Sequence X Procedure Review Teleconference
Wednesday 23rd May, 2018

Written By: Al Lopez

1. Terry Bates to meet with me at the Phoenix ASTM meetings for a discussion on the final procedure.
2. The PCM order table is complete. A minimum order quantity is 75 units. Ford will flash the CW and LSPI calibration as needed.
3. Review of Action Items List (below)
   3.1 Blowby measuring procedure discussion. Not all labs are using the cart to measure blowby. LZ has switched to the J-tech. Demetrius agreed to write up a draft of the J-Tech procedure for review at the next meeting. The intent is to add this to the procedure and have all labs convert to J-Tech at a later date.
   3.2 Correlation measurements of the J-tech to the cart have been performed at both Afton and LZ. The correlation is within the variability of the cart measurements.

4. Jason Soto presented engine differences between the 2016 engines that are in use and the 2018 engines that have been purchased. The presentation is attached.

2018 vs 2016 engine comparison.

5. Ron informed us that KS will be sending us a quote for AC2 pistons. These pistons are for LSPI tests. The pistons will be made to print. A concern was raised on the print dimensions for coating and the bore clearance.
6. Jason presented the Intertek method of measuring pistons. Attached. The group has realized that for proper piston to bore clearance the skirt diameter has been measured on the coating and not the two measurement buttons. See pictures. If the measurement is done on the buttons, the piston to bore clearance is out of specification – too large a clearance.

IAR Piston Measurments.pptx

   6.1 The group agreed to measure pistons in a controlled temperature environment to see if it affects the measurements.
   6.2 Pistons will be sent to KS to confirm our measurements.
   6.3 The coating thickness tolerance will be optimized to prevent the situation of an interference fit as was seen in the last batch of BB-AC2 pistons that were purchased. (AG9E6110AC2 2014 pistons were scrapped)

7. Demetrius from LZ presented a photo of how they measure piston skirts. The method was not approved by Ford due to skirt taper. The piston was laid on a

flat surface with a dial indicator used to measure the diameter. Demetrius agreed to use a caliper.

8. Felt at SWRI informed us that they use a round tip caliper that does not touch the coating and they measure at the buttons.
9. Christian from Afton reported that they use a micrometer with small tip to measure at the buttons.
10. In general, all of the test engineers believe that the measurements are actually being done on the coating otherwise the clearances would exceed service limit if done on the measurement button.
11. Measurement data will be acquired before a final procedure update is written. The pistons will be an ongoing agenda item for future meetings.

CW Procedure Review Action Items

Date	Action Item	Champ
3/26/2018	PCM Survey and Lab Orders	all
	Chem test listing - remove unused tests from list	Jason to r
	Measure rings on 2018 engines and compare to EJ7E6148AA (BC)	Jason
	Oil filter adaptor housing on 2018 engines will not house cooler	All
	J-tech procedure for BB	Christian
	Shutdown condition and restart review and outline	All
4/9/2018	Target June ASTM or letter ballot	
	List of changes from LZ internal audit	Demetrius
	Oil Filter housing part number for purchase from dealer, life time buy	Jason
	Check blocks for different oil passage for cooling	All
	Ron to check on oil cooling for new engines	Ron
	Long term change of oil cooling, aftermarket options	Felt, Jason
	EEE fuel , requirement of COA check - decide on periodic checks	All
	Redistribute pistons BB from SWRI to IAR. Swap pallet of 6 BB for 6 BC	Jason, Felt
	Redistribute pistons AA 4 hole, CA six hole - even distribution from 2 containers	Felt, Jason
	Remove any unused chem tests from the procedure	All
4/18/2018	Each lab to purchase oil filter housings, from dealer	ALL
	Check procedure for wording on fuel analysis, wait for TGC	Jason
	Editorial review	Rich AL
	Different balancer on 2018 engines	Jason, Cha
	Identify pistons, rings, engines in one spreadsheet	Al
4/25/2018	Forward Draft of CW, add latest version to TMC	Jason, Rich
	Buy old style dampers from service, re-use is recommended, add part numbers	All
	Estimate number of oil filter housings and purchase from service if necessary	All

	Internal balancer housing oil passages	Ron, Jason
	Procedure edits, visc and total test time on Form 6 and Form 3	Rich

