Class Syllabus Winter 2022

Diesel engine rebuild HVE-224

07:00am:10:50 ATH-126 **Instructor** Dan McIntosh (541)917-4575

Jan 3th to March 18 Office hours 6:30-7:00 M-Th

mcintod@linnbenton.edu

Heavy equipment diesel department policy: Failure to wear face coverings in the classrooms, shop and labs that cover the mouth and nose at all times Will result in you being removed from lab class for that day after the second warning. Continued failure to wear face coverings after being removed from the class for the day will result in the removal from all lab classes for the remainder of the term.

Masks Required Statewide

CLASSROOM REQUIREMENTS FOR ALL STUDENTS AND FACULTY DUE TO COVID-19

Linn-Benton Community College has established rules and policies to make the return to the classroom as safe as possible. It is required for everyone to follow all of the campus rules and policies. To participate in this class, LBCCrequires all students to comply with the following:

- Wear a mask or face covering indoors at all times. Your mask or face covering must be properly worn (fully covering nose and mouth and tight-fitting). Mesh masks, face shields, or face covering that incorporates a valve designed to facilitate easy exhalation are not acceptable. If you have a medical condition or a disability that prevents you from wearing a mask or cloth face covering, you must obtain an accommodation from CFAR (Center for Accessibility Resources) to be exempt from this requirement. ***State guidelines do not limit*** class size. Physical distancing accomodations can be made upon request and cleaning supplies are also available for personal use.

Safety: The safety of our students is our primary concern at LBCC adherence to safety and conduct policies are rigorously enforced

Text required:**CDX Medium and Heavy vehicles/CDX Engines book active licence**
Required Materials: Laptop or tablet 8x11" capable of CDX, Service Advisor and Parts advisor.

Theme Cover to turn in "Lab book"
OSHA Approved Safety Glasses must be provided by the student
OSHA Approved Muff style hearing protection
Clean coveralls and must be worn and kept clean.
Thumb drive 5 gig or bigger

Student file link for winter 2022

This course will be lecture and lab class with elements of self study and research.

Lecture posting as produced and posted to the google drive .

The "Recorded lecture file" will be a good reference.

Class notes A copy of your lecture notes will be required on monday following the lecture

The Daily Journal assignment

Think of this as a time card entry. Each day a few lines describing what you are doing on your engine project. (ie measuring the crankshaft out of round and taper, replacing cam bearings.)

Note: All Assignments must be typewritten

Course Description

This course covers operating principles, maintenance, repair, and inspection of diesel engines. In addition, students will study standardized manufacturer specifications as they pertain to correct operation and performance. Students will disassemble and measure each engine component to evaluate it for reapplication or remanufacture. The class is geared more to understanding of the operational principles thereof for diagnostics rather than the remanufacturing of a diesel engine but both go hand in hand.

Course Objectives

To provide students with instruction and practice in diesel engine operation.
Provide perspective of diesel engine development and technology.
Explain the advantage of compression ignition and high compression ratio engines.
Explain why the diesel engine has such high efficiency and torque.

Course student learning outcomes

1 Demonstrate safe use of tools in engine repair
2 Troubleshoot diesel and high compression gas engines
3 Repair diesel and high compression gas engines
4 Maintain diesel and high compression gas engines

Assessments of Student Learning Outcomes Assessment:
Written test questions, hands-on evaluations, and lab projects

Absences Policy: Eight undocumented absences in an 11 week class, or four undocumented absences in a 5 week class, shall result in an automatic course grade of "F" for material nonparticipation.

Only absences covered through the Center for Accessibility Resources documentation, or DOCUMENTED emergency absences (for yourself only) will be excused. Job conflicts, oversleeping, car trouble, travel delays, traffic jams, and other minor life events are not considered emergencies.

Documentation must be physically handed to the instructor within five (5) business days (Monday through Friday) of the absence for it to be excused.

Safety: The safety of our students is our primary concern at LBCC adherence to safety and conduct policies are rigorously enforced.

NIOSH Z-87 approved eye protection is required at all times in the lab.

Closed toed work shoes are required.

Clothing shall be properly fitted and worn correctly.

Jewelry should not be worn while working.

Tie up long hair securely, and/or tuck it into a cap.

Hearing protection required when sound levels exceed OSHA threshold limits (running

engines, air tools, and power tools, etc.)

Report all injuries to your instructor immediately.

Proper safety stands are required when working under lifted equipment.

Front and rear ground guides are required when moving equipment into and out of the shop.

Uniform: Sponsorship shirt/program uniform shirt.

No student will be admitted to class not wearing an approved Diesel Department uniform. This will result in a forfeiture of daily grade.
Uniform will consist of:

Clean sponsorship **uniform shirt**, or Clean Snap-On uniform shirt
Clean preferably dark denim **work pants**
OSHA Approved **Safety glasses** (worn in the lab at all times)
Preferably dark **Leather shoes**
Notepad 1 pen and pencil. Small working flashlight
OSHA Approved ear muffs to be worn during high noise conditions.
Clean and maintained coveralls worn in the shop during all lab activities.
Students will not participate in lab activities without proper uniform and will be removed from the lab till proper uniform is met.(forfeiture of professionalism grade will result.

Learning Styles and Resources

We will use lecture-discussion, multimedia presentations and electronic database materials.
If you are having difficulty with any of the concepts or procedures in this course, or have a preferred learning style, do not hesitate to talk with me. I am available for consultation or tutoring and will work with you to explore the many resources available to make your education more successful.

The Learning Center is an excellent resource for improving your skills as a lifelong learner and is a great place to study and do homework. They have computers, mini courses on study skills and a very helpful staff. They will help you with any subject you are taking at LBCC.

Grading System

Student progress may be discussed at any point during the quarter. Grade definitions are outlined in the general catalog.

A - 90%-100%
B - 80%-89%
C - 70%-79%
D - 60%-69%
F - Below 60%
IN - Available with student initiated grade contract
AU - Audit classes do not apply to certificate or degree
W - Students must select this grade prior to the end of the second week of class for a full refund.

John Deere C and F Pape And Coastline Students **must complete** pass assigned JDU courses

to earn a passing grade in this course See JDU completion list in student files google drive or seek out a hard copy from John Alvin. It is the individual student's responsibility to seek out required classes.

John Deere Agricultural Students **must complete** pass assigned JDU courses

to earn a passing grade in this course See JDU completion list in student files google drive or seek out a hard copy from John Alvin.
It is the individual student's responsibility to seek out required classes.

