Casting Engine Transmission Center

Global Machinery and Equipment Specification Document

Engine Test Approved Components List

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GMNA Manufacturing Engineering
Casting, Engine, & Transmission Center.

Document Management Information

This Specification shall take effect as of the Published Date of the document.

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Any questions or comments with respect to this specification should be directed to the GMPT Manufacturing Engineer responsible for the project.

Revision History

Published	Version	Section Number	Change Description & Impact
2010-02-12	2.5	ALL	UPDATE TO NEW SPECIFICATION TEMPLATE
		ALL	ADDED REQUIREMENTS FOR HOT TEST
		3.1	REMOVED LEBOW (HONEYWELL) AND SENSORDATA FROM APPROVED TORQUE TRANSDUCERS. UPDATED TYPES AND RATINGS FOR TORQUE TRANSDUCERS.
		3.1	UPDATED POWER SUPPLY REQUIREMENTS FOR ENGINE SENSORS TO INCLUDE FUEL PRESSURE SENSORS AND APPLICABLE FOR TORQUE TO TURN
		3.1	REPLACED PCB WITH DISCOM AS AN APPROVED SUPPLIER FOR NVH
		3.4	UPDATED COMPUTER REQUIREMENTS. HOST AND REPORT NOW PART OF GM-IT REQUIREMENTS.
		3.5	ADDED SIGPOD FOR TORQUE TO TURN PROCESS SIGNAL VERIFICATION SYSTEM
		3.5	REPLACED USON VECTOR UNIT WITH QUALITEK MR UNIT, AND ADDED CINCINNATI TEST SYTEMS SENTINEL I-24 TESTER.
		3.5	REPLACED INFICON 1000 MODULAR HELIUM MASS SPECTROMETRY LEAK TEST WITH A 2000 UNIT
		3.6	UPDATED BOSCH REXROTH REQUIREMENTS FOR ELECTRIC DRIVES AND CONTROLS

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TABLE OF REGIONAL SPECIFIC REQUIREMENTS

1.0 INTRODUCTION

The purpose of this document is to list the functional requirements and/or suppliers for components used in GMNA CETC engine test systems. All components selected for use shall be submitted to the GMNA CETC responsible engineer for approval. If a specific part number is obsolete or unavailable, the equipment supplier shall recommend a direct replacement through the deviation process.

1.1 SCOPE OF DOCUMENT

The scope of this document applies to all equipment associated with engine test - including cold test, leak test and torque to turn.

1.2 LEGAL REQUIREMENTS AND REGULATIONS

The Supplier shall be fully responsible to design, build, and deliver all equipment included within the GM purchase order agreement in full compliance with governmental laws and regulations applicable to the final destination location for the equipment.

GM requirements shall not supersede applicable governmental laws and regulations of the final destination location for the equipment unless a specific exemption has been obtained from the authority having jurisdiction.

1.2.1 ORDER OF PRECEDENCE

Where GM requirements, and/or governmental laws and regulations, conflict with one another the manufacturing system design shall adhere to the strictest of these requirements.

1.3 INDUSTRY AND INTERNATIONAL STANDARDS

All machinery and equipment delivered to GM by the Supplier shall be designed and built to comply with current industry internationally accepted Standards. GM CETC Specifications may reference various internationally recognized Standards to provide the Supplier with the specific GM interpretation of the Standards requirements that the Supplier shall adhere to and implement in the design of their equipment.

1.4 RESOLUTION OF CONFLICT

Contact the GM Manufacturing Engineer in the event of a conflict between the requirements of this document, the references cited herein, or GM CETC Standards and Specifications. The Supplier shall inform the GM Manufacturing Engineer responsible for the project of all requirements conflicts. The GM Manufacturing Engineer shall direct the Supplier on appropriate action to take in order to resolve the conflict in accordance with GM change management procedures.

2.0 DEFINITIONS AND ACRONYMS

1 Gigabyte (GB) = 1,000,000,000 bytes

1 Terabyte (TB) = 1,000 GB

AGP – Accelerated Graphics Port

DDR2 SDRAM – double data-rate two synchronous random access memories

DIMM – Dual In-Line Memory Module – a series of dynamic random access integrated circuit memory chips

EMI – Electromagnetic Interference

ESD – Electrostatic Discharge

eSATA – External Serial Advanced Technology Attachment – is a computer bus designed primarily for the transfer of data between a computer and an external mass storage device.

