercon (this is an internal review for both parties).

Machine builder is responsible to do the PHSR of the machine, if the machine is stand alone.
If the machine is part of a Tiercon machines system, then the machine builder is responsible for the re-design and implementation of the new safety circuit and the machine builder has to do the PHSR of the machines system after the new machine is integrated into this; Tiercon has to provide all the necessary documentation in its possession related to the system.

7.0 Pneumatic Specification

7.1 General design/Construction

7.1.1 Each piece of equipment shall have one air drop only.

7.1.2 The pneumatic circuit shall start with a drop leg to catch water in the lines. This drop leg will be 36" long and have a 1/4" ball valve at the bottom of the drop to facilitate draining.

7.1.3 The pneumatic circuit shall have a safety lockout dump valve prior to the filter, regulator and lubricator (FRL). The dump valve shall be a “Wilkerson Series V”. (If a soft start dump valve is required - consult The Tiercon Tooling Engineer).

7.1.4 The pneumatic circuit shall have a “Wilkerson”, filter, regulator and lubricator (FRL) after the dump valve.

7.1.5 The use of an accumulator (air pig) shall be incorporated in systems where multiple cylinder motions are occurring at once in the cycle or if the use of 8" bore and larger cylinders are used. All pressure vessels shall be equipped with a suitable safety relief valve that can be manually tested. All pressure vessels must be provided with the appropriate nameplates showing CRN’s, OIN#’s, etc. Documentation including the Certificate of Inspection must be provided. Absolutely no welding or modifications shall be conducted on a certified pressure vessel.

7.1.6 Use single piece fittings and flexible lines on all moving machine members. The use of rigid pipe where movement does not take place is optional.

7.1.7 Use “Pisco” punch-in fittings for all flexible lines.

7.1.8 Use metric blue coloured poly-hose for flexible lines. All piping and fitting shall be imperial when possible (NPT) (piping and fitting should be 1/4" or larger when possible).

7.1.9 Do not use sealing tape (Teflon) for sealing threads. If sealing media is needed, use “Locktite” #69 or equivalent.

7.1.10 Pneumatic systems must be designed around a maximum working air pressure of 90 psi.

7.1.11 An auxiliary air supply shall be installed on the supply side of the lockout valve for equipment cleaning. There shall be a 1/4" quick connect installed. (Standard Industrial Series 25).

7.1.12 Low-pressure regulator shall be used for pneumatic actuators, which do not require more than 60 psi to accomplish their operation.

7.1.13 All regulators shall incorporate a gauge displaying psi graduations. All regulator gauges must be visible from the exterior of the equipment (outside of general guarding but guarded to prevent accidental physical damage).

7.1.14 Where mid to high pressure is critical to equipment function and consistency, a FESTO low-pressure sensor shall be incorporated into the pneumatic circuit. This sensor will shut down the equipment and provide info to the PLC to allow failure detection.

7.1.15 All pressure gauges must be tagged indicating the function of the gauge, and the correct setting of the pressure regulator.

7.1.16 No valve, regulator or FRL shall be mounted more than 5 feet above the floor level, (consult The Tiercon Tooling Engineer if there is a design conflict).

7.1.17 All solenoid valves shall have adjustable flow controls.

7.1.18 All solenoid valves shall operate on 24 volt D.C.

7.1.19 All solenoid valves must be mounted on the exterior of the equipment (but guarded to prevent accidental physical damage) and be easily accessible (visually and physically) for maintenance and adjustment.

7.2 Pneumatic Actuators

7.2.1 All actuators to be “FESTO” brand. (If there is a design conflict, consult Tiercon Plastics Engineering).

7.2.2 All actuators over a 1 inch stroke must have adjustable cushions or bumpers.

7.2.3 All actuators shall conform to NFPA mountings.

7.2.4 If actuator mounting is rigid, alignment couplers must be used to reduce side loading to the piston and seals.

7.2.5 Individual flow controls may be required for adjusting speeds in the forward and reverse motion. Use “Pisco”.

7.2.6 Actuators with extruded aluminum bodies are preferred over the tie rod and cap type.

7.2.7 All actuators shall have a magnetic piston for position sensing. (even if no sensors are fitted)

7.2.8 All actuator motions shall be sensed for position using Hall Effect or proximity switches. (forward/ reverse)

7.2.9 The selection of actuators should be considered from **standard stock items** and of North American manufacture.

7.3 Pneumatic Valves

7.3.1 Safety lockout dump valves shall be “Wilkerson V” series.

7.3.2 Pilot valves and quick exhaust valves may be “Mac”.

7.3.3 Solenoid valves shall be designed in the system to eliminate motion if a power failure were to occur. When a valve is used for clamping a part, the solenoid shall remain

energized during the working cycle. Two or three position, double solenoid, four-way valves shall be used. (Consult Tiercon for design conflict.)

7.3.4 Valves shall be incorporated in a manifold layout when possible.

7.3.5 All valves, including pressure reducing valves, must have a brass identification tag containing a number stamped or legibly engraved on the valve or machine adjacent to the valve. This may be the output address number and operation description.

7.3.6 All valves shall conform to or exceed JIC standards.

7.3.7 All valves shall have a method of manual override as well as pilot indicator light.

7.3.8 No valve, regulator or FRL shall be mounted more than 5 feet above the floor level. (Consult Tiercon if there is a design conflict.)

7.3.9 All solenoid valves shall operate on 24 volt D.C.

7.3.10 All valves must be mounted on the exterior of the equipment (guarded against accidental physical damage) and be easily accessible (visually and physically) for maintenance and adjustment (Mounted inside the machine frame).

7.3.10 All valve exhausts shall have mufflers installed.

7.3.11 All machines should have pressure accumulators.

8.0 Hydraulic Specification

8.1 General - Power Units

8.1.1 Reservoir to be "L" shaped. Under no circumstances will a system with the pump inside the tank be allowed. Tank lid to be sealed, hinged and lockable with a padlock. Motor base area will have a 1" lip all around completely to prevent leakage getting to the floor.

8.1.2 Pumps to be pressure compensated. "Vickers" brand to be used. (Consult Tiercon if there is a design conflict).

8.1.3 Pump to be mounted to the motor by aluminum bell housing. Drive coupling access hole will be in the up or outside position. Hole must have a guard.

8.1.4 Pump drive couplings to be "Lovejoy" brand.

8.1.5 Electric motor will have a rotation arrow painted on the fan cover and must conform to electrical standards as specified.

8.1.6 Pump to be protected by suction strainer that conforms to pump manufacturer specifications.

8.1.7 Pump to be protected by inline check valve.

8.1.8 Regulator and gauge shall be mounted on the exit side of the pump.

8.1.9 Pump to be isolated by hose.

8.1.10 Maximum acceptable pump pressure is 1500 psi.

8.1.11 Hydraulic circuit shall have a relief valve as a backup to the pump compensator.

8.1.12 Hydraulic circuit to include a return line filter "Hycon" or "LHA" design.

8.1.13 Power unit to have a liquid filled gauge with an isolator valve.

8.1.14 Power unit shall have level and temperature sensing to shut down the motor if a fault occurs. Level sensor to shut unit down after a loss of oil equal to 45 seconds of pump run time is realized.

8.1.15 Power unit must have a temperature sensor. If the temperature of the system rises to 135 deg. C. the unit must shut down automatically.

8.1.16 Hydraulic oil to be specified at time of power unit design. (Consult The Tiercon Tooling Engineer & Maintenance), preferred standard AW 46.