Pape Kenworth Students **must complete** pass assigned Kenworth online courses

to earn a passing grade in this course See Kenworth fleet training list in student files google drive or seek out a hard copy from John Alvin.
It is the individual student's responsibility to seek out required classes.

https://drive.google.com/drive/folders/1mHRZFZ09jxmC9uL06JM-XdWfyEGECSJP?usp=sharing

Final Grade: Determined by the following breakdown:

Professional and Safe Work Habits	15%
Quizzes / Homework / Tests chapter tests	20%

Lecture notes/lab book	15%
Lab Projects	30%
Mid Term Exam	10%
Final Exam	10%

Shop clean-up is the responsibility of all students in this class.

Shop clean up will start 20 minutes before the end of class.

Any work area that is left in unsatisfactory condition at the end of the lab, must be cleaned by students responsible, and approved by the instructor or **Instructional assistant** before students will be allowed to continue with any lab projects.

Shop clean up will include:
Any trash put in trash cans
Hoses and cords properly stored
All shop and specialty tools put away
Student tool boxes returned to the proper area and tools maintained.
Floor swept and oil pads picked up and disposed of.
Any fluid spills must be cleaned up immediately

Tool Policy:

- Students are responsible for the use, care, maintenance, and inspection of tools in their custody.
- Students are responsible for their assigned toolbox and its contents. Missing tools will be replaced at the responsible student's expense
- Tools will be cleaned, returned to their storage location(s), and checked in at the end of class

https://www.linnbenton.edu/current-students/student-support/center-for-accessibility-resources/

Request for Special Needs or Accommodations 1-03-2020

Students who may need accommodations due to documented disabilities, who have medical information which the instructor should know, or who need special arrangements in an emergency should speak with their instructor during the first week of class. If you believe you may need accommodations but are not yet registered with

the Center for Accessibility Resources (CFAR), please visit the CFAR Website for steps on how to apply for services or call (541) 917-4789.

LBCC Comprehensive Statement of Nondiscrimination

LBCC prohibits unlawful discrimination based on race, color, religion, ethnicity, use of native language, national origin, sex, sexual orientation, gender, gender identity, marital status, disability, veteran status, age, or any other status protected under applicable federal, state, or local laws. For further information see Board Policy P1015 in our Board Policies and Administrative Rules. Title II, IX, & Section 504: Scott Rolen, CC-108, 541-917-4425; Lynne Cox, T-107B, 541-917-4806, LBCC, Albany, Oregon. To report: linnbenton-advocate.symplicity.com/public_report

Course outcomes

1 Demonstrate safe use of tools in engine repair
2 Troubleshoot diesel and high compression gas engines
3 Repair diesel and high compression gas engines
4 Maintain diesel and high compression gas engines

Course content

Week 1 CO1

Safety, informational resources, engine components, operation, terminology timing diagrams, disassembly procedures and sequence **AED 5.1 p53**

Week 2 CO 2

Precision measurement, basic engine components and operation **AED 5.2 P56**

Week 3 CO 2,3

Cylinder heads, blocks **AED 5.6 P61**

Week 4 CO 2,3

Crankshaft, Cylinder sleeves **AED 5.6 P61**

Week 5 CO 2,3

Connecting rods, pistons, rings, midterm exam **AED 5.6 P61**

Week 6 CO 2,3
Engine valves and valve trains **AED 5.6 P61**

Week 7 CO 2,3
Lubricating and cooling system **AED 5.5 5.6 P60 P61**

Week 8 CO 2,3
Engine induction and forced induction Turbocharging/supercharging **AED 5.6 P60**

Week 9 CO 2,3,4
Engine troubleshooting **AED 5.8 P64**

Week 10 CO 1, 2,3,4
Engine subsystems and auxiliary systems **AED 5.6 P60 5.7 P62,63,64**

Week 11 Final exam

I have read this document and understand it’s content.
By signing this document I agree to and agree to abide by its policies.

Signature_____ Date _____

CDX Medium and Heavy vehicles Activities list and assignments
Engines class Winter term 2020 CDX Engines textbook

****TAKE CHAPTER TESTS & PRETESTS****
Unless otherwise stated

Week 1: Jan 3-6 2022 AED 5.1 P55

READ Chapters 1,**6**,**7**

TAKE Chapter 1 **pretest** (**section #**1)
TAKE Chapter 6 **pretest** (**section #**3)
TAKE Chapter 7 **pretest** **(section #**3)

DISCUSS Be prepared to discuss chapter 1,6,7 by Thurs. Week 2

Daily journal entry 4 per week for each student due on Thursday with a lab book.

Week 2: Jan 10-13, 2022 AED 5.3 P57

READ **Diesel engine fundamentals** Chapters 8,9,10

TAKE Chapter 8 **pretest** **(section** #3)
TAKE Chapter 9 **pretest** **(section** #3)
TAKE Chapter 10 **pretest** **(section** #3)

TAKE chapter test chapter 1 Section (online)
TAKE chapter test chapter 6 Section (online) **Diesel engine fundamentals**

TAKE chapter test chapter 7 Section (online)

Nc-3 training pmi-2 /5/6

DISCUSS Be prepared to discuss chapter 08 by Tues and 9-10 by Monday
Daily journal entry 4 per week for each student due on Thursday with a lab book.

Week 3: Jan 17-20 2022 (Monday) Martin Luther King Day no school) AED 5.3 P57

Monday no school Martin luther king day

READ Chapters 11,12,13 Engine construction (long block)

TAKE Chapter 11 **pretest** **(section** #3)
TAKE Chapter 12 **pretest** **(section** #3)
TAKE Chapter 13 **pretest** **(section** #3)

TAKE chapter test chapter 8 Section (online)

TAKE chapter test chapter 9 Section (online)

TAKE chapter test chapter 10 Section (online)

Daily journal entry 4 per week for each student due on Thursday with a lab book.