5/16/2018	Add PCM part number to the procedure, Ron to follow up with FCS, Al - APL	Ron Al
	Christian and Demetrius to forward J-Tech procedure	Demetrius
	Photos of new parts on 2018 engines - information only , not part of procedure	Jason
	Verify piston measurements - dots , measuring tool	All
	Add piston measurement procedure and forms for recording data	All

5/24/2018	Piston measurments of different batches	Ron
	Demetrius draft for J-Tech	Demetrius
	Measure pistons in metrology under controlled temp, check room temps	
	Send sample pistons to KS, BC for CW that are in the engines	

FORD 2.0L ECOBOOST 2016 VS 2018 ENGINES

By: Jason Soto

05/21/2018

Pistons

- 2016 engines came with a mix of BC and BB pistons.
- BC pistons are used for CW and BB pistons for FLSPI.
- 2018 engines came with CA and AA pistons.
- BC, CA, and AA pistons all use the same piston rings.
- BB pistons use different rings. A limited lifetime purchase was made.

Pistons cont.

- BB and BC pistons have a cast top. AC and AA pistons have a machined top.

- BB and BC pistons have four smoke holes. AC and AA pistons have six smoke holes.

Crankshaft Balancer

- 2018 on the left and 2016 on the right.
- We will continue to use the 2016 style balancer. 2018 balancers will not be used.
- 2016 style balancers can be reused or purchased from the dealership.

Timing Chain Tensioner

- 2018 tensioner on the left and 2016 on the right.
- The timing chain tensioner is a critical batched component for the chain wear test. Only the 2016 style batched tensioners should be used for CW. Save the 2018 style tensioners for potential use in FLSPI.

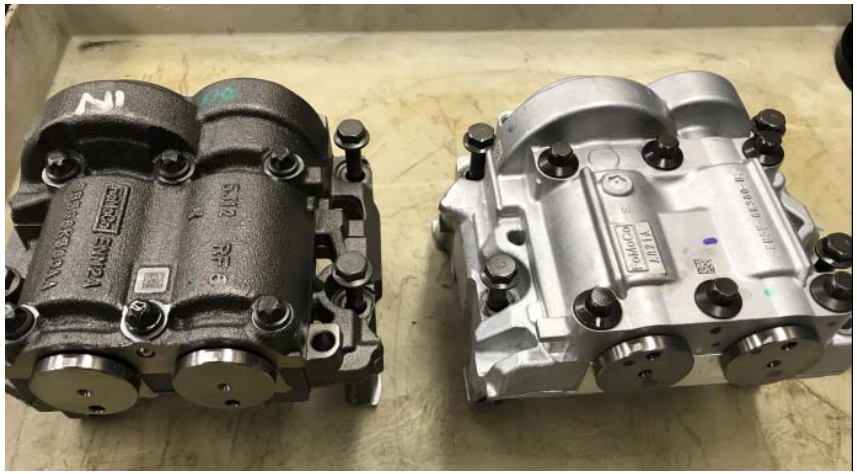
Crankshaft Timing Gear

- 2018 timing gear on the left and 2016 on the right.
- The 2018 gear does not us a diamond washer.
- The crankshaft timing gear is a critical batched component for the chain wear test. Only the 2016 style gear should be used. Save the 2018 style timing gears for potential use in FLSPI.

Oil Filter Housing

- 2018 oil filter housing on the left and 2016 on the right.
- The 2018 oil filter housing does not accept an oil cooler.
- Only the 2016 style oil filter housing should be used for CW and FLSPI.

Balanced Shaft Assembly



- 2016 balanced shaft assembly on the left and the 2018 on the right.
- The shaft assembly is not used in the CW test.
- Only the 2016 style assembly should be used for FLSPI.

Conclusion

- Ron is looking into having additional AC2 pistons made. Continue to use BC pistons for CW and BB pistons for FLSPI in the meantime.
- Only the 2016 style crankshaft balancer should be used for CW and FLSPI testing.
- Only the batched timing chain components should be used for CW.
- Only use the 2016 style oil filter housing that accepts an oil cooler for CW and FLSPI testing.
- Only use the 2016 style balanced shaft assembly for FLSPI.