8.1.17 Reservoir to have sight level gauge with temperature indicator.

8.1.18 Accumulators shall not be used - cycle time permitting. (Consult The Tiercon Tooling Engineer).

8.1.19 Accumulators to have auto dump circuit when unit is shut down.

8.1.20 Hydraulic power unit shall have combination full voltage starters fused with disconnect. (Allen Bradley 51 only, 110 Volt A.C., type 5-1Z industrial dust type).

8.1.21 Power unit will have a pressure filter sized for the job.

8.1.22 All valving and porting will be properly labeled by lamacoid label or stamped brass tag or stamped into the manifolds.

8.1.23 All manual overrides and adjustments must be accessible.

8.1.24 Tank to have 2 3/4" NPT spare ports for remote oil fill line.

8.1.25 Hydraulic power unit shall shut down after 30 min. of machine idle time.

8.1.26 Suction and return line fittings will have a 300-psi minimum rating.

8.1.27 Heat exchangers shall be provided as necessary; the cooling shall be oil to air. No water-cooling will be accepted.

8.1.28 Hydraulic power units shall be located as close as possible to cylinder valves. Floor space shall be considered when designing the equipment with a power unit. If the power unit is located on top of the equipment, an access ladder must be provided.

8.1.29 Under no circumstance will re-usable hose/fittings be acceptable – crimp/swaged style only.

8.1.30 All hydraulic hose and fittings are to be of a “matched” set. Preferred brand is “Parker”.

8.2 Hydraulic Actuators

8.2.1 Hydraulic actuators shall be “Parker” brand with cushions both ends.

8.2.2 Actuators shall have class 2 seals.

8.2.3 Cylinders must have a rod gland drain port.

8.2.4 All cylinders to have piston seals not piston rings.

8.2.5 Piston rod alignment couplers shall be used to reduce side loading on piston rod and seals. This will eliminate premature rod and seal wear.

8.3 Hydraulic Valves

8.3.1 Hydraulic valves to be “Vickers” with DIN connections and light indicator for spool location.

8.3.2 Any operator accessed areas (operator load and unload stations) will be controlled by a 3-position double solenoid valve with center position “P” port blocked - A and B to tank. The valve will have a sandwich position check to prevent drifting.

8.3.3 All machine operators must be controlled from drifting due to leaking valves, (drifting should be a concern when developing a hydraulic/mechanical system).

9.0 Conveyors

9.1 General

9.1.1 Conveyor design and layout shall be reviewed and approved by The Tiercon Tooling Engineer and Maintenance prior to any fabrication.

9.1.2 Portions of conveyors or other moving machinery that are not visible from the control station, and when starting up may endanger any worker, shall be equipped with automatic start-up warning devices, (lights, buzzers, horns, etc.).

9.1.3 Emergency Stop (E-Stop) switches shall be located every 8 feet on conveyors 15 feet long or longer. A pull cord may also be considered as an E-Stop device.

9.1.4 Logistics must be considered when designing a conveyor layout. Access to important controls, equipment, and regular traffic routs must be taken into consideration.

9.1.5 All conveyor drive, idle sprockets and chain or pulleys shall be guarded against any pinch points.

9.2 SKF - FlexLink®

9.2.1 When possible, “FlexLink®” conveyor shall be the conveyor of choice. Two systems profiles are approved for use:
(Consult the Tiercon Tooling Engineer prior to system design)
6 XH - 103mm (4") belt width
7 XM - 85mm (3 3/8") belt width

9.2.2 Custom fabricated side guides may be considered when designing a “FlexLink” system. Custom side guides may offer improved rigidity and be more cost effective over standard “FlexLink” side guides.

9.3 Slider Bed Conveyors

9.3.1 Conveyor bed should be constructed of 10-gauge material.

9.3.2 All drive rollers and take up rollers must be easily removable for service without alterations to the conveyor bed. It could be assumed that conveyors will butt one end to the next.

9.3.4 At the exit end of the conveyor, the pinch point where the belt wraps around the roller at each side must be guarded.

9.3.5 All light duty, low profile applications shall be “Dorner” brand, (may be magnetic).

9.3.6 Custom magnetic conveyors shall be either “Dorner” brand, “Industrial Magnetics Inc.” brand or “Bunting” brand.

9.3.7 Custom magnetic elevators or low crating (incline or decline) conveyors will be designed and fabricated by “Industrial Magnetics Inc.”. The conveyor shall be designed around the actual production parts (parts to be transferred) and test proven to Tiercon prior to shipment.

9.3.8 Conveyor reducers to be “Browning” brand.

9.3.9 Conveyor drive voltage shall be 575 A.C. if using a motor 1/2 Hp or larger. Variable speed conveyors shall be controlled by an “Allen Bradley” A.C. inverter.

9.3.10 Conveyor pulleys to be “Browning” brand with standard shaft and key sizes. Taper lock bushings shall be used for assembly.

9.3.11 Conveyor pulley take ups to be “Browning Masterline” brand.

9.4 Chain Belt Conveyors or Accumulators

9.4.1 Conveyors of this type must be designed and submitted to Tiercon for approval before construction begins.

9.4.2 Conveyor chain must be supported at the same height across the bed of the conveyor. Raised support sections will wear into the chain and cause premature chain life.

9.4.3 Chain should be driven on “Murtfeld Profile”, not flats.

9.4.4 Conveyors over 10 feet in length must have a floating roll to take up the catenary loop.

9.4.5 Extra duty wear guides must be installed after any curves.

9.4.6 Conveyor chain shall be “Intralox” brand, (consult The Tiercon Tooling Engineer at design stage).

10.0 Facilities

10.1 No structural member of the supporting building steel shall be altered in any way unless approved by a licensed Professional Engineer employed by or acting as agent for Tiercon. Costs for engineering analyses and certifications are to the responsibility of the installing contractor. This includes drilling or welding to the metal or other structural member.

10.2 No loads may be hung from or attached to any structural member of the supporting building steel unless approved by a licensed Professional Engineer employed by or acting as agent for Tiercon. Details of all loads and attachments shall be provided to Tiercon for analyses and approval before construction and installation begin. Costs for engineering analyses and certifications are the sole responsibility of the installing contractor.

11.0 Equipment Finish

11.0.1 All bare metal surfaces except hardened tooling must be protected from corrosion using one of the following methods:
- Epoxy paint, spray coat (powder coat preferred)
- Black oxide
- Anodizing
- Flash chrome plating

11.0.2 All welded frames, brackets and structural supports, shall be coated with epoxy paint applied by a spray process. (Glidden epoxy safety blue OSHA standard).

11.0.3 All machine base plates shall be flash chrome plated.

11.0.4 All aluminum components shall be anodized (clear or coloured) to prevent oxidation.

11.0.5 All steel, mechanical, working parts or fixtures shall be black oxide treated.

11.0.6 All wear items (either by friction or impact) shall be manufactured from A2 or D2 steel and shall be heat treated to an appropriate hardness in the Rockwell C scale. (Consult the Tiercon Tooling Engineer).

11.0.7 All machined or fabricated components, including tooling, shall have all sharp edges removed, providing that function or performance is not restricted.

11.0.8 All weldments shall be clean of flux and weld spatter. Grinding may be required to improve fit or finish.

11.0.9 All bare metal surfaces, which require any coating shall be properly cleaned and prepped prior to the coating application.

11.0.10 Welded “guard” frame assemblies shall be painted safety yellow. (Glidden epoxy safety yellow #5260 OSHA standard).

11.0.11 All mesh guarding shall be 1" square. PVC coated, black fencing with an aluminum frame (Bosch brand).

11.0.12 Hardened tooling may be TIN or TICN coated for increased wear life.

11.0.13 “Lexan” shall be used for any view ports or windows.