DISCUSS Be prepared to discuss chapter 11,12,13 by Thurs

Week 4: Jan 24-27 2022 AED 5.3 P57

READ Chapters 14-15-16

TAKE Chapter 14 **pretest** **(section** #3)

TAKE Chapter 15 **pretest** **(section** #3)
TAKE Chapter 16 **pretest** **(section** #3)

TAKE chapter test chapter 11 Section (online)

TAKE chapter test chapter 12 Section (online)

TAKE chapter test chapter 13 Section (online)

Daily journal entry 4 per week for each student due on Thursday with a lab book.
DISCUSS Be prepared to discuss chapter 11-12 Wen

Week 5: (Midterm) Jan 31 to Feb 3, 2022 AED 5.3 P57 AED5.7 p62, 63

READ Chapters 17 ,18,19

TAKE Chapter 17 **pretest** **(section #0**5)

TAKE Chapter 18 **pretest** **(section #0**5)

TAKE Chapter 19 **pretest** **(section #0**5)

TAKE chapter test chapter 14 Section (online)

TAKE chapter test chapter 15 Section (online)

TAKE chapter test chapter 16 Section (online)

Daily journal entry 4 per week for each student due on Thursday with a lab book.
DISCUSS Be prepared to discuss chapter 14-16 Wen

Week 6: Feb 07-10 , 2022 AED5.7 p62, 63

READ Chapter 20,28,29
TAKE Chapter 20 **pretest** **(section #06)**
TAKE Chapter 28 **pretest** **(section #06)**
TAKE Chapter 29 **pretest** **(section #06)**

TAKE chapter test chapter 17 Section (online)

TAKE chapter test chapter 18 Section (online)

TAKE chapter test chapter 19 Section (online)

Daily journal entry 4 per week for each student due on Thursday with a lab book.
DISCUSS Be prepared to discuss chapter 15 by Wen

Week 7 Feb 14-16, 2022 AED5.7 p62, 63
READ chapter 30,31,32
TAKE Chapter 30 **pretest** **(section #05)**
TAKE Chapter 31 **pretest** **(section #05)**
TAKE Chapter 32 **pretest** **(section #05)**

TAKE chapter test chapter 20 Section (online)

TAKE chapter test chapter 28 Section (online)

TAKE chapter test chapter 29 Section (online)

Daily journal entry 4 per week for each student due on Thursday with a lab book.
DISCUSS Be prepared to discuss chapter 17-18 by Wen

Week 8 Feb 21-24 , 2022 (No school Monday Presidents day) AED5.7 p62, 63

READ **chapter 7,8**
TAKE Chapter 7 **pretest** **(section #05)**
TAKE Chapter 8 **pretest** **(section #05)**

TAKE **chapter** **test** **chapter 7** **Section** (online)

TAKE **chapter** **test** **chapter 8** **Section** (online)

DISCUSS Be prepared to discuss chapter 19 by Wen
Daily journal entry 4 per week for each student due on Thursday with a lab book.

Week 9 Feb 28- March 3 , 2022 AED5.7 p62, 63 AED5.5 p60

Work on finishing Engines LAB Book
TAKE Test Course #4 TEST Diesel fuel and fuel systems chapter 19
TAKE Test Course #5 TEST Air induction and exhaust systems chapter 20

Daily journal entry 4 per week for each student due on Thursday with a lab book.

Week 10 March 7-10 , 2022 (Dead Week) Review for final exam

Work on finishing Engines LAB Book
Daily journal entry 4 per week for each student due on Thursday with a lab book.

Week 11 March 14-17 , 2022 (finals week) March 20 last day of term

Student name_____ Student name _____

2022

Diesel Engines Lab Book

This lab book is a term project to be filled out as a record of progress in return for a grade.

All engines that ran before teardown must run properly in the end to receive a passing grade. Groups of two students may use this lab book and one book can be turned in for each group.

<u>This book will be turned in every Thursday at the end of class combine with your four weekly journal entries I will initial your progress and hand them back out on Monday.</u>

Completed Lab book shall be turned in no later than Monday of dead week.

<u>List of Precision and Running fits</u>

Engine Block (NETEF Engines section C) **AED 5.6 P61**

1. Block deck surfaces *Flatness* (**Snap-on Precision Straightedge**) ***(Feeler gage)***

2. Main Bearing block bore *size*
(Precision measurement)+(Calculation) (Dial bore gage or "T"gage)(Micrometer) (Specification)

3. Main Bearing block bore *out of round concentricity*
(Precision measurement)+(Calculation) (Dial bore gage or "T"gage)(Micrometer) (Specification)

4. Main Bearing bore *ALIGNMENT* ***(visaly read bearings) or (Master shaft)***

5. Block camshaft bore *size*
(Precision measurement)+(Calculation) (Dial bore gage or "T"gage)(Micrometer) (Specification)

6. Block camshaft bearing bore *out of round*
(Precision measurement)+(Calculation) (Dial bore gage or "T"gage)(Micrometer) (Specificati
7. Block camshaft bearing bore *alignment* ***(visaly read bearings) or (Master shaft)***

8. Block liner *bore size femail bearing surface*
(Precision measurement)+(Calculation) (Dial bore gage or "T"gage)(Micrometer) (Specification)

9. Block liner bore *out of round*
(Precision measurement)+(Calculation(Specification)

10. Block cylinder bores *counterbores (***Depth micrometer) (Specification)**

Sleeves **AED 5.6 P61**
11. Cylinder liner *inside diameter* **(Precision measurement)+(Calculation) (Dial bore gage or "T"gage)(Micrometer)**

12. Cylinder liner outside *diameter or oversize*
(Precision measurement)+(Specification) (Dial bore gage or "T"gage) (Micrometer)

13. Cylinder liner *out of round (inside)* **(Precision measurement)+(Calculation) (Dial bore gage or "T"gage)(Micrometer) (Specification)**

14. Cylinder *liner taper (inside)* **(Precision measurement)+(Calculation) (Dial bore gage or "T"gage)(Micrometer) (Specification)**

15. Condition of cylinder sealing surfaces (wet sleeve) **(Visual)**

Misc **AED 5.6 P61**
16. Deck plate if applicable **(Precision measurement)+(Calculation) (Micrometer)(Specification)**

17. Cylinder liner deck height
(Special linear height gage. Dial indicator) (**Snap-on Precision Straightedge) *(Feeler gage)***

Piston **AED 5.6 P61**
18. Piston to *cylinder liner clearance*.**(Precision measurement)+(Calculation) (Dial bore gage or "T"gage)(Micrometer)**

19. Piston *size and if over size* **(Precision measurement)+(Calculation) (Micrometer)**

20. Piston *round and out of round* **(Precision measurement)+(Calculation) ((Micrometer)**

21. Piston to *wrist pin clearance* **(Precision measurement)+(Calculation) (Dial bore gage or "T"gage)(Micrometer)**

22. Piston *ring end gap* ***(Feeler gage)***
23. Piston ring clearance ***(Feeler gage) or Template***
24. Piston *TDC deck height* **(Depth micrometer or dial indicator) (Specification)**

Connecting rod assemblies AED 5.6 P61

25. Connecting rod big end, out of *round* **(Precision measurement)+(Calculation) (Dial bore gage or "T"gage)**

26. Connecting rod big end *size* or under size.
(Precision measurement)+(Calculation) (Dial bore gage or "T"gage)

27. Connecting rod *big end bearing to crankshaft journal clearance*
(Precision measurement)+(Calculation) (Dial bore gage or "T"gage)

28. Connecting rod small end, *size or oversize bushing or bore*
(Precision measurement)+(Calculation) (Dial bore gage or "T"gage)