FBD – fully buffered DIMM

FSB – Front Side Bus – the primary path between the CPU and the memory

IIS – Internet Information Services

IDE – Integrated Drive Electronics – a computer hardware bus used primarily for disk drives

LTO-3 – Linear Tape-Open-3 – 3rd generation of a computer storage magnetic tape

NIST – National Institute of Standards and Technology

PCI – Peripheral Component Interconnect – an industry standard bus for attaching peripherals to computers

PCI-e or PCI Express – is a computer expansion card interface structured around point-to-point serial links called lanes rather than a bus.

RAID – Redundant Array of Independent Disks

RAID 1 – an array of disks which creates an exact copy of a set of data

RAID 5 – segments logically sequential data, such as a file, and distributes the segments to multiple physical disk drives within the array. It contains a parity drive in the event one drive fails and the system crashes, the data can be restored by utilizing the other drives in the array. A minimum of 3 disks is required for a complete RAID 5 configuration.

RFI – radio frequency interference

SCSI – Small Computer System Interface – is a a set of standards for physically connecting and transferring data between computers and peripheral devices

SQL – Structured Query Language – is a database computer language designed for the retrieval and storage of data in a relational database management system

TCP – Transmission Control Protocol is one of the core protocols of the Internet protocol suite

TFT – Thin Film Transistor

3.0 REQUIREMENTS

NOTE:

The technical requirements and associated approved components represent cost-effective solutions at the time of specification development. Due to technology and pricing changes, alternate components which meet or exceed the stated requirements and are more cost-effective may be proposed through the deviation process.

Computer hardware shall be purchased in the same country as the plant site location in order to facilitate proper service and support, power cable plugs, keyboard configurations, etc.

3.1 SENSOR/TRANSDUCER APPROVED COMPONENTS LIST

			Applicability			
Component	**Application/Requirements (see note in 3.0)**	**Approved Supplier(s)**	**Leak Test**	**Torque to Turn**	**Cold Test**	**Hot Test**
Pressure Transducer	• Sensing range selected to meet specific requirements for Intake, Exhaust and Oil pressure measurements. • Unity gain minimum • Fixed 6-pin bayonet connector, Bendix® style, to mate with PT06E-10-6S (SR) electrical connector • Internal Shunt Calibration • 1/4"-18 NPT Female Threads • Output voltage -5 to +5 VDC	***Viatran*** Model 245 ***PCB*** Series 1500		**X**	**X**	**X**
Transducer Power Supply	• Transducer power supply shall be linear type (24 VDC). • Non-switching			**X**	**X**	**X**
Rotary Torque Transducer	• Torque flange (preferred option) • Transformer coupled rotary • Type determined by sizing requirements per specifications.	***HBM, PCB***		**X**	**X**	
Ignition Sensing Transducer	• Variable reluctance sensor	***AI-TEK (Air Pax)*** Sensor - #70085-1010-002 or #70085-1010-175 Cable - CA-79-8-60-01-00 ***ElectroCorp*** Sensor - #AN3030 or AN3040			**X**	
Ignition Coil Power Supply	• Linear design, programmable 0.00-15.00 VDC, 15 Amp • Non-switching • User must be able to calibrate				**X**	

Component	Application/Requirements (see note in 3.0)	Approved Supplier(s)	Applicability			
			Leak Test	Torque to Turn	Cold Test	Hot Test
Engine Control Power Supplies	• Linear, 5 VDC, 1 Amp • Linear, 12 VDC, 10 Amp • Non-switching • User must be able to calibrate				X	X
Engine Sensor Power Supplies	• For all applicable engine sensors, i.e. cam, crank, and fuel pressure sensors • Linear, 5 VDC, 1 Amp • Non-switching • Trim adjustable output voltage • User must be able to calibrate			X	X	
Noise (NVH) Sensing Transducer	• Filter – A hardware filter shall be used • Single channel amps only.	***Discom*** *BKS09 (ICP sensor) with cable* ***Dataforth*** Accelerometer Input Module – SCM5B48		X	X	
Weather Station (Pressure, Humidity and Temperature Transmitter)	• Combined Pressure, Humidity and Temperature Transmitter • Resolution: 0.1mbar, 0.1%RH, 0.01°C • Pressure range 500mbar to1100mbar • Humidity range 0%RH to100%RH • Temperature range -40°C to 60°C • 24 VDC power, D9-connector • Ethernet connection	***Vaisala*** Ex. P/N - PTU30011A01A0BCPB1A4E1B1B0B0A			X	X
Weather Station (24VDC Power Supply and Disconnect Switch, etc)	• Selection shall match supplier for rest of assembly system				X	X
Oil Temperature Transducer	Infrared device shall have the following features: • +/- 1 degrees C or better accuracy	***Omega*** P/N - OS65-V-R4-3 with OS-NIST			X	X