11.1 Nesting Requirements (if applicable to design)

11.1.1 All nesting to be set on aluminum base plate of dimension (LxWxH inches), to fit the part in question. With common quick change over mounting features and locations to allow the nests/fixtures to be interchangeable on any common station provided by the supplier.

11.1.2 All nesting to be of non marking material(s) and be designed and constructed in such a way as to allow individual sections to be removed if damaged.

11.1.3 Nut runners, Rivet guns, Riv-nut guns and like may need mutilation protection (e.g. protective covers, socket covers, body covers e.g. Atlas Copco 4220 5203 02, 4220 3154 03)

11.1.4 All nesting to be designed and constructed in such a way as to allow for complete and proper support in areas where point to point contact is made / required.

11.1.5 All nesting to be capable of "locking in" the part until the current process is completed and the operator/PLC releases the part based on a predefined opeartion.

11.2 Workstations (general requirements may change based on product requirements):

11.2.1 All general workstation working surfaces to be of standard dimensions (L x W inches) 48 x 24 and constructed of ½" steel or aluminum.

11.2.2 All stations to be made of 2.0inch x 2.0inch x 1/4inch square tubing.

11.2.3 All station work surface's to be height adjustable in the "up/down" position, from 36 inches to 48 inches.

11.2.4 All stations to include 2 sets of over head lighting. 1 set of black UV lighting (if required by operation) and 1 set of florescent lighting with independent on/off switches and safety covers.

11.2.5 Distance from the tabletop to the lighting must be adequate enough to provide clearance for the work to be performed and allow for a 250 +/- 25 foot candles of lighting from the fluorescent's.

11.2.6 All stations to include 1 electrical receptacle with a dual plug mounted at the back of the station.

11.2.7 All stations to include any and all pneumatic, electrical, PLC, and other requirements as to enable functionality of the quoted nests/fixtures/station.

11.2.8 All stations to be capable of mounting common nest/fixture as per 4.3.1. (if required by operation/process)

11.2.9 All stations to be equipped with 4 non marking swivel/locking castors (4 inch diam. x 2 inch wide)

11.2.10 All stations to be painted safety blue

12.0 Documentation and Training

12.1 Documentation

12.1.1 Documentation shall be provided in the form of a manual. This manual shall be enclosed in a tree ring binder(s) of the appropriate size. Three identical copies of the manual shall be provided to Tiercon of the equipment ship date. Two identical copies of the manual in electronical format shall also accompany the hard copy versions. The manual shall have a title page and a table of contents displaying the following sections:

12.1.2 Section 1: Brief outline of machine operation.

12.1.3 Section 2: Machine operational procedures including: (preferably in flow chart form)
- Start up (power up)
- Set up (tooling, fixtures, changeover)
- Home all (position all operations at home)
- The sequence of actions to recover from all possible different situations
- Cycle start or operation start
- Shut down (power down)

12.1.4 Section 3: Mechanical assembly prints (AutoCAD format)

12.1.5 Section 4: Mechanical detailed prints (AutoCAD format)

12.1.6 Section 5: Electrical panel layout (AutoCAD format)

12.1.7 Section 6: Electrical schematics (AutoCAD format), to include PLC modules placement, devices DIP switches settings, and IP addresses assignment.

12.1.8 Section 7: Pneumatic schematics (AutoCAD format)

12.1.9 Section 8: Hydraulic schematics (if applicable) (AutoCAD format)

12.1.10 Section 9: Mechanical bill of materials

12.1.11 Section 10: Electrical bill of materials

12.1.12 Section 11: Pneumatic bill of materials

12.1.13 Section 12: Hydraulic bill of materials (if applicable)

12.1.14 Section 13: Purchased components literature

12.1.15 Section 14: Proposed maintenance schedule (matrix or chart format)

12.1.17 The supplier shall provide the drawings source code, for Tiercon to have the possibility to do future developments

12.2 TRAINING:

The supplier shall be required to provide training at their facility for the operation, set up, and

maintenance of the equipment for selected Tiercon employees.

13.0 Environmental

13.1 All new materials which may enter the plant, must be approved by the Tiercon Health, Safety and Environmental Coordinator (H.S. & E. Coordinator). Material Safety Data Sheets (MSDS) must be provided in advance of any material shipment to Tiercon. During the MSDS review, the H.S. & E. Coordinator may either accept or reject the material.

13.2 MSDS must be provided with WHMIS label ratings.

13.3 The supplier of a material must agree to accept return of all or any portion of the material, which was provided to Tiercon. Materials, which Tiercon does not use, shall be returned to the supplier for disposal.

13.4 If outside ventilation or exhausts are required, Tiercon must be notified in writing at the earliest time possible in the project. The supplier must provide the required information for the application for a Certificate of Approval (C of A) for exhausts.

13.5 The supplier shall be responsible to provide all engineering for outside ventilation and exhausts. Documentation of the engineered specifications must be presented to Tiercon at the earliest time possible in the project.

14.0 Equipment Capability Requirements

ACCEPTANCE / PERFORMANCE CRITERIA

PURPOSE
The purpose of this Chapter is to set forth the procedure to implement the Tiercon Corp. Equipment Testing and Certification Policy regarding testing of the design, construction, operating functions and production output for Equipment and tooling supplied for use by the Buyer.

SCOPE
Production and production support Equipment and tooling supplied to Buyer shall comply with the requirements contained herein for design, construction, controls, quality, equipment, process capability and throughput.

Testing is applicable to Equipment, tooling, etc. on a system basis. For purposes of this Chapter, "Workstation" means a singular piece of Equipment that represents one element of the System. The System is evaluated with regard to support functions required to sustain its operation.

STAGES OF TESTING

Certification Test
Pre-shipment trial run of the System at a Supplier's facility. Comprised of the following three items:

1) A (3) shift dry cycling of System will take place on (1) 8 hr shift for (3) consecutive days.

2) A 300 piece sequential build will be done on a station by station basis - i.e. run all 300 pieces through station #1 then all 300 pieces through station #2 etc. for the entire assembly system.

3) A minimum (4) hour system run will be a full system test with components. During this test, all areas of the system will be evaluated.

Process Quality	Safety
Controls and Trace ability	Ergonomics
Mistake-proofing	Production Throughput
System Layout	Construction Materials

Re-certification Test

Testing of the system after it has been installed and begun operation at the Buyer's production facility. Comprised of the following three items:

1) A (3) shift dry cycling of System will take place on (1) 8 hr shift for (3) consecutive days.
2) A 300 piece sequential build will be done on a station-by-station basis. I.e. run all 300 pieces through station #1 then all 300 pieces through station #2, etc. for the entire assembly System.

3) A minimum (4) hour System run will be a full System test with components. During this test, all areas of the System will be evaluated.

Process Quality	Safety
Controls and Trace ability	Ergonomics
Mistake proofing	Production Throughput
System Layout	Construction Materials

Final Acceptance

This test will be a thirty (30) day System run. During this test, all areas of the System will be evaluated.

Process Quality	Safety
Controls and Trace ability	Ergonomics
Mistake proofing	Production Throughput
System Layout	Construction Materials

Test Deviations

The Buyer's Project Manager forth herein must approve any deviations from any testing procedure or requirement set in writing. Such approval shall specify the deviation, location of any such test to be performed, a schedule of all tests that must be completed, and any deviation in testing procedures.