29. Connecting Rod small end Fit to wrist pin.
(Precision measurement)+(Calculation) (Dial bore gage or "T"gage)

Notes: Main features of Connecting rod assemblies; IE Bolts , Studs. Cracked or machined

Crankshaft AED 5.6 P61

30. Crankshaft main journal *out of round* 2/1000+ "will kill you"
(Precision measurement)+(Calculation)(Micrometer)

31. Crankshaft main journal *Size* or under size **(Precision measurement)(Micrometer)**

32. Crank throw out of round **(Precision measurement)+(Calculation)(Micrometer)**

33. Crank throw size or under size **(Precision measurement) (Micrometer)**
34. Crankshaft thrust surface condition **(Visual)**
35. Crankshaft end thrust (**amount**) (**Dial indicator)**

35.5 Notes: Describe the Main features of Crankshaft assemblies; IE Cast or forged . Drilled for oil. Internally or externally balanced, bolt on balance weights or integral.

Camshaft AED 5.6 P61 (engine components)

36. Camshaft bearing journal size or under size
37. Cam shaft to bearing clearance
38. Camshaft thrust surface condition and end thrust
39. Camshaft lift

Rocker Shaft and rockers (NETEF Engines section B)

40. Rocker shaft diameter
41. Rocker bushing condition

Heads and manifolds AED 5.6 P61

42. Head surfaces flatness
43. Head to intake surface flatness
44. Head to exhaust surface flatness
45. Intake manifold surface flatness
46. Exhaust manifold flatness

Valves AED 5.6 P61

47. Valve seats condition (NETEF Engines section B)
48. Valve seat pocket dimension
49. Valve Guides inside diameter
50. Valve seats condition visual inspection
51. Valve Guides inside diameter
52. Valve stem diameters

Auxiliaries: AED 5.6 P61

53. Oil pump gear/housing clearances (most important)
54. Balancer shaft bearing fits

55. Balancer Shaft end thrust
56. Gear train idler preload (if applicable)
57. Gear train Backlash
58. Blower end clearances (if applicable)
59. Blower Beater clearances (if applicable)
60. Turbocharger Axial play
61. Turbocharger Radial play
62. Main bearing oil clearances
63. Rod bearing Oil clearance (As read with Plasti-gauge)
64. Crankshaft End play
65. Gear train Backlash

Recorded measurements

STEP # 1 Camshaft lift: measured before take down as per Deere Service advisor or instructor.

	Ext vlv	Intake	Injector
Cyl 1	---------	----------	----------
Cyl 2	---------	----------	----------
Cyl 3	---------	----------	----------
Cyl 4	---------	----------	----------

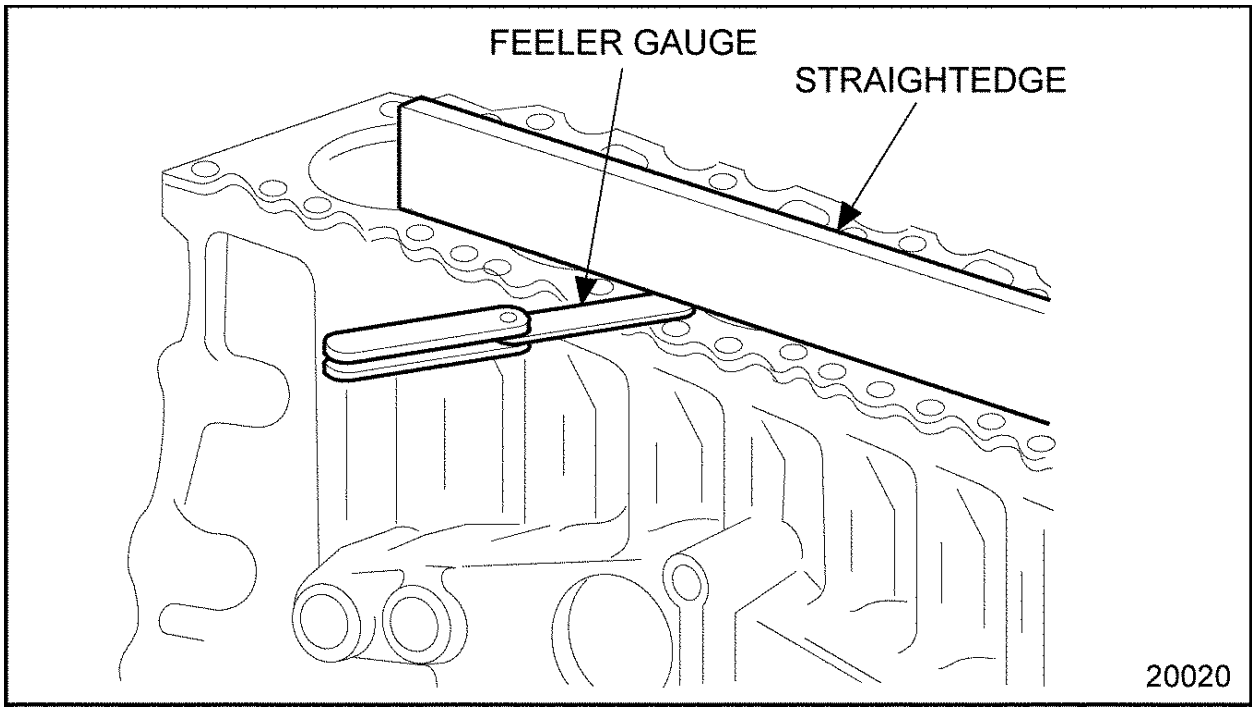
Cyl 5	---------	----------	----------
Cyl 6	---------	----------	----------

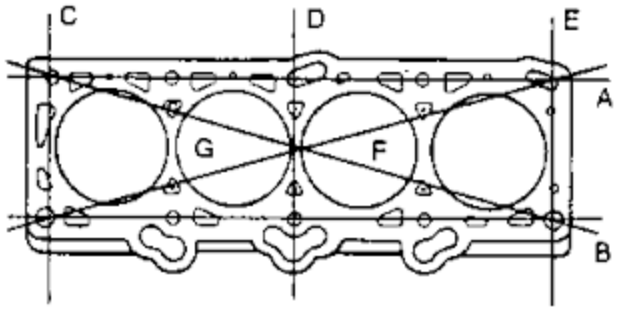
Engine Inspection Worksheets

Engine Block (NETEF Engines section C)

1. **Block deck surfaces Flatness** (C#3)

Place Straight edge across flat parts place feeler-gauge under and record warpage