Component	Application/Requirements (see note in 3.0)	Approved Supplier(s)	Applicability			
			Leak Test	Torque to Turn	Cold Test	Hot Test
	• Laser pointer for positioning. • Immune to walkie talkie interference • Integral digital display • GM common code 1015-16P1 • IR temperature transmitter • NEMA-4 enclosure • 0-5 VDC output, 0-125 DEG C, 15:1 optics • NIST traceable calibration certificate					
Instrumentation Quick Coupling	• Simple push-pull action to connect and disconnect lines–no tools required. • Leak-tight O-ring seal systems. • Valved Coupler (Body) – Tooling Side. • Non-valved Nipple (Stem) – Transducer Side. • Material: 316 Stainless Steel	***Parker*** *CPI Series* ***Swagelok*** *QC Series*		**X**	**X**	**X**
Thermocouples and Resistance Thermometers (RTDs)	• ≤ 300 °C – PT 100; RTD • ≤ 1250 °C – K-Type; Thermocouple					**X**
Air/Fuel Ratio Sensor Controller (Wide Band O_2 Sensor)	• AFR or Lambda ratio • ± 0.10 AFR accuracy • < 100ms latency	***Innovate Corporation*** *LC-1* ***Horiba*** *MEXA-700 Lambda*				**X**

3.2 SIGNAL ACQUISITION/CONDITIONING APPROVED COMPONENTS LIST

Component	Application/Requirements (see note in 3.0)	Approved Supplier(s)	Applicability			
			Leak Test	Torque to Turn	Cold Test	Hot Test
Signal Conditioning	• Differential configuration required. • Isolation resistance of no less than 100,000 ohms (100k ohms).	***Dataforth 5B Series*** (or equivalent subject to GMPT approval through the deviation process)		X	X	X
Signal Conditioning Power Supply	• Power supply for 5B backplane. • Linear, 5 VDC, • Non-switching.			X	X	X
Analog / Digital PC Boards	• PCI or PCI-e form factor required • Each signal / sensor shall have a dedicated channel in the A/D board • Shall be able to sample all channels for each phase in parallel. • Differential wiring. • If more than one A/D board is used then the boards must be able to sample in parallel.	***National Instruments***		X	X	X

3.3 WIRING APPROVED COMPONENTS LIST

Component	Application/Requirements (see note in 3.0)	Approved Supplier(s)	Applicability			
			Leak Test	Torque to Turn	Cold Test	Hot Test
Transducer Cabling	• Individually shielded pairs and overall shield. • Flex requirement shall be considered for Cat Track and robotic applications	***Alpha Wire, Belden, TPC Wire & Cable***		**X**	**X**	**X**
Computer Ribbon Cable	• Data Acquisition Backplane to Cable Adapter • Shielded flat ribbon cable for EMI/RFI/ESD considerations. • Two drain wires for insured grounding.	***Alpha Wire, Belden, Hitachi Cable Manchester***		**X**	**X**	**X**

