1. **Revision Log**

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| Revision Log |
| Revision Level | Revision Date | Section | Description | Revised By |
| A | 9/21/16 | 45.2.1.55.3.1 | Corrected reference document names/numbersAdded requirement for shielded and twisted pair wiring for high-speed communications cables.Added approval requirement for non-standard connectors on the pogo pin block. | SJR |
| B | 8/3/17 | Many | Many updates and added audit questions | NT |
| C | 5/21/18 | 5.3.1 | Updated requirements | NT |
| D | 8/7/18 | 5.4 | Software application backup requirements | GR |
| E | 5/17/19 |  | Mass update, complete re-write to standard | NT |
| F | 7/27/20 | 4.13 | Updated Work Instruction file name | NT |
| G | 4/28/21 | 3.25.15.3.15.3.35.3.45.4.1 | Updated Role name from APSE to TDEUpdate Roles and Responsibility sectionUpdated NI PXI Chassis part numbers and added 2 more Pogo Pin blocks suppliersNew sectionNew sectionAdded new statement | NT |
| H | 10/17/22 | 4.0 | Updated Reference 4.5 document name | N. Taylor |
| I | 12/1/2023 | Header | Replaced GHSP logo with newer version | BB |
| ‘ | CN: RS | MX: BA |
| US: JA | Other (as req’d): |

1. **Purpose:**
	1. To define the global standard for the use of Product Test Systems within GHSP manufacturing facilities.
2. **Scope:**
	1. This global standard applies to all GHSP manufacturing facilities.
3. **Definitions:**
	1. APE – Advanced Process Engineer
	2. TDE – Test Development Engineer
	3. TPE – Technical Project Engineer
	4. EOL – End of Line
		1. The final function test station for an assembly cell.
	5. DAQ – Data Acquisition
		1. An input module with analog and/or digital input.
	6. DUT – Device Under Test
		1. The component or assembly currently being evaluated.
	7. Coordinated Data Acquisition
		1. Synchronized logging of sensor data and network traffic during the test cycle. Often required for gear select modules that require sensor calibration after assembly.
	8. CAN – Controller Area Network
		1. CAN bus is a vehicle network standard designed to allow microcontrollers and devices to communicate with each other in applications without a host computer.
	9. LIN – Local Interconnect Network
		1. LIN is a serial network protocol used for communication between components in vehicles.
	10. PWM – Pulse Width Modulation
		1. PWM is a modulation technique used to encode a message into a pulsing signal with a fixed frequency.
	11. PCB – Printed Circuit Board
		1. Typically, a fiberglass sheet with metal traces etched in to one or more sides to connect components in a circuit.
	12. ESD – Electrostatic Discharge
		1. The sudden flow of electricity between two electrically charged objects caused by contact, an electrical short, or dielectric breakdown. The electric charge may be tens of thousands of volts, which can cause permanent damage to components or systems.
	13. PXI – PCI eXtensions for Instrumentation
		1. PXI was developed by National Instruments. It allows an external enclosure to be seen as internally connected to a host computer as well as adding timing and signal coordination between DAQ modules.
	14. NI – National Instruments
		1. Manufacturer of DAQ equipment and the LabVIEW programming language.
	15. MDA – Manufacturing Defects Analyzer
	16. ICT – In-Circuit Test
	17. FT – Functional Test
4. **References:**
	1. CP-WI-MFG-X302 Global Standard Robotic Application and Setup
	2. CP-WI-MFG-X303 Global Standard Vision Systems
	3. CP-WI-MFG-X307 Global Standard Servo
	4. CP-WI-MFG-X309 Global Standard Laser Application and Setup
	5. CP-WI-MFG-X311 Global Standard Assembly Equipment
	6. CP-WI-MFG-X313 Global Standard Leak Testers
	7. CP-WI-MFG-X314 Global Standard Load Cells
	8. CP-WI-MFG-X315 Global Standard Data Acquisition
	9. CP-WI-MFG-X316 Global Standard Sensor Devices
	10. CP-WI-MFG-X318 Global Standard Barcode Reader and Printer
	11. CP-WI-MFG-X319 Global Standard Electrical Schematics HMI and PLC
	12. CP-WI-MFG-X321 Global Standard Lot Traceability
	13. EM-WI-COR-X19 ESD Control Program
	14. PD-PR-132 Statement of Work Development
5. **Method:**
	1. **Roles and Responsibilities**
		1. The APE is responsible for determining the production test sequence with the TDE to ensure that the machine cycle time can be met, and all internal customer requirements are met.
		2. The TDE is responsible for establishing the production test plan requirements for the EOL Tester/Final Function Tester.
		3. The TDE is responsible for selecting appropriate hardware and developing the test application.
		4. The TDE is responsible for determining data storage requirements for raw test data (i.e. TDMS files, CSV files).
		5. The APE or TDE will coordinate with the IT Analyst to implement lot trace support (CP-WI-MFG-X315).
	2. **System Requirements**
		1. Communications
			* All communication with the DUT will be accomplished using the customer specified method. If a customer specification does not exist or does not address all the needs of the manufacturing process, a GHSP standard communication method will be used. Nonstandard methods will not be used without approval from all stakeholders, including but not limited to the APE, TDE, Software Engineer, Technical Project Engineer, and Systems Engineer – Test for the program.
			* All communications between system components will be accomplished using Ethernet/IP. Alternate communications protocols must be approved by all stakeholders – including but not limited to the APE, TDE, Manufacturing Engineer – for the program, prior to machine builder selection in the RFQ process.
			* For communication between the PLC and test system software, data structures will be used to group signals, flags, and data. Separate data structures will be used by the PLC and test software for tags written to by each system. Writing of data to tags by multiple sources is not allowed.
			* PC test software shall wait for PLC notification that a DUT is in position for test, execute the test, and report test results to the PLC. All machine safety monitoring and control are required to be managed by the PLC.
			* High-speed communications cables must be shielded, properly grounded (only one end connected to ground) and contain twisted pairs of wires for data lines. Individually shielded twisted pairs are not required.
		2. A GHSP Standard Frame will be used as the base of the test system (CP-WI-MFG-X311). Deviations must be approved by the APE, TDE, Process Engineer, and Manufacturing Engineer prior to machine builder selection in the RFQ process.
		3. For test systems that require handling of electronic components or PCBs, appropriate ESD countermeasures must be employed (EM-WI-COR-X19).
		4. For test systems that require leak testing, a standard leak test device must be used (CP-WI-MFG-X313).
		5. For test systems that utilize robots, standard robotic units must be used (CP-WI-MFG-X302).
	3. **Hardware Selection**
		1. For products with vehicle network interface (CAN, LIN, etc.) that DO require coordinated data acquisition.
			* National Instruments
				+ PXIe chassis
				+ PC controlled