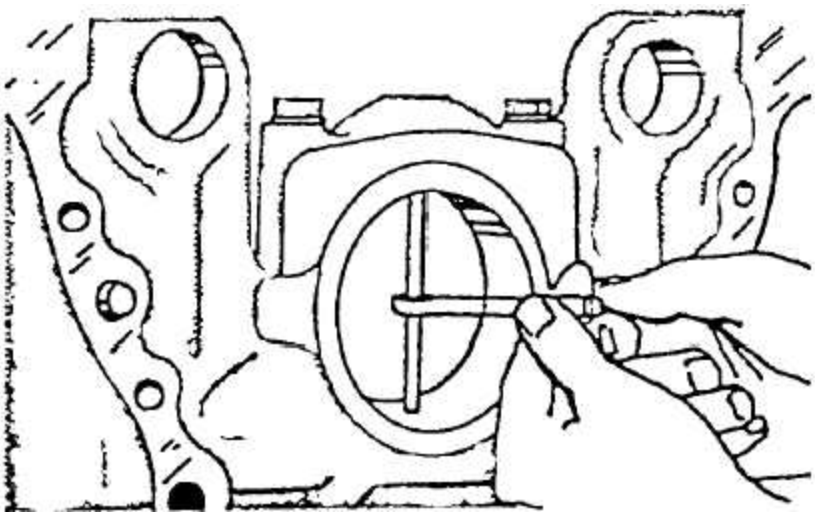
Deck1 Flat A: B: C: D: E: F:

G: H: I: J: K: L:

M: N: O: P: Q: R:

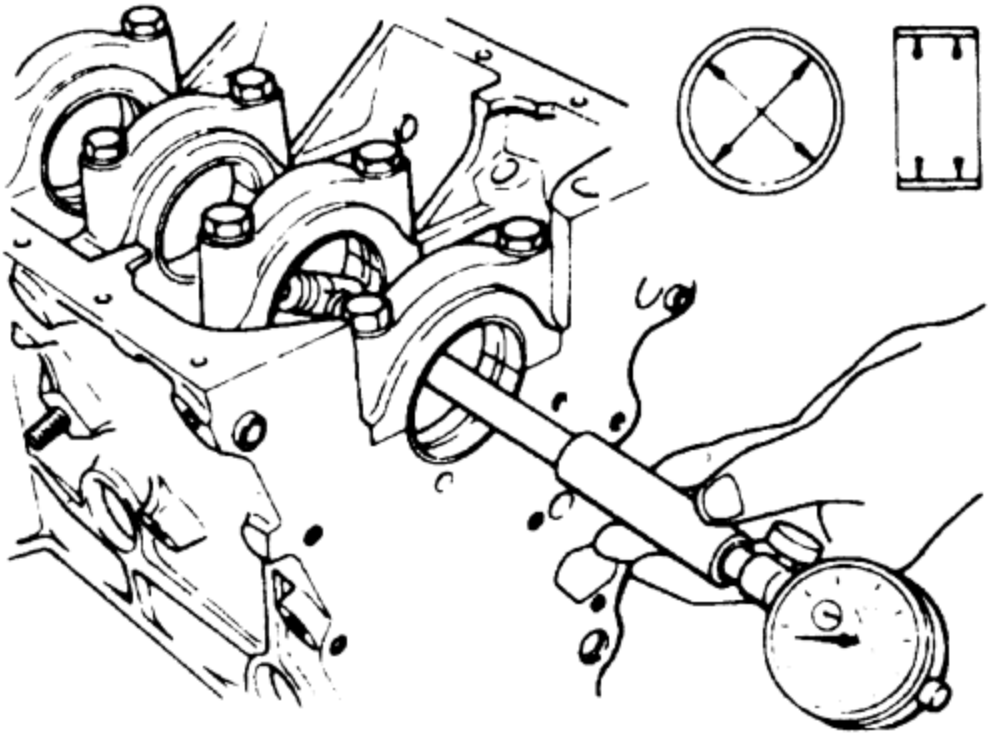
Lengthwise 1 A-F	___	___	___	___	___	___
Lengthwise 1 G-L	___	___	___	___	___	___
Lengthwise 1 M-R	___	___	___	___	___	___
Across From A to M	___	___	___	___	___	___
Across From B to N	___	___	___	___	___	___
Across From C to O	___	___	___	___	___	___
Across From D to P	___	___	___	___	___	___
Across From F to R	___	___	___	___	___	___
Diagonal A to R	____	____	___	___	___	___
and from M to F	____	____	___	___	___	___

2. **Main Bearing block bore ,*size***



	12 to 6 o=clock		**2 to 8 o=clock**	
	Stp1 / Stp2		Stp1 / Stp2	
Thrust Main	-----	-----	-----	-----
Use spaces as needed				
Main 1	-----	-----	-----	-----
Main 2	-----	-----	-----	-----
Main 3	-----	-----	-----	-----
Main 4	-----	-----	-----	-----
Main 5	-----	-----	-----	-----
Main 6	-----	-----	-----	-----
Main 7	-----	-----	-----	-----

3. **Main Bearing block bore *round/out of round, and concentricity***



	Stp1 /	Stp2
Use spaces as needed		
Thrust Main	-----	-----
Main 1	-----	-----
Main 2	-----	-----
Main 3	-----	-----
Main 4	-----	-----
Main 5	-----	-----
Main 6	-----	-----
Main 7	-----	-----

4. Main Bearing block bore *ALIGNMENT* description read parts inspection

5. **Block camshaft bore *size***

	12 to 6 o=clock		**2 to 8 o=clock**	
	Stp1 / Stp2		Stp1 / Stp2	
Thrust end	-----	-----	-----	-----
Use spaces as needed				
Bore 1	-----	-----	-----	-----
Bore 2	-----	-----	-----	-----
Bore 3	-----	-----	-----	-----
Bore 4	-----	-----	-----	-----
Bore 5	-----	-----	-----	-----
Bore 6	-----	-----	-----	-----

Camshaft 2 (for dual camshafts or overhead camshafts.