IAR FORD 2.0L ECOBOOST PISTON MEASUREMENTS

Jason Soto

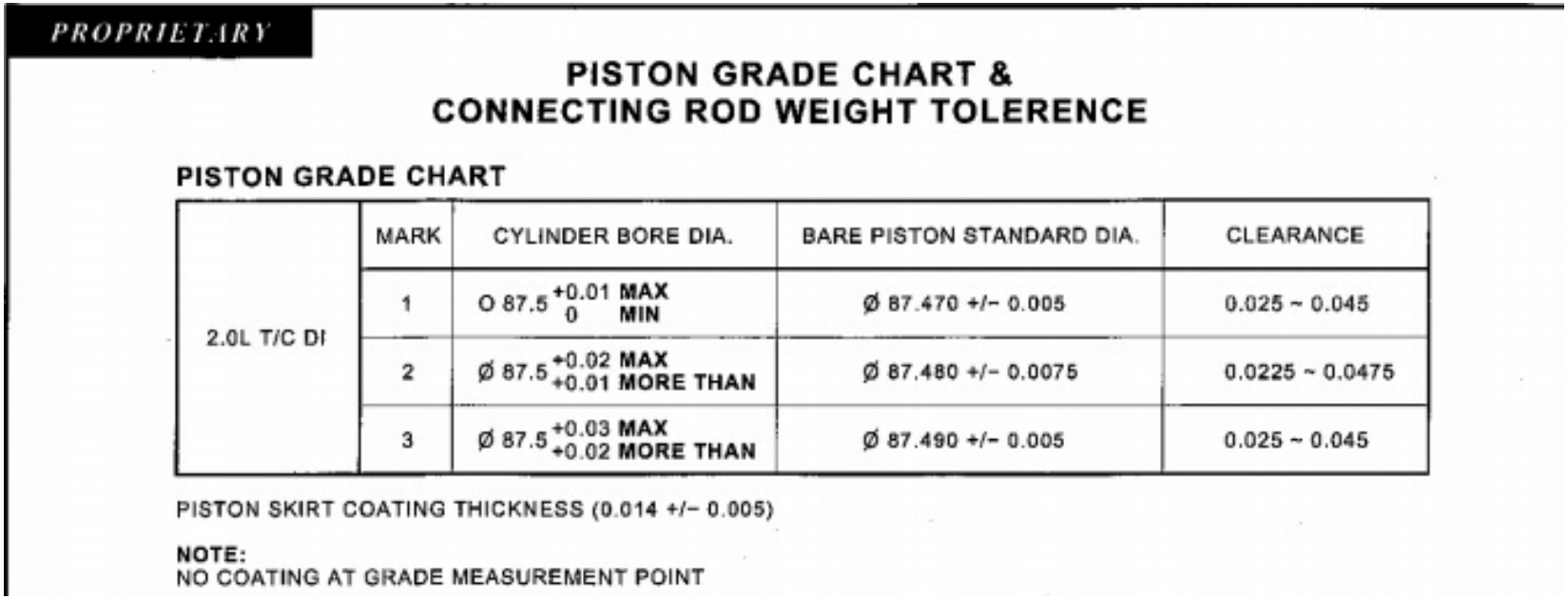
05/23/2018

Blade Micrometer

Round Face Micrometer

Micrometer Comparison

Piston Grade Chart



PROPRIETARY

PISTON GRADE CHART &
CONNECTING ROD WEIGHT TOLERENCE

PISTON GRADE CHART

	MARK	CYLINDER BORE DIA.	BARE PISTON STANDARD DIA.	CLEARANCE
2.0L T/C DI	1	O 87.5 +0.01 0 **MAX MIN**	Ø 87.470 +/- 0.005	0.025 ~ 0.045
	2	Ø 87.5 +0.02 +0.01 **MAX MORE THAN**	Ø 87.480 +/- 0.0075	0.0225 ~ 0.0475
	3	Ø 87.5 +0.03 +0.02 **MAX MORE THAN**	Ø 87.490 +/- 0.005	0.025 ~ 0.045

PISTON SKIRT COATING THICKNESS (0.014 +/- 0.005)

NOTE:
NO COATING AT GRADE MEASUREMENT POINT

- Piston to bore clearance that covers all three piston grades: 0.0225 - 0.0475 (grade 2)

BC Piston Measurements

Piston Measurement Point	New Piston Measurement (BC)	Average Cylinder Bore Diameter	Piston/Bore Clearance
W/ Coating	87.483	87.510	.027
W/O Coating	87.452	87.510	.058

- Flat blade micrometer used to measure w/o coating.
- Round face micrometer used to measure piston w/ coating.
- Clearance: 0.0225 - 0.0475 (Grade 2).
- Coating thickness is .015mm per side.