3.4 COMMERCIAL HARDWARE & SOFTWARE APPROVED COMPONENTS LIST

3.4.1 Test Station Computer Systems

Component	Application/Requirements (see note in 3.0)	Approved Supplier(s)	Applicability			
			Leak Test	Torque to Turn	Cold Test	Hot Test
Test Station Hardware	• **Backplane** - PCI Bus Backplane, 20 percent spare slots (minimum) • **I/O Ports** - (3) USB port(s) minimum • **Processor** – Dual Core Intel® Xeon® Processor 3.33GHz, 6MB L2, 1333 Cache (minimum) • **Operating System** – Microsoft Windows XP Professional • **Memory** – 4GB DDR SDRAM at 667MHz or faster • **Video Adapter** – PCI express, 256MB RAM minimum, support true color with 1280 x 1024 video resolution • **Hard Drives** – Dual 160GB SATA 3.0Gb/s,7200 RPM Hard Drive with 8MB DataBurst Cache™ RAID 1 • **Network Adapter** – 10/100/1000 Ethernet • **Optical Drives** - 16XDVD AND 16XDVD+/-RW, w/ Cyberlink PowerDVD™ and Roxio Creator™	***Dell*** Precision Desktop Workstation Ex. T7500 Including 3 Year ProSupport for End Users and 3 Year NBD On-Site Service - Important Information ***ADLINK*** RK-210S Series RK-410S Series		**X**	**X**	**X**
Test Station Monitor	• 19” flat panel display – TFT active matrix • Viewing features such as height-adjustable, panel swivel, tilt as well as pivot • 1280 x 1024 native resolution • 800:1 or greater contrast ratio • Horizontal viewing angle of 170° and vertical viewing angle of 160° 0.294mm or finer dot pitch • 60Hz or greater vertical scan rate at native resolution • 250 cd/m^2 or greater image brightness	***Dell*** Ex. Professional P190S 19-inch Flat Panel Monitor with Height Adjustable Stand (or equivalent subject to GMPT approval through the deviation process)		**X**	**X**	**X**
Keyboard/Pointing Device	• **Keyboard** – Full size, standard layout with USB connection • **Pointing Device** – Optical mouse with USB connection. Track wheel		X	**X**	**X**	**X**

			Applicability			
Component	**Application/Requirements (see note in 3.0)**	**Approved Supplier(s)**	**Leak Test**	**Torque to Turn**	**Cold Test**	**Hot Test**
	integrated with 2 buttons					
Anti-Virus Software		***McAfee*** Virus Scan Enterprise Edition *(GM Corporate Standard)*	**X**	**X**	**X**	**X**
Remote Connectivity Software		***Symantec*** pcAnywhere Host & Remote, version 12.5 or newer		**X**	**X**	**X**
Backup and Restore Software		***Acronis*** True Image Echo ® - Workstation	**X**	**X**	**X**	**X**
Uninterruptible Power Supply	• Line interactive Uninterruptible Power Supply (UPS) sized to meet system requirements • Integrated with USB 2.0 to signal loss of power			**X**	**X**	**X**
Computer Enclosure	• Air conditioned • Mounting - drawer type slide mechanism • Security locks for individual doors • 120VAC GFI outlet for external devices • USB outlet for external devices (minimum of 1) • Ethernet port for network access • Shelf for laptop by 120VAC outlet, USB port and Ethernet port • GM personnel to approve cabinet layout prior to purchasing			**X**	**X**	**X**

			Applicability			
Component	**Application/Requirements (see note in 3.0)**	**Approved Supplier(s)**	**Leak Test**	**Torque to Turn**	**Cold Test**	**Hot Test**
Ethernet Switch	• Industrial rated, unmanaged and/or managed switch • Selection shall match supplier for rest of assembly system	***Hirschmann*** See *CL-E-Hirschmann* for part number details Auto configuration adapter required	**X**	**X**	**X**	**X**

3.4.2 Repair Station Computer Systems

Component	Application/Requirements (see note in 3.0)	Approved Supplier(s)	Applicability			
			Leak Test	Torque to Turn	Cold Test	Hot Test
Repair Station Hardware and Software Bundle	• **Processor** – Intel Core® 2 Duo, 3GHz, 1333MHz/6MB L2 or faster • **Operating System** – Microsoft Windows XP Professional w/ Resource CD and DVD contains Diagnostics and Driver for Dell Precision Syst **Memory** – 2GB or more DDR2 SDRAM at 667MHz EEC or faster • **Keyboard** – Full size, standard layout with USB connection • **Pointing Device** – Optical mouse with USB connection. Track wheel integrated with 2 buttons • **Monitor** – 19" LCD (digital connection) • **Video Adapter** – 256 MB or more, PCI express • **Hard Drives –** Dual 146 GB with RAID 1 array SAS Controller • **Network Adapter** – Integrated 10/100/1000 Ethernet • **Optical Drives** - Dual Drives: 16x DVD + 16x DVD+/-RW w/ Cyberlink Power DVD and Roxio Creator	***Dell*** Precision Desktop Workstation Ex. T5500 Ex. Professional P190S 19-inch Flat Panel Monitor with Height Adjustable Stand Including 3 Year ProSupport for End Users and 3 Year NBD On-Site Service - Important Information			**X**	
Security Software		***McAfee*** Virus Scan Enterprise Edition *(GM Corporate Standard)*			**X**	
Color Printer	• Ethernet connection • 1200 dpi resolution, minimum • 10 pages per minute (color), minimum	***Hewlett Packard*** HP Deskjet 6940dt Printer (C8973A) - or equivalent subject to GMPT approval through the deviation process			**X**	
Remote Connectivity Software		***Symantec*** pcAnywhere, version 12.5 or newer			**X**	