Thrust end	-----	-----	-----	-----
Insert if needed				

6. Block camshaft bore *out of round 12/6 -9/6*

Thrust end -----

Bore 1	-----	Bore 4	-----
Bore 2	-----	Bore 5	-----
Bore 3	-----	Bore 6	-----

Camshaft 2 (omitted)

7. Block camshaft bore alignment. Description read parts

8. Block liner Bores (outside die) size 4 depths 12 and 3 o'clock (dry sleeve) Wet sleeve upper and lower.

	12 to 6 o=clock				**3 to 9 o=clock**			
	Stp1 / Stp2		Stp3 / Stp4		Stp1	Stp2	Stp3	Stp4
Bore 1	-----	-----	-----	-----	-----	-----	-----	-----
Bore 2	-----	-----	-----	-----	-----	-----	-----	-----
Bore 3	-----	-----	-----	-----	-----	-----	-----	-----
Bore 4	-----	-----	-----	-----	-----	-----	-----	-----
Bore 5	-----	-----	-----	-----	-----	-----	-----	-----
Bore 6	-----	-----	-----	-----	-----	-----	-----	-----

9. Block cylinder bores out of round

Bore 1	-----	-----	-----	-----
Bore 2	-----	-----	-----	-----
Bore 3	-----	-----	-----	-----
Bore 4	-----	-----	-----	-----
Bore 5	-----	-----	-----	-----
Bore 6	-----	-----	-----	----

10. Block cylinder Bores counterbores (if applicable outside die)

	Stp1 / Stp2	Stp3 / Stp4		
Bore 1	-----	-----	-----	-----
Bore 2	-----	-----	-----	-----
Bore 3	-----	-----	-----	-----
Bore 4	-----	-----	-----	-----
Bore 5	-----	-----	-----	-----
Bore 6	-----	-----	-----	-----

Sleeves C#5

Is my engine a Wet sleeve, Dry press fit sleeve; Dry slip fit sleeve, Partial wet sleeve or a thin wall repair sleeve. **Make notation**

_____

11. Cylinder liner inside diameter (C#5)

	12 to 6 o=clock				3 to 9 o=clock			
	Stp1 / Stp2	Stp3 / Stp4			Stp1	Stp2	Stp3	Stp4
Bore 1	-----	-----	-----	-----	-----	-----	-----	-----
Bore 2	-----	-----	-----	-----	-----	-----	-----	-----
Bore 3	-----	-----	-----	-----	-----	-----	-----	-----
Bore 4	-----	-----	-----	-----	-----	-----	-----	-----
Bore 5	-----	-----	-----	-----	-----	-----	-----	-----
Bore 6	-----	-----	-----	-----	-----	-----	-----	-----

12. Cylinder liner outside diameter

	Dia.	Clearance between block and liner
Bore 1	-----	Size ----------
Bore 2	-----	Size ----------
Bore 3	-----	Size ----------
Bore 4	-----	Size ----------
Bore 5	-----	Size ----------
Bore 6	-----	Size----------

13. Cylinder inside out of round (C#5)

(Note) out of round is a product of subtracting the smallest reading from the largest.

	Step1 / Step2	Step3 / Step4		
Bore 1	-----	-----	-----	-----

Bore 2 ----- ----- ----- -----

Bore 3 ----- ----- ----- -----

Bore 4 ----- ----- ----- -----

Bore 5 ----- ----- ----- -----

Bore 6 ----- ----- ----- -----

14. Cylinder liner inside taper (C#5)

Bore 1 ----- Bore 3 ----- Bore 4 -----

Bore 2 ----- Bore 5 ----- Bore 6 -----

15. Condition of cylinder sealing surfaces (wet sleeve) inspection make notations for each cylinder

Bore 1 ----- Bore 2 -----

Bore 3 ----- Bore 4 -----

Bore 5 ----- Bore 6 ------

<u>Deck plate (If applicable)</u>

16. Deck plate if applicable Include notation

Thickness around cylinders---------- Book Spec. --------

17. Cylinder liner deck height

Bore 1 ----- Bore 2 ----- Bore 3 -----

Bore 4 ----- Bore 5 ----- Bore 6 -----

Max adjacent difference ---- Max overall difference ----

Book Spec for each ----------

Pistons

18. **Piston to *cylinder liner clearance***.(actual) Book Spec _____

Piston 1 ----- Piston 2 -----

Piston 3 ----- Piston 4 -----

Piston 5 ----- Piston 6 -----

19. Piston size and oversize

	12 to 6 o=clock		**3 to 9 o=clock**	
	Stp1 / Stp2		Stp1	Stp2
Bore 1	-----	-----	-----	-----
Bore 2	-----	-----	-----	-----
Bore 3	-----	-----	-----	-----
Bore 4	-----	-----	-----	-----
Bore 5	-----	-----	-----	-----
Bore 6	-----	-----	-----	-----

Oversize (Y/N) 1----- 2----- 3----- 4----- 5----- 6-----

20. Piston round and out of round

Piston 1	-----	Piston 2	-----
Piston 3	-----	Piston 4	-----
Piston 5	-----	Piston 6	-----

21. Wrist pin Diameter

	3 points along pin			Out of round
Pin 1	-----	-----	-----	-----
Pin 2	-----	-----	-----	-----
Pin 3	-----	-----	-----	-----
Pin 4	-----	-----	-----	-----
Pin 5	-----	-----	-----	-----
Pin 6	-----	-----	-----	-----

22. Piston pin boss diameter

Pos 1	Pos2	Out of round

Piston 1	-----	-------	----------
Piston 2	-----	-------	----------
Piston 3	-----	--------	----------
Piston 4	-----	--------	----------
Piston 5	-----	---------	----------
Piston 6	-----	---------	----------

23. Piston to wrist pin *clearance*

Piston 1	-----	Piston 2	-----
Piston 3	-----	Piston 4	-----
Piston 5	-----	Piston 6	-----

24. Piston ring end gap L (Used when bore gage unavailable)

Top

	Ring1	Ring2	Ring3	Ring4	Ring 5	Ring 6
Bore 1	-----	-----	-----	-----	-----	-----
Bore 2	-----	-----	-----	-----	-----	-----
Bore 3	-----	-----	-----	-----	-----	-----
Bore 4	-----	-----	-----	-----	-----	-----
Bore 5	-----	-----	-----	-----	-----	-----

Bore 6 ----- ----- ----- ----- ----- -----

Piston ring groove clearance

	Top Ring1	Ring2	Ring3	Ring4	Ring 5	Ring 6	Ring7	Ring8
Piston 1	-----	-----	-----	-----	-----	-----	-----	-----
Piston 2	-----	-----	-----	-----	-----	-----	-----	-----
Piston 3	-----	-----	-----	-----	-----	-----	-----	-----
Piston 4	-----	-----	-----	-----	-----	-----	-----	-----
Piston 5	-----	-----	-----	-----	-----	-----	-----	-----
Piston 6	-----	-----	-----	-----	-----	-----	-----	-----

25. Piston TDC deck height

Piston 1 ----- Piston 2 ----- Piston 3 -----

Piston 4 ----- Piston 5 ----- Piston 6 -----

<u>Connecting rods</u>

26. Connecting rod big end *size and undersize.*

	12-6	2-8	Over/under size
Bore 1	-----	-----	Size ----------
Bore 2	-----	-----	Size ----------
Bore 3	-----	-----	Size ----------
Bore 4	-----	-----	Size ----------

