Ford Specific CQI-9 requirements

a) The Ford Specific CQI-9 requirements are a 'checklist' used to provide objective evidence that supplier heat treat processes, regardless of tier level, meet requirements of Ford W-HTX standard not addressed in AIAG CQI-9 Heat Treat System Assessment.

b) Use of this document
Suppliers:
1. Perform a full CQI-9 assessment per Ford's requirements in Ford specifics to ISO/TS 16949
2. Complete this checklist for Ford Specific CQI-9 requirements ("Ford Specific CQI-9 Req." tab in this document) - see CQI-9 for instructions on completing each column in the checklist
3. Ensure that if any requirements of the assessments in 1 and 2 above are not met, develop action plans to meet all requirements, with timing

c) Suppliers complete the assessments listed in b) above at least annually and after any heat treat process and/or heat treat equipment changes.

d) Suppliers are required to keep completed copies of the CQI-9 Heat Treat System Assessment, the completed Ford Specific CQI-9 requirements "checklist", and accompanying corrective action plans, covering the most recent 2 annual assessments. These copies are to be maintained at the supplier location and available to Ford upon request.

Note: The intention of having the "checklist" is to simplify the review of heat treat processes for conformance to AIAG CQI-9 and to Ford W-HTX requirements.

CQI-9 Ford Specific Requirements

DATE OF AUDIT: **January 13, 2012**
COMPANY: **Metex Heat Treating Ltd.**

Ford Specific CQI-9 requirements

Requirements and Guidance				Assessment			
W-HTX Element/Pg #	**W-HTX Requirements and Guidance not included in CQI-9**	**CQI-9 section**	**Objective Evidence**	**NA**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
Scope (pg 7)	CQI-9 assessment and Ford Specific CQI-9 assessment is also to be completed for brazing and sintering.	Scope 1.2		**X**	**N/A**		
Carburizing/ Carbonitriding/ Carbon Correction (pg 24)	- Alarms, if used for process monitoring, must be set at acceptable control limits. - Quench media Soluble oil: Concentration must be checked daily. - Quench media Soluble oil: Suspended solids must be checked semi-annually. - Microstructure for batch heat treat must be checked per batch and when any of the process parameters are out of spec.	Process Table A	Alarms are present for oil over and under temperature. Quench media is visually checked daily for cleanliness, agitation, temperature. Suspended solids are checked quarterly. Microstructure is checked daily per furnace. Per lot on Batch carburized Ford product.		**YES**		
Neutral Hardening (pg 26)	- Alarms, if used for process monitoring, must be set at acceptable control limits. - Quench media Soluble oil: Concentration must be checked daily. - Quench media Soluble oil: Suspended solids must be checked semi-annually.	Process Table A	Alarms are present for oil over and under temperature. Quench media is visually checked daily for cleanliness, agitation, temperature. Suspended solids are checked quarterly. Microstructure is checked daily per furnace.		**YES**		
Tempering/Stress Relieving/ Annealing/Normalizing/ Solution Heat Treat/Age Hardening (pg 27, 29, 30)	- Alarms, if used for process monitoring, must be set at acceptable control limits.	Process Table A and E	Alarms are present for over and under temperature		**YES**		
Nitriding/ Nitrocarburizing (pg 28)	- Alarms, if used for process monitoring, must be set at acceptable control limits. - Dissociation of ammonia must be checked in gas nitriding twice a shift and after any change (or per batch). - Gas ratios for ferritic nitorocarburizing must be checked twice a shift and after any change (or per batch).	Process Table B		**X**	**N/A**		

Ford Specific CQI-9 requirements

Requirements and Guidance				Assessment			
W-HTX Element/Pg #	**W-HTX Requirements and Guidance not included in CQI-9**	**CQI-9 section**	**Objective Evidence**	**NA**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
Brazing/Sintering (pg 31)	Assess Brazing/Sintering heat treat processes per Attachment 1 for WHTX - Brazing & Sintering Process Table.	Scope 1.2		**X**	**N/A**		
Vacuum Carburizing (pg 25)	Assess Vacuum Carburizing heat treat processes per Attachment 2 for WHTX - Vacuum Carburizing Process Table.	Scope 1.2		**X**	**N/A**		
Salt Bath (pg 32)	- Alarms, if used for process monitoring, must be set at acceptable control limits. - Bath activity and exhaust smoke analysis must be done every batch and after any change. - Visual condition of quench media must be checked each shift. - Quench media Soluble oil: Concentration must be checked daily. - Quench media Soluble oil: Suspended solids must be checked semi-annually.	Process Table A and B		**X**	**N/A**		
Induction (pg 33)	- Cycle time must be visually checked and logged twice a shift and after any change. - In the absence of an alarm system for high and low control limits quench media temperature must be checked and logged each shift and after any change. Quench level must be checked each shift and after any change. - Quench media Soluble oil: Concentration must be checked daily. - Quench media Soluble oil: Suspended solids must be checked on semi-annual bases. - Quench media Oil: Water content, Suspended solids, Viscosity, Quenchability, Flash and fire point must be checked on semi-annual bases. - Flame processes: Oxygen to fuel ratio shall be monitored and recorded.	Process Table D	Cycle time is checked with every process set up. Quench media temp and level is logged every 2 hours. Clean batches of water Quench media are made more often than 2x yearly. Quench oil is checked quarterly. Souble oil not applicable.		**YES**		