RESPONSIBILITIES

This subchapter describes the responsibilities for Certification Testing of the System at the Supplier's facilities, Re-certification Testing at the Buyer's facility and Final Acceptance Testing at the Buyer's facility. Buyer shall provide all component raw materials for the Equipment testing. The Buyer and Supplier shall agree upon the quantity of components in writing prior to the preliminary design review. If for any reason the Supplier requires additional quantities above and beyond the quantities stated above, as a direct result of Equipment malfunctions or unexpected results that are the direct responsibility of the Supplier, the Supplier shall assume complete financial responsibility for the procurement of these components. Buyer will provide the Supplier the option to purchase these components at the Buyer's current costs.

Responsibilities for Certification Testing at Supplier Facilities

1) Certification testing of the System at the Supplier's facilities shall be the responsibility of the Supplier, subject to Buyer's review, during Certification Testing at Supplier's facilities. Supplier shall provide operators, material handlers, maintenance personnel, etc. reflecting the setup that is currently utilized at the designated Buyer's facility. These personnel to be reviewed and agreed upon a minimum of 30 days prior to the Certification Test.

2) Certification testing of the system at the Supplier's facilities shall be carried out in accordance with the Specification and in accordance with any requirements established for the specific System or Workstation.

3) The results of the Certification Test must be approved by the Buyer even if a sub-contractor is used for Workstation build.

4) Buyer personnel shall be present for all System Testing, for which approval is required.

Responsibilities for Re-certification Testing at the Buyer's Facility

1) Re-certification Testing of the System at the Buyer production facility shall be the responsibility of Buyer, with a Supplier's team present during Re-certification Testing at Buyer's facilities. Buyer shall provide trained and/or qualified operators, material handlers and maintenance personnel to support Equipment operation.

2) Re-certification Testing of the System shall be carried out in accordance with requirements of this Specification and in accordance with any requirements established for the specific System or Workstations being tested.

3) Workstation sub-equipment suppliers shall assist and support the Supplier in the execution of the Re-certification Testing at the Buyer's facility.

4) Supplier shall observe the Re-certification Testing. A designated individual from the Supplier will serve as coordinator for the Supplier.

5) The Buyer must approve the results of the Re-certification Testing.

Responsibilities for Final Acceptance Testing at the Buyer Facility

1) Acceptance Testing of the System at the Buyer's production facility shall be the responsibility of Buyer, with a Supplier's representative present. Buyer shall provide personnel to support the Equipment operation and handling of materials, typical of production, during Acceptance Testing at Buyer's facilities.

2) Acceptance Testing of the System shall be carried out in accordance with requirements of this specification and in accordance with any requirements established for the specific System or Workstation being tested.

3) Supplier shall observe the Acceptance Testing of the System. A designated individual from the Supplier will serve as coordinator for the Supplier.

4) The Buyer must approve the results of the Final Acceptance Test.

TEST METHODS
Testing of the System for the Certification Test, Re-certification Test and Final Acceptance Test will involve tests and examinations conducted under any combination of the qualification conformance methods defined in the following subsections.

Inspection
Inspection means examination (including testing) of supplies and services, including, when appropriate, raw materials, components, and intermediate assemblies, to determine their conformity to contractual requirements, which include all applicable drawings, specifications, and purchase descriptions.

Analysis
Analysis is an element of inspection that takes the processing of accumulated results and conclusions, and is intended to provide proof that verification of a requirement(s) has been accomplished. The analytical results may comprise a compilation of interpretation of existing information or derivation from lower level examinations, tests, demonstrations, or analyses.

Demonstration
Demonstration is an element of evaluation that includes both readily observable functional operations and technical means of determining performance characteristics, physical and chemical properties or elements of materials, supplies and components to determine compliance with requirements.

DESIGN/CONSTRUCTION VALIDATION

Certification Test
The following areas will be reviewed during the certification test for compliance to specifications and requirements:

Construction materials will be reviewed during this test to assure that they meet the requirements in the functional specification and the preferred components list.
All safety issues will be reviewed during this test to assure that they meet the requirements in the Tiercon
Corp. General System Specification.
All ergonomic issues will be reviewed during this test to assure that they meet the requirements in the Tiercon
Corp. General Equipment Specification.
The evaluation for the effectiveness of mistake-proofing systems during this test will be based on the following
parameters:
100% inspection - no value added beyond reject station and reject cannot be used.
Defect cannot pass to next station.
Defect will not be made due to processing error.
If a defect is made, it is rendered unusable and/or is deposited into a lockbox.
The operation must be able to accurately distinguish parts at the specification boundaries.
Notice given
operator of a defect generated.
If a defect is generated, the process is stopped, and the defect is segregated into a lock box. Manual restart is required.
If a process defect occurs, a warning light or sound alerts the operator and part is segregated into a lock box. Process will shut down after three successive defects.
System layout will be evaluated on the basis of component accessibility.

Size dimensions will be measured for compliance to space requirements prior to execution of the
acceptance test.
Placement/orientation dimensions will be measured for compliance to approved drawing prior to execution
of the acceptance test.
Locations of power panels.

Re-certification Test
The same areas as outlined in previous chapter will be reviewed during the re-certification test for compliance to specifications and requirements.

PROCESS QUALITY LEVEL MEASUREMENT
This subsection describes process quality requirements as they relate to the Certification Test, Re-certification Test and Final Acceptance Test. The activities described relate to the ability of the System to sufficiently produce a quality product.

Gages

- Reference Tiercon Corp. Gage Design and Build Standard.

Testing/Gauging Characteristics
Acceptance Testing Characteristics, both attribute and variable shall be defined at Preliminary Design Review. These characteristics shall be noted on the individual workstation drawings.

Certification Test

Variable Data - Equipment Capability

Must demonstrate statistical process stability, using the appropriate Statistical Process Control (SPC) chart, prior to calculating Cpk. Minimum sample of 300 sequentially produced parts, evaluated in subgroups of 5 each.

Cpk must be 1.67 or greater, using the calculated Sigma value from the individual measurements, no R-Bar/d_2.

Conducting the Study:

Prior to the 300 consecutive piece run, the following must be done:
Make sure the Equipment; material and personnel are available at the planned date and time.
Assure that the input material is within specifications.
Make sure the Equipment and tool drawings match the applicable part prints for the run.
Set-up and operating instructions must be complete and followed during the run.
Evidence of capability of the process should have established from prior small lot runs.
Tiercon Corp. will provide measurement devices, unless otherwise specified.

Running the Equipment:
All calibrations to Equipment gauging must be completed prior to the start of the 300 pieces run.

Allow the Equipment to continue to run, if possible. All stoppages must be recorded, and appropriate adjustment or repair must be documented.

The Equipment must be run under normal conditions, meaning the Equipment must be run, at full speed, with no extra inspections, no added personnel, and no unusual equipment.

The 300 pieces are run through the Equipment and kept in sequential order. Some type of marking/tagging may be needed to keep them in order.

The variable measurements will be made in subgroups of 5 and 20 subgroups taken evenly through the run. (Check 5, skip 10, etc.)

Calculation of Cpk:

Calculation of Cpk will be made in accordance with the "*Statistical Process Control*" Reference Manual from AIAG.

The process must exhibit a Cpk of 1.67 or higher.

Attribute Data - Equipment

Must demonstrate 100% capability by accepting in specification parts and rejecting out of specification parts during a 300 part run, containing both good and bad parts.

If possible, boundary samples should be agreed upon prior to the start of the acceptance test.

Conducting the Study:

The procedure outlined for the variable study is applicable for the attribute study, except for the items covering the variables, measurements and analysis.

The following procedure should be followed:

The results (good/bad or go/no go) should be documented on a tally sheet of some type. This sheet would also indicate any discrepancies and state what action was taken.

If out of specification parts are used, any automated gauging should indicate a "bad" part 100% of the time.