			Applicability			
Component	**Application/Requirements (see note in 3.0)**	**Approved Supplier(s)**	**Leak Test**	**Torque to Turn**	**Cold Test**	**Hot Test**
Backup and Restore Software		***Acronis*** True Image Echo ® - Workstation			**X**	
Uninterruptible Power Supply	• 1000 watt minimum line interactive Uninterruptible Power Supply (UPS) sized to meet system requirements • USB 2.0 connection				**X**	
Computer Enclosure	• Air conditioned • Mounting - drawer type slide mechanism • Security locks for individual doors • 120VAC GFI outlet for external devices • USB outlet for external devices (minimum of 1) • Ethernet port for network access • Shelf for laptop by 120VAC outlet, USB port, and Ethernet port • GM personnel to approve cabinet layout prior to purchasing				**X**	

3.5 TEST SUPPLIER SPECIFIC HARDWARE & SOFTWARE APPROVED COMPONENTS LIST

Component	Application/Requirements (see note in 3.0)	Approved Supplier(s)	Applicability			
			Leak Test	Torque to Turn	Cold Test	Hot Test
Cold Test System	Test Stand, Repair Station, Host and Reporting Software	***Bauer Controls***			X	
Hot Test System	Hot Test Cell	***Bauer Controls*** ***AVL - Puma*** ***ATW – CAPAC***				X

Torque to Turn System	• Network interfaces:
	  • Profibus DP slave / Profinet
	  • Ethernet
	  • Digital I/O
	  • Q-DAS interface
	• 15" Flat Panel Touch Screen. Reference controls project books for required accessories.
		Bauer Controls - *PCS*
		Sciemetric – *SigPod PSV Model 1508*
				X		

Pressure Decay and Mass Flow Leak Tester	• Pneumatic test panel to be supplied by leak tester supplier • Station PLC to control machine motion • qs-STAT capable (data PC to be provided per assembly area, i.e. engine line, head sub-assembly, test loop.)	***Uson*** - *Qualitek mR* ***Cincinnati Test Systems*** - *Sentinel I24*	X			
Instrumented Ball Valves	• Used to isolate tester and test fixture • Maximum leak rate 0.1 cm^3/min at 1000 psig.	***Parker*** ***Swagelok***	X	X	X	
Leak Test Control Valves	• Used to isolate multiple fill points for an individual test channel • Solenoid valve: 2-way; normally closed • Maximum leak rate 0.1 cm^3/min at 50 psi.	***Versa*** ***ASCO***	X	X	X	

Component	Application/Requirements (see note in 3.0)	Approved Supplier(s)	Applicability			
			Leak Test	Torque to Turn	Cold Test	Hot Test
Helium Mass Spectrometry Leak Test		***Future Technologies, Incorporated (FTI)*** with an **Inficon LDS2010 Modular Component Helium Leak Detector**	**X**			
Exhaust Gas Emission Analyzer	• 5 Gases: HC, CO, CO_2, O_2, NO_X, and AFR or Lambda • Accessory - calibration gases	***EMS Emission Systems, Inc*** *Model 5000-2* ***Horiba*** *MEXA-584L (w/ option O_2, NO_X)*				**X**
Opacity Meter	• High Accuracy • Easy maintenance • Accessory – opacity filters	***AVL*** *AVL 439 Opacimeter* ***Telonic Berkeley*** *Model 107*				**X**