Ford Specific CQI-9 requirements

Requirements and Guidance				Assessment			
W-HTX Element/Pg #	W-HTX Requirements and Guidance not included in CQI-9	CQI-9 section	Objective Evidence	NA	Satisfactory	Not Satisfactory	Needs Immediate Action
Loading rate and cycle parameters (pg 15)	Control plan must have maximum delay between quench and temper and it must be monitored and logged.	2.7; A3.8; B3.9; C3.4; E3.7	Control plan as well as process recipe database specifies belt speed in continuous furnace. Parts are checked at a minimum every 2 hours to verify process. Belt speed is monitored through operator logs and remote data collection. In batch furnace it is signed off by the operator in the process sheet		**YES**		
Processing temperature (pg 11)	Overtemp/Undertemp (when applicable) must be set at 50 deg F over the process set temperature to protect material and furnace from overheating.	N/A	Compliant except for furnace zone 1. Undertemp is set at -500F per control plan		**YES**		
Monitor of carbon atmosphere (pg 11)	Dew point test is not acceptable for inverted delta parts.	3.7; 3.8; A3.3; A3.4; B3.2; B3.3; E3.3; E3.4	Carbon probes are used for atmosphere. Dew point, 3 Gas and Shim are correlated as back up per Process table A.		**YES**		
Furnace atmosphere (pg 12, 13)	If applicable, refrigerator temperature must be monitored. Check furnace conditions for positive internal furnace pressure. Check furnace conditions for presence of air and gas leaks.	3.7	N/A		**N/A**		
Condition of quench (pg 15)	Additions to quench systems must be recorded in logging record.	3.14	Quench additions are recorded on the 2 hour log.		**YES**		

Ford Specific CQI-9 requirements

Requirements and Guidance				Assessment			
W-HTX Element/Pg #	**W-HTX Requirements and Guidance not included in CQI-9**	**CQI-9 section**	**Objective Evidence**	**NA**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
Rules for checking service T/C (SAT test) and temperature instrumentation (pg 34)	The calibrated test thermocouple must be placed adjacent to the service thermocouple with the two junctions within 2 inches of each other. The test results of the instrument, thermocouple, and protection tube checks must be appropriately logged. The date that a given thermocouple or protection tube is replaced must be recorded. Service Thermocouples should be checked in place at their normal operating temperatures (not by removing the thermocouples from the normal operating temperature and checking them at a lower temperature).	Item # 2.0 of the applicable Process Table	Compliant to CQI-9 and as outlined here.		**YES**		
Microstructure (pg 17, 22)	At the minimum, microstructure must be checked @ 100X and 500X. Visual standards are required. Results must be recorded.	Item # 4.0 of the applicable Process Table	Microstructures are checked as per ASTM standards. Staff are degreed and trained Metallurgists. Reference structure micrographs are available.		**YES**		

Ford Specific CQI-9 requirements

Requirements and Guidance				Assessment			
W-HTX Element/Pg #	W-HTX Requirements and Guidance not included in CQI-9	CQI-9 section	Objective Evidence	NA	Satisfactory	Not Satisfactory	Needs Immediate Action
Hardness (pg 18, 23)	- When tempering is done immediately after the quenching, the testing may be done after tempering rather than after both quenching and tempering. The heat treater shall maintain average and range or other statistical charts as appropriate for hardness to detect trends in the process and to serve as a quality record. File, Rockwell, or Brinell scale shall be used as indicated on the Engineering Drawing unless the affected Product Engineering Office permits the use of an alternative hardness scale and the change is noted in the control plan. Surface hardness testing with files (refer to SAE J864), where an indentation hardness test is not specified and/or for purposes of correlation, shall only be used if authorized by the affected Ford Supplier Technical Assistance (STA) engineer. When checking the hardness tester with certified blocks the distance between the centers of two adjacent indentations shall be at least three times the diameter of the indentation and the distance to the edge of the test piece shall be at least two and a half times the diameter of the indentation.	Item # 4 of the applicable Process Table	Hardness is checked as per ASTM and SAE standards. Lab is approved by the Standards Council of Canada ISO/IEC 17025		YES		
Case Depth (pg18, 23)	Case depth checks may be made on production parts or test bars provided correlation to production parts has been established. However, case depth for induction and flame processes must be checked on production parts. Case depth records shall be maintained on average-range or other statistical charts as appropriate to detect trends in the process and to serve as a quality record.	Item # 4 of the applicable Process Table	Case depth is checked as required. Statistical data is logged on case depth for parts with inverted delta		YES		