If rejects occur as part of the normal operation and are segregated by the automated gage, those rejected parts should be verified that they are truly out of specification. All rejects should be documented as to cause.

Re-certification Test

Variable Data - Equipment Capability

Must demonstrate statistical process stability, using the appropriate Statistical Process Control (SPC) chart,
prior to calculating Cpk. Minimum sample of 300 sequentially produced parts, evaluated in subgroups of 5
each.

Cpk must be 1.67 or greater, using the calculated Sigma value from the individual measurements, no
R-Bar/d_2.

Attribute Data - Equipment

Must demonstrate 100% capability by accepting in specification parts and rejecting out of specification parts
during a 300 part run, containing both good and bad parts.

All of the Re-certification Tests at Buyer's location shall be run identical to the original Certification Test
performed on the Supplier's floor.

Final Acceptance Testing

Variable Data - Process Capability
At Buyer's facility, a five- (5) day period of production must demonstrate statistical process stability and a Cpk of 1.67 or greater. Again, using the calculated Sigma value.

Attribute Data - Process Capability
At Buyer's facility, over a five- (5) day period of production must demonstrate 100% capability by accepting in specification parts and rejecting out of specification parts.

Conducting the Study
The study shall be completed similar to the Certification Tests, but with the following exceptions.

The variable measurements will be gathered in subgroups of five consecutive parts each hour and plotted on a variables control chart.

The attribute samples should be gathered in subgroups of five consecutive parts and plotted on a Control Chart for Attribute Data using the no or Number of Units Nonconforming method.

All system or subsystem rejects should be documented and put into a Pareto Chart for targeting any further action.

Any system SPC output should be compared to the manual charts. All discrepancies in results must be acted upon.

Our target process capability is a Cpk of 1.67 or greater.

CONTROLS AND TRACTABILITY SYSTEMS
This subsection outlines areas of the controls and trace ability systems and the detail of the requirements to be reviewed at the Certification Test, the Re-certification Test and the Final Acceptance Test.

Certification Test

Complete inspection of electrical hardware to meet the Buyer's requirements.
- A punch list will be put together for line-by-line verification of items listed in each of the referenced specifications.
- A Controls Engineer may inspect each control panel, motor control center, etc. included in the assembly system.

Complete verification of electrical, operator interface, and control systems.
- A Controls Engineer may observe the operation of equipment in order to verify correct operation.

A Controls Engineer may observe operator interaction with control panels.

Complete inspection of software and associated software documentation is proceeding in a way that will meet the Buyer's requirements.

Complete verification of diagnostic systems

A Controls Engineer may verify that diagnostic systems are proceeding in a way to meet the Buyer's requirements

Re-certification Test

Complete inspection of electrical hardware to meet the Buyer's requirements.

A punch list will be put together for line-by-line verification of items listed in each of the referenced specifications.

A Controls Engineer may inspect each control panel, motor control center, etc. included in the assembly system.

Complete verification of electrical, operator interface, and control systems.

A Controls Engineer may observe the operation of equipment in order to verify correct operation.

A Controls Engineer may observe operator interaction with control panels.

Complete inspection of software and associated software documentation are proceeding in a way that will meet the Buyer's requirements.

A Controls Engineer may verify that software and associated software documentation are proceeding in a way that will meet the Buyer's requirements.

Complete verification of diagnostic systems

A Controls Engineer may verify that diagnostic systems are proceeding in a way to meet the Buyer's requirements.

Final Acceptance Test

Complete inspection of electrical hardware to meet the Buyer's requirements

A Controls Engineer may inspect each control panel, motor control center, etc. included in the assembly system.

Complete verification of electrical, operator interface, and control systems

A Controls Engineer may observe the operation of equipment in order to verify correct operation.

A Controls Engineer may observe operator interaction with control panels.

Complete inspection of software and associated documentation

A Controls Engineer may verify that software and associated software documentation are proceeding in a way that will meet the Buyer's requirements.

Complete verification of diagnostic systems

A Controls Engineer may verify that diagnostic systems fully meet the requirements of Buyer, including all diagnostic messages known at the time of acceptance.

PRODUCTION THROUGHPUT

Certification Test

The following areas will be reviewed during the certification test for compliance to throughput/capacity expectations as required in the specification.

At the beginning of the shift, Supplier representatives and Buyer representatives conducting the acceptance test will agree that material and operators are available for a full shift of acceptance testing.

Overall System acceptance test duration is a nominal test of 4 hours. "Nominal" is defined as 4 hours from the time the first complete piece clears the end of the system line and is ready for packaging. Actual "clock running" time will include the nominal test time, system start up/set up time, system load time, and shut down and clear time.

Once the Supplier representative indicates that the System is ready for acceptance testing, the clock will be started on command and WILL NOT BE STOPPED OR RESET FOR ANY REASON. The clock will be stopped at the completion of System shut down and clear.

During this test, no adjustments to Equipment will be allowed. During execution of the acceptance test, items of concern regarding the design, fabrication, and/or operation of the System will be noted.

System Start Up

Any custom containers and/or packaging required to support the System must be used in the test. Buyer shall provide all containers necessary to support the test. Buyer and Supplier must approve the quantity of containers.

The entire conveyor shall be void of all materials prior to full-system acceptance-test start up. Materials may be staged on pallets, etc., near the point of use. All system functions must be in a "shut down" condition (same condition as is normal when the system is down during a non-operating shift).

ITEMS TO BE DOCUMENTED AT SYSTEM START UP

- Total quantity of materials present at start up.
- Time to load material in-feed queues.
- Start up sequence of the line and the time for the System to reach a fully loaded condition.
- Time from switch-on to the first good part arriving at pack out.

System Performance

SYSTEM PERFORMANCE REFERENCE ITEM 1 IN STATEMENT OF WORK DEFINE OVERALL EXPECTED SYSTEM PERFORMANCE:

- Accumulated station utilization (example):

STATION #	1	2	3	4	5	
% up time	.85	.85	1.0	1.0	1.0	
						System Utilization
Condition a	up	up	up	up	up	
p(a) =	.85	.85	1.0	1.0	1.0 =	.72
Condition b	down	up	up	up	up	
p(b) =	.15	.85	1.0	1.0	1.0 =	.13
Condition c	up	down	up	up	up	
p(c) =	.85	.15	1.0	1.0	1.0 =	.13
Condition d	down	down	up	up	up =	
p(d) =	.15	.15	1.0	1.0	1.0 =	.02

Total available time 1.0

Evaluation checkpoints are as follows:

- Available Operating Time: = (480 min per shift * shifts) - scheduled down time
- System Up Time: = Available operating time - unscheduled down time
- System Cycle Time: = Total parts produced/theoretical system throughput
- Theoretical Throughput: = Available operating time/designed system cycle time
- Percent (%) Utilization (& Efficiency): = Up time/available operating time

or

- System efficiency (%): = Total part produced/maximum system throughput
- Production Yield (%): = Acceptable parts/total part produced
- System Productivity (%): = System utilization * production yield
- Theoretical System Throughput: = Productivity * maximum system throughput

Station Cycle Times Will Be Based on the Following Information:

- Detail the steps in a cycle and document the cycle time for each station (base on predetermined time study).
  Cycle time = time to complete 1 cycle of a consistent, repeatable function.
- Available Operating Time = shifts * 7.1 hours Up time = available operating time - unscheduled down time
- Utilization (& Efficiency) - unmanned station only = Up time * PFD/available operating time.
  (PFD = personal, fatigue, & delay factor & 95%)
- Maximum Throughput = available operating time/cycle time
- Expected parts produced - up time/cycle time
- Product Yield = estimated acceptable parts/expected parts produced
- Productivity = utilization & efficiency * yield
- Projected throughput = maximum throughput * productivity

Delays

Avoidable Delays (Normal Production Downtime)
As listed, will be individually evaluated at time of occurrence:

Operator Error	Safety Incident
Insufficient Parts	Waiting for Material
Bad Parts	No operator at station
Untrained Operators	Tools not available
Power Outage	

Unavoidable Delays (inherent to line design or manufacture)

As listed, may be cause to abandon and reschedule test after evaluation and/or Equipment restoration.