3.6 ELECTRIC DRIVES AND CONTROLS APPROVED COMPONENTS LIST

			Applicability			
Component	**Application/Requirements (see note in 3.0)**	**Approved Supplier(s)**	**Leak Test**	**Torque to Turn**	**Cold Test**	**Hot Test**
Asynchronous Motors (Main Drive Line)	• Sized per requirements in SP-M-Cold System Reqts • Encoder, 4096 PPR minimum • Smooth shaft • Vibration Severity S1 - DIN ISO-2373 • Flange and Foot Mounting • Reference controls project books for required accessories.	***Bosch-Rexroth*** IndraDyn A - MAD with fan cooling ***Siemens*** 1PH7			X	
Drive Line Servo Controller	• Profibus DP Interface • Encoder Emulation • Standard Display Panel	***Bosch-Rexroth*** IndraDrive C or IndraDrive M (Basic Control CSB01.1C-PB-ENS-MEM-NN-S-NN-FW) ***Siemens*** MASTERDRIVES VC 6SE70 or SIMODRIVE 611U			X	
Synchronous Motors (Servomotor)	• Sized per requirements in SP-M-Torque To Turn Reqts • Encoder, 4096 PPR minimum • Smooth shaft • Reference controls project books for required accessories.	***Bosch-Rexroth*** IndraDyn S - MSK		X		
Servo Drives	• Profibus DP Interface • Encoder Emulation • Standard Display Panel	***Bosch-Rexroth*** IndraDrive C or IndraDriveM (multiple axis) (Basic Control CSB01.1C-PB-ENS-MEM-NN-S-NN-FW)		X		

3.7 CALIBRATION VERIFICATION EQUIPMENT

Component	Application/Requirements (see note in 3.0)	Approved Supplier(s)	Applicability			
			Leak Test	Torque to Turn	Cold Test	Hot Test
Advanced Modular Calibration System	• Fully integrated calibration system: electrical, frequency, temperature, and pressure calibrator, which provides simultaneous measurement and source capabilities, as well as pressure generation • Accredited initial calibration	***Druck*** Example ordering information : Calibrator Model DPI 620 CE Pressure module Model PM 620 20 bar Pneumatic pressure station Model PV621 Pressure relief valve Model IO620-PRV-P3 Pressure station carrying case Model IO620-CASE-3	X	X	X	X
Hand Held Shaker	• Acceleration Output: (±3%) 1.00 g rms (9.81 m/s² rms) • Velocity Output: 0.39 in/sec rms (9.81 mm/s rms) • Operating Frequency: (±1%) 159.2 Hz • Maximum Load: 7.4 oz (210 gm) • Accredited Initial Calibration	***PCB Piezotronics*** Model 394C06 ***Bruel & Kjaer*** Model 4294-002		X	X	
Infrared Calibrator: Hot/Cold Blackbody Calibration Source	• From -18 to 149°C (0 to 300°F) • NIST Traceable Calibration Certificate Included with Three Data Points • 115VAC or 230VAC	***Omega*** Example ordering information : Model BB701 (for 115VAC)			X	X

Component	Application/Requirements (see note in 3.0)	Approved Supplier(s)	Applicability			
			Leak Test	Torque to Turn	Cold Test	Hot Test
Constant Temperature Liquid Circulating Bath	• Working Range 5 to 120°C (40 to 250°F) • Temperature stability +/-0.01 using water at 40°C • NIST Calibration • Bath and mounting bridge • Lid for bath • 115VAC or 230VAC	***Omega*** Example ordering information : Thermo regulator Model HCTB-3020 BATH-8 (8 liters) LID-8			X	X
Non-Contact Tachometer	• Class 3R visible laser • Tripod mounting • N.I.S.T. traceable Certificate of Calibration included	***Monarch*** Pocket Laser Tach 200, (include carrying case)		X	X	X

4.0 APPENDICES

4.1 REFERENCE DOCUMENTS

This section contains a list of GM Standard Specifications that are referenced in this document. These documents are sources of additional requirements, provide information and/or background material:

4.1.1 GM Powertrain Engine Cold Test System Requirements (SP-M-Cold Test System Reqts)

4.1.2 GM Powertrain Leak Test Station Requirements for Cylinder Head and Engine Assembly (SP-M-Leak Test Reqts - Engines)

4.1.3 GM CETC Cylinder Head and Engine Assembly Torque to Turn Specification (SP-M-Torque to Turn)

4.1.4 GM CETC Containerized Engine Audit Hot Test Cell Requirements (SP-M-Audit Hot Test Cell Reqts)

4.1.5 Program Book / Guidelines for Hirschmann Ethernet Switches (CL-E-Hirschmann)