**0.0 Revision Log**

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| Revision Log | | | | | |
| Revision Level | Revision Date | Section | Description | | Revised By |
| REL | 05052016 | ---- | Initial Release | | DE |
| A | 3/15/19 |  | Mass updates, complete re-write to standard | | NT |
| B | 8/3/21 | 5.2.1  5.5.5 | Added Epson as a preferred brand, removed preferred robot series  Removed the Robot Flow Diagram requirement | | NT |
| C | 10/10/22 | 4.0  5.2.1  5.3  5.4  5.5  5.6  5.0 | Added 4.10 Reference  Added Yaskawa as a preferred brand  Updated 5.3.1, added 5.3.2  Updated 5.4.1  Added 5.5.1, 5.5.7, 5.5.8, 5.5.9, and 5.5.10  Added 5.6.3  Added 5.7, 5.8, and 5.10 | | N. Taylor |
| D | 12/1/2023 | Header | Replaced GHSP logo with newer version | | BB |
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| Approval: | | CN: RS | | MX: BA | |
| US: JA | | Other (as req’d): | |

1. **Purpose:** 
   1. To define the global standard for the utilization of Robots within GHSP manufacturing facilities.
2. **Scope:** 
   1. This global standard applies to all GHSP manufacturing facilities.
3. **Definitions:** 
   1. ANSI – American National Standards Institute
      1. Voluntary standardization system used as a reference for robotic safety requirements beyond OSHA regulation.
   2. OSHA – Occupation Safety and Health Administration
      1. This is a government agency responsible for laws relating to workplace safety. These regulations are used to define minimum requirements for robotic safety.
   3. RIA – Robotic Industries Association
      1. A trade group on North America organized specifically to serve the robotics industry.
   4. Collaborative Robot
      1. A collaborative robot (or cobot) is a robot intended to physically interact with humans in a shared workspace.
      2. More effectively, it is the **task** the robot is performing and the **space** in which the task is being performed, not the robot itself, that make it collaborative.
   5. Minimum Safe Distance Calculation
      1. Used to determine the required minimum safe distance for safety devices (i.e. light curtain) placement relative to the pinch point(s) or hazard. Reference CP-WI-MFG-X301 for ANSI Formula.
4. **References:**
   1. ANSI/RIA R15.06:2012 = Industrial Robots and Robot Systems-Safety Requirements
   2. ISO 10218-1:2011 = Robots and robotic devices – Safety requirements for industrial robots – Part 1: Robots
   3. ISO 10218-2:2011 = Robots and robotic devices – Safety requirements for industrial robots – Part 2: Robot systems and integration
   4. ISO/TS 15066:2016 = Robots and robotic devices – Collaborative robots
   5. ANSI B11.19:2010 = Performance Requirements for Safeguarding
   6. All regional requirements, that meet or exceed international standards
   7. CP-WI-MFG-X301 Global Standard Production Equipment Safety, Ergonomic, and Delivery Checklist
   8. CP-WI-MFG-X319 Global Standard Electrical Schematics, HMI, and PLC
   9. CP-WI-MFG-X327 Global Standard Assembly Equipment Manual
   10. OS-WI-MFG-X70 Lockout Tagout Verification
5. **Method:**
   1. **Risk Assessment**
      1. A risk assessment shall be performed during the equipment design phase
      2. If doing a risk assessment for a Collaborative Robot application, you shall use the same process/methodology as a “standard” application **plus** you need to assess added conditions stated in ISO/TS 15066
   2. **Robot Selection**
      1. Preferred Brands

*Selection outside the preferred brand requires approval by the Advanced Process Engineer and Global Standards Team*

* Fanuc
  + 3, 4, and 6 axis applications
  + Collaborative applications
* Epson
  + 3, 4, and 6 axis applications
* Denso
  + 4 and 6 axis applications
* Yaskawa
  + 3, 4, and 6 axis applications
* Universal Robots
  + Collaborative applications
* SEPRO
  + Molding applications
* STAR
  + Molding applications
    1. Robot Communication Selection

*Selection outside the preferred method requires approval by the Advanced Process Engineer and Global Standards Team*