Jammed Press
Routing Maintenance
Software Bugs
Good parts incoming but parts outgoing fail G/NG resulting from Equipment
Internal delay resulting from design of workstation

Insufficient conveyor speed
Parts not captured correctly in fixture
Equipment cycle causing overall cycle to exceed requirement
Workstation distances (Equipment) too far for cycle time
Excessive or no communication time between Equipment

System Cycle Times will be based on the following information:

- Expected System Cycle Time = Longest single station cycle time.
- System Utilization (& Efficiency) = largest accumulated up time (i.e. 72% for the above case).
- Maximum System Throughput = available time/system cycle time
- Expected Parts Produced = System Utilization * Maximum System Throughput

System Scrap will be based on the following information:
Maximum scrap allowances will be based on a station-by-station basis and determined at Preliminary Design Review. These allowances, allowances for other fall out (testing, etc.) and system uptime shall combine to allow for a system throughput of at least 71% in accordance with item 1 of the statement of work.

- Expected System Yield: (Example)

Station #	1	2	3	4	5
% Scrap rate	02	.05	.03	.01	.02

Station	% Scrap	% Yield
0	0	100%
1	2%	98%
2	5%	93.1%
3	3%	90.3%
4	1%	89.4%
5	2%	87.6%

Accumulated product yield = 87.6%

System Shutdown will be based on the following information:

- Time to complete assembly of in-process components for the purpose of clearing the line.
- Time to complete routine housekeeping procedures at line shutdown.
- Time to shut down Equipment.

System changeover shall be evaluated to determine if it meets the requirements of a 10-minute Changeover from one part number to another which can be defined as a 10 minute changeover per station with the ability to change each station as soon as the part number is through station.

Re-certification Test
The same areas as outlined in the previous chapter will be reviewed during the Re-certification Test for compliance to throughput/capacity expectations as required in the System specification.

TEST SCHEDULING
The Supplier shall provide Buyer with not less than thirty (30) days notice before scheduling a Certification Test in order to allow Buyer personnel to schedule their trip to the Supplier's plant.

TEST RESULTS APPROVAL
Upon successful completion of each test (Certification, Re-certification and Final Acceptance), Buyer shall confirm the successful completion of such test as follows:

The Buyer's Project Engineer shall review the final certification test report as compiled by the Supplier for the project, sign it and give a copy to the Buyer's Project Manager. The test report shall include a summary of all data, analysis and information per the requirements of this Chapter of the Tiercon Corp. General Equipment Specification.

Buyer's Project Manager will review and, if appropriate, approve such test report. If the Buyer Project Manager fails to approve the results of the test he or she should state the reasons for withholding such approval to the Buyer Project Engineer and the Supplier. Thereafter, the Supplier will take appropriate corrective action to address the reasons identified by the Buyer Project Manager and repeat the test for which approval was not obtained.

After the Buyer Project Manager has approved the results set forth in the test report prepared and forwarded in accordance with this Chapter, the Buyer Project Manager will sign the test report and deliver a copy thereof to the Supplier.

Test reports prepared in accordance with this Chapter and signed by both the Buyer Project Engineer and Buyer Project Manager will be used as follows.

A completed test report relating to the Certification Test will constitute the Supplier's authority to deliver the System subject to making appropriate transportation arrangements with Buyer Purchasing.

A completed test form relating to Re-certification Test or Final Acceptance test, as the case may be, will constitute the Supplier's authority to invoice Buyer for whatever payments are contractually required upon successful completion of such tests.

15.0 Equipment Performance and Inspection Sign Off

For equipment inspection and signoff. Use the New or modified equipment buy off check list.

16.0 Delivery and Installation

16.0.1 Tiercon expects a timely deliver. A penalty clause may be part of the contract for late delivery of equipment and systems. A bonus clause may also be part of a contract for early delivery.

16.0.2 Delivery details and responsibilities shall be outlined in the purchase order contract.

16.0.3 Equipment installations, set-up, and warranty work shall be conducted in a “safety first” mind set. The contractor and/or supplier shall be required to complete the “Acknowledgement Form” in the Tiercon, “Contractor Health, Safety and Environmental Policy”.

16.0.4 Installations shall be coordinated under the schedule developed by the Project Manager.

17.0 Supplier Warranty and Support

(Minimum warranty requirements)

17.1 The supplier shall provide a basic warranty equal to or better than the following:

17.1.1 All components and/or materials designed, manufactured or specified by the supplier shall be warranted to be free of defects and premature wear for a period of one year consisting of a three-shift operation or a total of 6000 operational hours.

17.1.2 Upon written request by Tiercon, the supplier shall provide materials and labour to repair or replace components and/or materials designed, manufactured or specified by the supplier. Expenses incurred by the supplier, through a warranty claim period, shall be the sole responsibility of the supplier.

17.1.3 Warranty Claims shall be corrected by the supplier, at the Tiercon facility. If repair or replacement is not physically possible at the Tiercon facility, the return of the equipment to the supplier shall be conducted at the suppliers' expense.

17.1.4 A written response outlining the intended corrective action must be submitted to Tiercon within 24 hours of receiving the written Warranty Claim.

17.1.5 Purchased components (off the shelf components) shall be warranted by their respective manufacturers warranty, provided, that the component(s) are not undersized, improperly installed or modified by the supplier. If components are undersized, improperly installed or modified by the supplier, a Warranty Claim shall be submitted to the supplier.

17.1.6 Components modified or poorly maintained by Tiercon, shall result in a void in the warranty, to those specific components.

18.0 Approved Component/Brand Name List

18.1 Mechanical (ref. Section 5.0)

Component Description	Brand Names/Series
Bronze Bearings	Browning
Calibrated Adjustment Devices	Siki
Cam Followers	Torrington
Casters	4” casters
Central Lubrication System (grease)	Tarbon Modu-flo
Central Lubrication System (oil)	Lincoln
Clutch Break Assemblies	Warner Electric
Drive Chain & Chain Sprockets	Browning / Tsubaki
Gear Motors	S.M. Cyclo / Sew Eurodrive
Gear Reducers	David Brown / Browning
Index Drives	Ferguson w/overload output clutch
Linear Bearings and Slides	Thomson or THK or Gilman
Radial Bearings	SKF or FAG
Safety Fencing	Bosch 1” x 1”
Seals	Chicago Rawhide
Self Lubricating Wear Products	AMPPCO
Table height adjustment	Suspa MLS-0007, ErgoSwiss, or Dynalift 4M-DIA-12-S
Tapered Roller Bearings	Timken or FAG
Timing Belt & Sprockets	Browning or Gates
Toggle Clamps	Destaco
Manual tools	
Nut runners, manual	Atlas Copco STR series; ST series still available
Nut runners, fixtured	Atlas Copco QST series
Riveters	Gesipa Taurus series (#2 mostly), with GRiv-Count
Riv-nut guns	ProSert XTN20
Screw guns	Atlas Copco Tensor ES series
Torque guns controllers	Atlas Copco PF6000; PF4000 still available