Ford Specific CQI-9 requirements

Requirements and Guidance				Assessment			
W-HTX Element/Pg #	**W-HTX Requirements and Guidance not included in CQI-9**	**CQI-9 section**	**Objective Evidence**	**NA**	**Satisfactory**	**Not Satisfactory**	**Needs Immediate Action**
Induction/Flame Pattern (pg 23)	The surface and cross-sectional pattern shall be checked as required by the Engineering Drawing or in-process specification.	Item # 4 of the Process Table D	Induction heat patterns are checked against process instruction and set up sheets		**YES**		

The objective of CQI-9 and WHTX is to define the requirements and to encourage Best Practices which will assure a quality part as well as promoting continuous improvement relative to quality and productivity. Exceptions to the CQI-9 and WHTX requirements or reductions of sampling strategies for control of heat treating processes may be used, provided they afford adequate protection of a process currently proven to be stable and capable, and have the concurrence of the affected Ford Supplier Technical Assistant (STA) engineer and/or Quality Planning Team and are documented in a control plan.

Ford Specific CQI-9 requirements Attachment 1
Brazing and Sintering Process Table

	Brazing/Sintering	
	Batch	**Continuous**
PROCESS MONITOR TEST FREQUENCIES:		
Check indicated temperature (Par. 2.1.1)	Every 2 hrs & after any change	Every 2 hrs & after any change
Monitor of furnace atmosphere (Par. 2.1.4, 2.1.5, 2.1.6) . Dew Point (only for non-Control Item parts), CO2, Carbon Potential, etc. . Flow Rate	Each batch & after any change/WA	Twice/shift & after any change/WA
Check condition of quench media (Section 2.2) . Temperature, Agitation, Visual Condition, Time, etc.	N/A	N/A
Check time in furnace, cycle time or belt speed (Par. 2.3)	Each batch	Twice/shift & after any change
Check load size or loading rate (Par. 2.3)	Each batch	Twice/shift & after any change
LABORATORY CONTROL TEST FREQUENCIES:		
Quench Media (Section 2.5)		
. Polymer Quenchants (Par. 2.5.1)		
Concentration	Daily/WA	Daily/WA
Suspended solids	Semiannual/WA	Semiannual/WA
. Water (Par. 2.5.2)		
Suspended solids	Semiannual/WA	Semiannual/WA
. Soluble oil (Par. 2.5.3)		
Concentration	Daily/WA	Daily/WA
Suspended solids	Semiannual/WA	Semiannual/WA
. Oil (Par. 2.5.4)		
Water content, suspended solids, viscosity and quenchability	Semiannual/WA	Semiannual/WA
. Flash and Fire Points	Semiannual/WA	Semiannual/WA
. Salt (Par. 2.5.5)		
Analysis & Contaminants	Semiannual/WA	Semiannual/WA
. Brine or Caustic (Par. 2.5.6)		
Concentration and/or Specific Gravity	Daily/WA	Daily/WA
Suspended solids	Semiannual/WA	Semiannual/WA
IN-PROCESS TEST FREQUENCIES:		
Microstructure (Par. 2.6.1)	*Weekly/WA*	*Weekly/WA*
Surface hardness (Par. 2.6.2)	Each batch/WS	Twice/shift/WS
Core hardness (Par. 2.6.2)	Each batch/WS	Twice/shift/WS
Case depth (Par. 2.6.3)	N/A	N/A

N/A - Not Applicable
WA - When Applicable
WS - When Specified

Ford Specific CQI-9 requirements Attachment 2
Vacuum Carburizing Process Table

	Vacuum Carburizing of Gears and Shafts
	Continuous/Batch
***PROCESS MONITOR TEST FREQUENCIES**:*	
Check furnace cell temperature (Par. 2.1.1)	*Each batch & after any change*
Monitor of furnace atmosphere (Par. 2.1.4, 2.1.5, 2.1.6) . Propane pressure and Flow Rate . Vacuum Pressure	*Each batch & after any change*
Check time in furnace, cycle time and transfer time (Par. 2.3) (Adherence to recipe)	*Each batch*
Check condition of quench media for High Pressure Gas Quench (Section 2.2.7) . Cooling Water Temperature, Cooling Water flow rate, pressure, type of gas (N2, He, etc), quench timing, fan speed (or power)	*Each Batch*
Check condition of quench media (oil) for Oil Temperature, agitation (Section 2.2.4)	*Each Batch*
Check load size or loading rate (Paragraph 2.3)	*Each Batch*
***IN-PROCESS TEST FREQUENCIES**:*	
Microstructure (Par. 2.6.1)	*Daily per furnace* (May rotate cells)*
Surface hardness (Par. 2.6.2)	*Each batch**
Core hardness (Par. 2.6.2)	*Each batch/WS**
Case depth (Par. 2.6.3)	*Each batch**

**Microstructure evaluation is required any time that one of the process parameters is out of specification or after any change.*

N/A - Not Applicable
WA - When Applicable
WS - When Specified