PC hardware shall be chosen based on test requirements and available options at the time of purchase. APE or TDE will coordinate with IT support to ensure compliance with company network and computer support policies.

Operating system will be determined by IT policy. Deviation from policy requires coordination and approval by IT prior to equipment purchase.

Embedded (real-time) controlled

Model varies by availability.

Embedded PC hardware shall be chosen based on test requirements and available options at the time of purchase.

Requires a separate development license for LabVIEW, available through the volume license agreement.

* + - * + Hardware and accessories

19” rackmount kit – front & back

68-pin cables – connects Load Box to DAQ module

DB-9 to RJ45 cables – connects CAN to Load Box

* + - * DUT Interface
				+ GHSP Test Lab Load Box

Load Boxes may be purchased through the Test Lab with approval of Test Lab Manager.

If Load Boxes will be assembled by an outside supplier, coordination should be made to have the units produced at the same time as the test lab units.

* + - * + Pogo-pin blocks

Preferred Suppliers

Mfg. ([www.doyleblocks.com](http://www.doyleblocks.com))

ECC ([www.eccco.com](http://www.eccco.com))

Quality Machine & Automation (www.qmautomation.com)

Skylark Machine (www.skylarkmachine.com)

Required (unless approved by TDE) block material is Acetal (Delrin) or G10.

Connector blocks need to be able to be changed out at the station quickly, without any soldering, to help reduce downtime. They can accomplish this with redundant pogo pins or a quick disconnect method, therefore allowing the connector to be replaced and fixed offline.

Appropriate pogo pin styles designed for data communication need to be selected and the signal lines need to be twisted pair.

Pogo pins must be 2/3 compressed when block is mated to DUT.

Connectors for pogo-pin block pigtails must be verified before ordering. Products that do not use a standard Test Lab Load Box will use a pigtail connector type specified by the TDE. Nonstandard connectors require approval by the TDE prior to purchase.

* + 1. For products with vehicle network interface (CAN, LIN, etc.) that DO NOT require coordinated data acquisition
			- National Instruments
				* cDAQ Chassis with appropriate modules
				* cRIO (only needed if there is no PC) is preferable for headless applications, that that do not require data acquisition or if deterministic timing of communications is required
		2. For products with vehicle network interface (CAN, LIN, etc.) that DO NOT require any data acquisition
			- Anybus
				* Communicator CAN – Ethernet/IP to CAN bus gateway
			- Intrepid Control Systems
				* neoECU-20 – Standalone CAN and LIN module. Requires separate development module and software license.
		3. For electronics subassemblies and PCBs
			- ICT
				* Keysight 3070
				* CheckSum Analyst 12KN
			- FT
				* NI PCIe DAQ
				* Keysight Power and Data Acquisition
				* Associated Research Power and High Pot Test Instruments
				* GenRad 2270 Interface form factor connections and enclosures
		4. For products without vehicle network interface
			- Product test systems without vehicle network interface must comply with all GHSP machine design and equipment standards.
	1. **Development Software and Run-time Environment**
		1. All National Instruments equipment will be interfaced with LabVIEW software. New projects will use a version of LabVIEW within the last 3 years, BUT needs to be confirmed “OK” by the TDE. Updates to existing projects will use the original development version. Driver versions will be determined prior to software development.
		2. LabVIEW executable files, libraries, drivers, or any other files needed for testing in the process, should be saved before any changes are made.
		3. LabVIEW program backups should be performed every time there is a change/update or at a semi-annual interval (6 months).
		4. When the machine is to be installed in a country where English is not the official language, the application display information shall be presented to the operator in the local language. A button must be provided, though, to display the information in English.
		5. For applications that DO NOT require any coordinated data acquisition (reference 5.3.3), the PLC is responsible for interfacing with the communication module.
	2. **Enclosures**
		1. The test system equipment shall be contained in a suitable enclosure. A 19-inch rackmount system is standard and rack mount equipment is preferred.
	3. **Signal Sharing**
		1. In the event the output from a sensor must be shared between the DAQ equipment and another device, the signals must be isolated to reduce noise or interference.
			+ Dataforth 8B or 5B series
				- Backplane required
				- DIN rail mount preferred
1. **Records:**
	1. Test programs to be included in the Assembly Equipment Manual
		1. Anytime a change to the test program is made, a PCR must be written and approved.
	2. All test programs must be stored on the facility server.