18.2 Electrical Controls (ref. Section 6.0)

Component Description	Brand Name
AC Contactors for non-motor loads	Allen Bradley / 700L
AC Control Relay	Allen Bradley / 700N
AC Frequency Drives	Allen Bradley/ PowerFlex, SEW Eurodrive
AC Motors (TEFC)	Leeson
Air Pressure Switch	FESTO, SDE1-D10-G2-W18-L-P1-M8-G, part # 192766 & part # 186158
Barcode Printer	Intermec PM43, optional PD42
Barcode scanners	Keyence SR1000; Zebra LI4278
Break Motors	Demag
Color camera	Keyence, Typical IV series
Control Voltage Circuit Breaker	Allen Bradley / 1492-G
DC Drives	Allen Bradley/ PowerFlex, SEW Eurodrive
DC Motors (TEFC)	Leeson or Baldor
DC Power Supply	Allen Bradley, Sola, Weidemueller
Disconnect	Allen Bradley
Door Latch Mechanism	Allen Bradley #149F-L4
Enclosures	Rittal
Fiber Optic sensors	Keyence
Foot Switches	Telemechanique
General Purpose Relays	Allen Bradley, Omron
Guard Door Interlock Switches	Schmersal AZM 200: AZ/AZM 200-B30-RTAG1-SZ in combination with AZM 200CC-T-1P2P.
In Line Voltage Filter	Islatrol
Light Curtains	Banner
Limit Switches	Allen Bradley / 500 Series
Lockout for enclosures	Allen Bradley
Operator Interface (HMI)	Allen Bradley / PanelView Plus 7 700 (7”)
Palm Button	Allen Bradley
Photoelectric Switches	Balluff, Allen Bradley
PLC	Allen Bradley/ CompactLogix or ControlLogix
Proxi Sensors Capacitive	Balluff
Proxi Sensors Inductive	Balluff, Festo
Push Button, Selector switches, Pilot Lights	Allen Bradley
Relays	Allen Bradley, optional Omron
Robots	Fanuc or ABB
Robot Interface Plug	HTS#42.50.24.00/43.12.24.40/04.42.68.24.00
Stack Lights	Allen Bradley, green-amber-red
Terminal blocks	Allen Bradley, Weiland, with screws
Timers and Counters	Omron
Twist Lock Power cord connectors	Hubbel
VDF	Allen Bradley Power Flex, SEW Eurodrive
Vision camera	Keyence
Wire Connectors	Brad Harrison

18.3 Pneumatic (ref. Section 7.0)

Component Description	Brand Name
Anti Tie-Down	Parker PXP/ARO #59191
Dump Valve	Wilkerson Series “V”
Flow Controls	Festo, Pisco
FRL	Wilkerson
Guided Cylinders	PHD, Festo
Low pressure sensor	Festo
Non-Rotating Cylinders	PHD, Festo
Pilot Valves	Asco
Pilot valves (24 volt DC)	Mac 45A Series
Push Lock Fittings	Pisco
Quick Connects	Standard Industrial Series #25
Quick Exhaust Valves	Humphrey
Rod-less Cylinders	PHD, Festo
Rotary Actuators	PHD, Festo
Suction Cups	Piab
Thread Sealant	Locktite / #69
Two Way Cylinders	NFPA mounting

18.4 Hydraulic (ref. Section 8.0)

Component Description	Brand Name
Actuators	Parker
Cylinders	Parker
Drive Coupling	Lovejoy
Flow Dividers	Parker
Hose and Fittings	Parker/Aeroquip
Hydraulic oil	AW 46 preferred
Pumps	Vickers or Dennison
Quick Connectors	Gates #89003/89013
Return Line Filter	Hycon or LHA
Starters, full voltage fused	Allen Bradley 51
Valves (110 volt AC)	Vickers or Dennison

18.5 Conveyors (ref. Section 9.0)

Component Description	Brand Name
Accumulator Chain	Intralox
Chain Guide	Murtfeld
Conveyor reducers, pulleys	Browning
Magnetic Conveyor	Dorner, Industrial Magnetics or Bunting
Pulley Take Ups	Browning Masterline
Standard Conveyor	SKF Flexlink® /XH Series SKF Flexlink® /XM Series
Straight Plastic Chain	Rex
Variable speed controller	Allen Bradley AC inverter

19.0 Confidentiality Agreement

Confidentiality Agreement

Between

Tiercon Industries Inc. and

This *Confidentiality Agreement* (hereinafter the "Agreement") is entered into by and between Tiercon Industries Inc. (hereinafter referred to as "Tiercon") with offices located at 591 Arvin Avenue, Stoney Creek, Ontario, L8E 5N7 and …….. (hereinafter referred to as "The Company"), a Canadian corporation with offices located at …….. This Agreement shall be effective as of the date this Agreement is executed by Tiercon, as indicated in Tiercon's signature block which appears at the end of this Agreement (hereafter the "Effective Date").

RECITALS

A. Tiercon is a custom injection moulder. Tiercon possesses certain confidential and proprietary information including, but not limited to, technical and business information regarding (i) thermoplastic moulding, (ii) plant and equipment for the development, processing and/or manufacture of thermoplastic parts, composites, and coloring thereof, (iii) processes, methods and plant operating conditions for the processing of thermoplastic resins into moulded parts and (iv) samples of Tiercon moulded parts (hereafter “Samples”), all of which is hereafter collectively referred to as "Tiercon Confidential Information".

B. The company is a manufacturer and seller of molds and other tooling (hereafter “The Company Molds”). The company possesses certain confidential and proprietary information including, but not limited to, technical and business information regarding (i) tooling and equipment for the processing and manufacture of thermoplastic resins, intermediates, composites, and coloring thereof, (ii) processes, methods and plant operating conditions for the manufacture and / or processing of thermoplastic resins, intermediates, blends, composites, and coloring thereof.

C. Tiercon and The Company wish to discuss the development of moulded long glass fiber running boards (the “Purpose of this agreement”). In such discussions and business relationships which may result therefrom between Tiercon and The Company, it is anticipated that The Company may disclose The Company Confidential Information to Tiercon and Tiercon may disclose Tiercon Confidential Information to The Company. To govern such disclosure, and the confidentiality of The Company Confidential Information and Tiercon Confidential Information, The Company and Tiercon wish to enter into this Agreement.

TERMS AND CONDITIONS

Now, therefore, in consideration of the receipt of The Company Confidential Information by Tiercon and receipt of Tiercon Confidential Information by The Company and the covenants made in this Agreement, The Company and Tiercon agree as follows:

1. The Company Confidential Information and Tiercon Confidential Information are hereinafter collectively referred to as "Confidential Information."

Confidential Information shall only be subject to obligations of confidentiality and restrictions on use or disclosure under this Agreement if it is either (a) in writing or other tangible form bearing the date of disclosure and clearly marked as "Confidential" when disclosed to the receiving party or (b) if not in tangible form (i.e. disclosed orally or observed), then identified as confidential when revealed and summarized in a writing clearly marked as "Confidential," and delivered to the receiving party within thirty (30) days of such disclosure.

Furthermore, samples provided by each party will be used for the Purpose of this Agreement and for no other purpose. Tiercon or The Company will not test or analyze Samples for their chemical composition, nor will Tiercon or The Company permit third parties to undertake chemical or other analysis of Samples. The final properties of Samples have not been determined, nor has their suitability for any particular application been established. MSDS's furnished with Samples describe the workplace safety aspects of using and disposing of the Samples. Caution must be applied during evaluation, since all possible workplace considerations may not be known at the time of Sampling.