Bore 5 ----- ----- Size ----------

Bore 6 ----- ----- Size----------

27. Connecting rod big end, Round or *Out of round*

Rod 1 ----- Rod 2 ----- Rod 3 -----

Rod 4 ----- Rod 5 ----- Rod 6 -----

28. **Connecting rod small end, *size or oversize***

12-6 2-8 Over/under size

Bore 1 ----- ----- Size ----------

Bore 2 ----- ----- Size ----------

Bore 3 ----- ----- Size ----------

Bore 4 ----- ----- Size ----------

Bore 5 ----- ----- Size ----------

Bore 6 ----- ----- Size----------

29. Connecting Rod small end Fit to wrist pin. **Interference fit** Yes-No (mark one)

Rod 1 ----- Rod 2 ----- Rod 3 -----

Rod 4 ----- Rod 5 ----- Rod 6 -----

Crankshaft

30. Crankshaft main journal *Size* or under size

	12-6		3-9		Out of round Note 1/1000"+ is too much
Main 1	-----	-----	-----	-----	-----
Main 2	-----	-----	-----	-----	-----
Main 3	-----	-----	-----	-----	-----
Main 4	-----	-----	-----	-----	-----
Main 5	-----	-----	-----	-----	-----
Main 6	-----	-----	-----	-----	-----
Main 7	-----	-----	-----	-----	-----
Main 8	-----	-----	-----	-----	-----

31. Crank throw size or undersize Crank throw out of round

	12-6		3-9		Out of round 2/1000+ is too much
Main 1	-----	-----	-----	-----	-----

Main	2	-----	-----	-----	-----	-----
Main	3	-----	-----	-----	-----	-----
Main	4	-----	-----	-----	-----	-----
Main	5	-----	-----	-----	-----	-----
Main	6	-----	-----	-----	-----	-----

32. Crankshaft thrust surface conditions make notation (visual inspection)

33. Crankshaft end thrust bearing thickness

Thickness ---------- Book Spec----------

Oversize _____

34. Number of cylinders ____ Firing order of engine_____

35. Engine Running Mates or companion cylinders _____

Camshaft

36. **Camshaft bearing journal** size or under size
Measure each bearing journal on your camshaft and make a notation for each

	12-6		3-9		Out of round
	Pos1	Pos2	Pos1	Pos2	
Brg. 1	-----	-----	-----	-----	-----
Brg. 2	-----	-----	-----	-----	-----
Brg. 3	-----	-----	-----	-----	-----

Brg. 4 ----- ----- ----- ----- -----

Brg. 5 ----- ----- ----- ----- -----

Brg . 6 ----- ----- ----- ----- -----

Undersize Yes or No? How much _____

37. **Cam shaft to bearing inside diameter** with bearings in

Brg 1 ----- ----- ----- ----- -----

Brg 2 ----- ----- ----- ----- -----

Brg 3 ----- ----- ----- ----- -----

Brg 4 ----- ----- ----- ----- -----

Brg 5 ----- ----- ----- ----- -----

Brg 6 ----- ----- ----- ----- -----

Oil clearance calculated____ ____ ____ ____ ____ ____

Cam shaft to bearing oil clearance (actual) Book Spec_____

38. Camshaft thrust surface condition and end thrust make notation

39. Camshaft Base circle diameter

	Ext vlv	Intake	Injector
Cyl 1	---	---	---
Cyl 2	---	---	---
Cyl 3	---	---	---
Cyl 4	---	---	---
Cyl 5	---	---	---
Cyl 6	---	---	---

39.5 Camshaft lift circle diameter :

	Ext vlv	Intake	Injector
Cyl 1	---	---	---
Cyl 2	---	---	---
Cyl 3	---	---	---
Cyl 4	---	---	---
Cyl 5	---	---	---
Cyl 6	---	---	---

39.75: Camshaft lift: calculated

	Ext vlv	Intake	Injector

Cyl 1	---------	----------	----------
Cyl 2	---------	----------	----------
Cyl 3	---------	----------	----------
Cyl 4	---------	----------	----------
Cyl 5	---------	----------	----------
Cyl 6	---------	----------	----------

Rocker Shaft or shafts and rockers

40. Rocker shaft diameter check for wear at all rockers

Cyl 1	---------	----------	----------
Cyl 2	---------	----------	----------
Cyl 3	---------	----------	----------
Cyl 4	---------	----------	----------
Cyl 5	---------	----------	----------
Cyl 6	---------	----------	----------

41. Rocker Bushings Check all rockers against book spec.

Cyl 1	---------	----------	----------
Cyl 2	---------	----------	----------
Cyl 3	---------	----------	----------
Cyl 4	---------	----------	----------
Cyl 5	---------	----------	----------
Cyl 6	---------	----------	----------

\

Head and manifolds

42. Head surfaces flatness

Flat A: B: C: D: E: F:

G: H: I: J: K: L:

M: N: O: P: Q: R:

Lengthwise 1 A-F			___	___		___	___	___	___		
Lengthwise 1 G-L			___	___		___	___	___	___		
Lengthwise 1 M-R			___	___		___	___	___	___		
Across From A to M			___	___		___	___	___	___		
Across From B to N			___	___		___	___	___	___		
Across From C to O			___	___	___		___		___	___	
Across From D to P			___	___	___		___		___	___	
Across From E to Q		___		___		___		___	___	___	
Across From F to R			___		___		___	___		___	___
Diagonal M to F			____		____		____			_____	
A to R		____		____		____			_____		

43. Head to intake surface flatness

Flat A: B: C: D: E: F:

G: H: I: J: K: L:

Lengthwise 1 A-F	___	___	___	___	___	___
Lengthwise 1 G-L	___	___	___	___	___	___
Across From A to G	___	___	___	___	___	___
Across From B to H	___	___	___	___	___	___
Across From C to I	___	___	___	___	___	___
Across From D to J	___	___	___	___	___	___
Across From E to K	___	___	___	___	___	___
Across From F to L	___	___	___	___	___	___
Diagonal from G to F	___	___	___	___		
A to L	___	___	___		___	

44. Head to exhaust surface flatness

Flat	A:	B:	C:	D:	E:	F:
G:	H:	I:	J:	K:	L:	

Lengthwise 1 A-F	___	___	___	___	___	___	
Lengthwise 1 G-L	___	___	___	___	___	___	
Across From A to g	___	___	___	___	___	___	
Across From B to h	___	___	___	___	___	___	
Across From C to I	___	___	___	___	___	___	
Across From D to J	___	___	___	___	___	___	
Across From E to K	___	___	___		___	___	___
Across From F to L	___	___	___	___	___	___	
Diagonal from G to F	___	___	___	___			
and from A to L	___	___	___		___		