* + - * EtherNet/IP
      * Euromap 67
  1. **Robot Cable Management**
     1. Robot arm shall have cable management.
     2. It is recommended that robots with teach pendants shall have a wonder winder or similar cable management system for the teach pendant cable. There shall be one cable management system for each teach pendant.
  2. **Robot Vision**
     1. Installation of vision into a robotic cell should be first investigated using the facilities’ preferred vision brand, unless the integrated robot vision will meet all requirements for the application.
  3. **Robot Setup and Programming**
     1. Documentation of robot programming / sequence of operation is required. Map showing robot cell, reference frames, and any other pertinent information will be provided.
     2. Programs will include the use of axis/soft limits set to keep the robot in the required work and service areas.
     3. Programs will include the use of any built-in collision detection capabilities.
     4. Reference frames will be used for each program.
     5. Tool Calibration Position will be included in the design of robot cells.
        + Tool Calibration Position needs to be in a location that requires no disassembly of equipment.
     6. The HMI and teach pendent must have a “Step Through Program” function, that allows the technician/engineer the ability to step to each robot movement location.
     7. Machine Reset will move the robot, safely without crashing, to the home position allowing it to be ready for a new cycle to start. Machine reset will not require the use of the teach pendant to get the robot back to home and ready for another cycle.
     8. Programming will be written in a manner that the robot does not pause during program execution. Flow will be smooth and efficient. Any inefficiencies in robot programming (regardless of cycle time) will not be allowed. Best practice would be to review proposed robot logic before programming to avoid rework.
     9. All Registers will be named
     10. The robot “hold” button, on the teach pendant, shall not dis-able the auto cycle. The robot should resume it’s normal process flow once the hold button is dis-engaged.
  4. **Robot End of Arm Tooling**
     1. Under normal operating conditions, all end of arm tooling functions will be able to be controlled through the teach pendant and/or HMI.
     2. When safety circuit is broken, all end of arm tooling functions during programming/manual operations must be through the teach pendant, with dead man switch activated, only.
     3. If the safety circuit is interrupted, the robot end of arm tooling shall not drop parts.
  5. **Robot Tool Change Requirements**
     1. Tool changer preferred brands
        + North America
          - ATI
          - Schunk
          - Applied Robotics
        + China
          - RSP
          - eins
  6. **Robot Safety Requirements**
     1. Access doors require double redundant safety switches
     2. Access requires the use of a trapped key system
        + Preferred access door safety switch and handle
          - Safety Switch: Allen Bradley, Guard Master, TLS2-GD2
          - Handle: Sliding Bolt, 440G-A27163
     3. When the access door is unlocked, all air to the cell gets dumped, EXCEPT the air to the robot/robots valve stack
     4. Access to cell requires the use of a Request to Enter signal, allowing the machine to finish processing before allowing entry.
        + This is not a part of the E-Stop Circuit. This need to be a part of the PLC “Request to Enter” code.
     5. When the Request to Enter process is initialized, the assembly cell and robot shall finish all of its processes, including emptying the end of arm tooling, before anyone can enter the cell.
        + It is recommended that the robot move to a “straight vertical” position after emptying it’s end of arm tooling, allowing people to move easily around the cell.
     6. In the event of a crash condition there needs to be a method of manual override to allow entry. Badge level controlled or special key.
  7. **Collaborative Robots**
     1. Robots designed for collaborative operation, when in automatic mode (not teaching mode), shall provide a visual indication when the robot is in collaborative operation and comply with one or more of the following:
        + Safety-rated monitored stop
        + Hand guiding operation
        + Speed and separation monitoring
        + Power and force limiting
     2. When in collaborative mode, the maximum speed the robot can move is 250mm/s (10in/s).
  8. **Robot Pneumatics**
     1. Each robot needs to have its own valve and I/O stack, separate from the main valve stack.
     2. The air line for the robot valve stacks shall be mounted before the safety dump valve in the air prep.
        + This applies to single and multi-robot cells
     3. Robot valve shut offs need to be mounted adjacent to the main pneumatic lock-out tag-out point.
        + A digital pressure sensor will be installed before each robot valve shut off

1. **Records:**
   1. All robot programs must be stored on the facility server.