2. The Company shall (a) hold Tiercon Confidential Information in confidence using the same care and caution The Company affords its own confidential information, but not less than a reasonable degree of care; (b) use Tiercon Confidential Information only for the Purpose of this Agreement; (c) reproduce Tiercon Confidential Information only to the extent necessary for the Purpose of this Agreement; and (d) restrict disclosure of Tiercon Confidential Information to employees with a need to know Tiercon Confidential Information for the Purpose of this Agreement.

Tiercon shall (a) hold The Company Confidential Information in confidence using the same care and caution Tiercon affords its own confidential information, but not less than a reasonable degree of care; (b) use The Company Confidential Information only for the Purpose of this Agreement; (c) reproduce The Company Confidential Information only to the extent necessary for the Purpose of this Agreement; and (d) restrict disclosure of The Company Confidential Information to employees with a need to know The Company Confidential Information for the Purpose of this Agreement.

The obligations of confidentiality and restrictions on the use or disclosure of Confidential Information under this Agreement shall not apply to any Confidential Information which (a) at the time of disclosure to the receiving party was known to the receiving party without restriction on disclosure; (b) is publicly known or later made public through no wrongful act of the receiving party; (c) is received by the receiving party free of restriction on disclosure from another source having the right to so furnish such Confidential Information; (d) is approved for release in writing by the disclosing party; or (f) is required to be disclosed by operation of law.

3. No license to a party under any patent, copyright, trademark, or any other intellectual property right is either granted or implied by the disclosure of Confidential Information by one party to the other party. Unless otherwise agreed to in writing between The Company and Tiercon, neither this Agreement nor the disclosure of Confidential Information by one party to the other shall constitute any representation or warranty of any kind with respect to Confidential Information disclosed. However, The Company warrants to Tiercon that it has the right to disclose The Company Confidential Information to Tiercon and Tiercon warrants that it has the right to disclose Tiercon Confidential Information to The Company.

4. Neither this Agreement nor the disclosure or receipt of Confidential Information shall constitute or imply any promise or intention to purchase products or provide any services by either party to the other or any commitment by either party to enter into any other business arrangement with the other.

5. Each party's respective Confidential Information and all copies thereof shall remain the property of the disclosing party and shall, at the disclosing party's option, be either promptly returned to the disclosing party upon the disclosing party's written request or destroyed by the receiving party, with such destruction confirmed in writing.

6. Nothing in this Agreement shall be construed as restricting or prohibiting either party from promoting or selling any of its products or services.

7. All disclosures under this Agreement shall be made within twelve (12) months after the Effective Date of this Agreement.

8. All obligations created by this Agreement shall expire two (2) years from the Effective Date of this Agreement.

9. In the event any legal action is required to enforce this Agreement, each party shall bear its respective attorney's fees and costs.

10. This Agreement shall be governed and interpreted under the laws of the Province of Ontario, except for its choice of law provisions.

11. This Agreement may be executed by facsimile signature in any number of counterparts, all of which taken together shall constitute one in the same instrument. After execution by facsimile, originals of this Agreement shall be executed and provided to The Company and Tiercon.

12. This Agreement constitutes the entire understanding between the parties hereto as to Confidential Information and merges all prior discussions between them relating thereto. No amendment or modification of this Agreement shall be valid or binding on the parties unless made in writing and signed on behalf of each of the parties by their respective duly authorized officers or representatives.

In witness thereof, the parties have executed this Agreement.

TIERCON INDUSTRIES INC.	THE COMPANY
By:	By:
Name:	Name:
Title:	Title:
Date:	Date:

20.0 Specification Acknowledgement Form

Specification Acknowledgement

You have received the **"Tiercon Equipment Design and Build Specification"** revision 01 – January 29, 2014 from Tiercon. Please review the specification carefully before submitting a project quotation.

Additional requirements may also be included with this package to cover details in addition to this specification.

Project Name: .....

The supplier has reviewed this specification, agrees with and shall conform to the **"Tiercon Equipment Design and Build Specification"** as documented.

Yes ☐ (if there are concerns, please list along with section the number)

1) .....Section No.....

2) .....Section No.....

3) .....Section No.....

4) .....Section No.....

5) .....Section No.....

(Use reverse of page if needed)

If for technical reasons, the proposed equipment, does not conform to the **"Tiercon Equipment Design and Build Specification"**, list which items abstain from this specification:

.....

.....

.....

.....

.....

.....

Supplier Name: .... Quotation Number: .....

Supplier Address: .... Phone No.: (_____).....

.... Fax No.: (_____) .....

Representative:..... ..... Date: mo/_____ day/_____ yr/_____

Tiercon Project Manager: .... Date: mo/_____ day/_____ yr/_____

Controlled Document Review/Revision Log

Revision Date	Revision Level	Prepared By:	Revision/Description
November 20, 2013	0	Manish Gandhi	Original copy
January 20, 2014	1	George Tatulea	Added Electrical and Programming Revised Standard
February 7, 2014	2	George Tatulea	Revised the Electrical and Programming Standard
February 10, 2014	3	George Tatulea	Revised the Electrical and Programming Standard
February 21, 2014	4	George Tatulea	Revised the Electrical and Programming Standard
May 6, 2014	5	George Tatulea	Revised the Electrical and Programming Standard
May 23, 2014	6	George Tatulea	Revised the Electrical and Programming Standard, hardware section
July 21, 2014	7	George Tatulea	Revised the sections 6.5.7.23, and 6.5.7.30
Nov 12, 2014	8	George Tatulea	Revised the sections 6.5.5. 3
February 6, 2015	9	George Tatulea	Revised the sections 6.0 and 18.2
August 29, 2016	10	Mark Bisutti	Revise 5.6, 5.7, 5.8
October 19, 2016	11	Jamie Westfall	Revised to include CoPlas and USA requirements.
January 31, 2017	12	Mirca Andrei	**6.5.7.4** BARCODE PRINTER – Revised to include integration of hardware and software and sample label requirements.
February 28, 2017	13	Mirca Andrei	**4.0.2 –** Updated to include quick changeover requirements for quoting by supplier.
April 4, 2018	14	Mark Bisutti	Revise 6.5.7.17 and 11.3b for mutilation protection of handtools
July 13, 2018	15	Mirca Andrei	**5.6.2** – Table construction for height adjustability must be frame in frame for safety.
Dec. 04 2018	16	Toma Nyiszli	6.5.7.25 STACK LIGHT – defined color codes as 3 colors 6.5.7.29 COLOUR CAMERA Removed reference to series 500
Mar. 27 2019	17	Toma Nyiszli	**5**.61. Manual Assembly Table: Changed fan make and model 6.5.7.31 Robots: Added reference for preferred robot Fanuc or ABB 15. Equipment Performance and Inspection Sign Off: Replaced section with reference to form TCE-FRM-094 New or modified equipment buy off check list
Apr. 25 2019	18	Toma Nyiszli	5.6.1. Changed table top base height to 34” 6.5.7.1.2 HMI: changed to PanelView Plus 7 700, previous model obsolete. 18.2 Electrical Controls: same change for PanelView
Mar. 16 2020	19	Toma Nyiszli	General form edits and cleanup; Approved components list update; Listed components in alphabetical order. Added list of approved tools for assembly cells; Added approved barcode scanners; Addition of MES requirements. Added reference to EHSP-207 H&S Requirements
May 06 2021	20	Mirca Andrei	Added 6.7.9.1 eternal RJ45 connections.
June 09 2021	21	Mirca Andrei	Updated 5.8.2 to include verification of item with plant.
July 01 2021	22	Mirca Andrei	Added Section 5.10 Equipment Lighting – General.

October 28, 2021	23	Mirca Andrei	**Added 5.0.2.1** lift tables must include a lift table “skirt” / “bellows” or similar protection device.