45. Intake manifold surface flatness

Flat	A:	B:	C:	D:	E:	F:
G:	H:	I:	J:	K:	L:	

Lengthwise 1 A-F	___	___	___	___	___	___
Lengthwise 1 G-L	___	___	___	___	___	___
Across From A to g	___	___	___	___	___	___
Across From B to h	___	___	___	___	___	___
Across From C to I	___	___	___	___	___	___
Across From D to J	___	___	___	___	___	___
Across From E to K	___	___	___	___	___	___
Across From F to L	___	___	___	___	___	___
Diagonal from G to F	___	___	___	___		
and from A to L	___	___	___		___	

46. Exhaust manifold flatness

Flat A: B: C: D: E: F:

G: H: I: J: K: L:

Lengthwise 1 A-F	___	___	___	___	___	___
Lengthwise 1 G-L	___	___	___	___	___	___
Across From A to g	___	___	___	___	___	___
Across From B to h	___	___	___	___	___	___
Across From C to I	___	___	___	___	___	___
Across From D to J	___	___	___	___	___	___
Across From E to K	___	___	___	___	___	___
Across From F to L	___	___	___	___	___	___
Diagonal from G to F	___	___	___	___		
and from A to L	___	___	___		___	

<u>Valve information</u>

47. Valve Seat Angle

Exhaust angle --------- Intake Angle ----------

48. Valve Face Angle

Exhaust angle --------- Intake Angle ----------

49. Interference angle

Exhaust I angle --------- Intake I Angle ----------

50. Valve seats condition visual inspection

cyl# 1
SEAT #1---- Seat#2---- Seat#3---- Seat#4-----

cyl# 2
SEAT #1---- Seat#2---- Seat#3---- Seat#4-----

cyl# 3
SEAT #1---- Seat#2---- Seat#3---- Seat#4-----

cyl# 4
SEAT #1---- Seat#2---- Seat#3---- Seat#4-----

cyl# 5
SEAT #1---- Seat#2---- Seat#3---- Seat#4-----

cyl# 6
SEAT #1---- Seat#2---- Seat#3---- Seat#4-----

cyl# 7
SEAT #1---- Seat#2---- Seat#3---- Seat#4-----

cyl# 8

SEAT #1---- Seat#2---- Seat#3---- Seat#4-----

Make notes about specific seats or problems here

51. Valve Guides(linear bearing) inside diameter

Cylinder #1

Exhaust valve	Position A	Position B	Position C	Position D
E Valve1	------	-----	-----	-----
E Valve2	------	-----	-----	-----

Intake vlvs	Position A	Position B	Position C	Position D
I Valve1	------	-----	-----	-----
I Valve2	------	-----	-----	-----

Cylinder#2

Exhaust valve	Position A	Position B	Position C	Position D
E Valve 1	------	-----	-----	-----
E Valve 2	------	-----	-----	-----

Intake vlvs	Position	Position	Position	Position
	A	B	C	D
I Valve1				
	------	-----	-----	-----
	A	B	C	D
I Valve2				
	------	-----	-----	-----

	A	B	C	D

Cylinder#3

Exhaust valve	Position	Position	Position	Position
	A	B	C	D
E Valve1				
	------	-----	-----	-----
	A	B	C	D
E Valve2				
	------	-----	-----	-----

Intake vlvs	Position	Position	Position	Position
	A	B	C	D
I Valve1				
	------	-----	-----	-----
	A	B	C	D
I Valve2				
	------	-----	-----	-----

Cylinder#4

Exhaust valve	Position	Position	Position	Position
	A	B	C	D
E Valve1				
	------	-----	-----	-----
	A	B	C	D
E Valve2				
	------	-----	-----	-----

Intake vlvs	Position	Position	Position	Position
	A	B	C	D
I Valve1				
	------	-----	-----	-----
	A	B	C	D
I Valve2				
	------	-----	-----	-----

Cylinder#5

Exhaust valve	Position	Position	Position	Position
	A	B	C	D
E Valve1				
	------	-----	-----	-----
	A	B	C	D
E Valve2				
	------	-----	-----	-----

Intake vlvs	Position	Position	Position	Position
	A	B	C	D
I Valve1				
	------	-----	-----	-----
	A	B	C	D
I Valve2				
	------	-----	-----	-----

Cylinder#6

Exhaust valve	Position	Position	Position	Position
	A	B	C	D
E Valve1				
	------	-----	-----	-----
	A	B	C	D
E Valve2				
	------	-----	-----	-----

Intake vlvs	Position	Position	Position	Position
	A	B	C	D
I Valve1				
	------	-----	-----	-----
	A	B	C	D
I Valve2				
	------	-----	-----	-----

52. Valve stems Diameter

Cylinder #1

Exhaust valve	Position				Position			
	A	B	C	D	A	B	C	D
E Valve1	------	-----	-----	-----	-----	-----	------	-----
	A	B	C	D	A	B	C	D
E Valve2	------	-----	-----	-----		-----	-----	------

Intake vlvs	Position		Position		Position			
	A	B	C	D	A	B	C	D
I Valve1	------	-----	-----	-----	-----	-----	------	-----
	A	B	C	D	A	B	C	
D								
I Valve2	------	-----	-----	-----	-----	-----	------	-----

Cylinder#2

Exhaust valve	Position				Position				Position				Position			
	A		B		C		D		A		B		C		D	
E Valve1																
	------		-----		-----		-----		-----		-----		------		-----	
	A		B		C		D		A		B		C		D	
E Valve2																
	------		-----		-----		-----		-----		-----		------		-----	

Intake vlvs	Position				Position				Position				Position			
	A		B		C		D		A		B		C		D	
I Valve1																
	------		-----		-----		-----		-----		-----		------		-----	
	A		B		C		D		A		B		C		D	
I Valve2																
	------		-----		-----		-----		-----		-----		------		-----	

Cylinder#3

Exhaust valve	Position				Position				Position				Position			
	A		B		C		D		A		B		C		D	
E Valve1																
	------		-----		-----		-----		-----		-----		------		-----	
	A		B		C		D		A		B		C		D	
E Valve2																
	------		-----		-----		-----		-----		-----		------		-----	

Intake valve	Position				Position				Position				Position			
	A				B				C				D	A	B	C	D
I Valve1																	
	------				-----				-----				-----	-----	------	-----	
	A				B				C				D	A	B	C	D
I Valve2																	
	------				-----				-----				-----	-----	-----	------	-----

Cylinder#4

Exhaust valve	Position				Position				Position				Position				
	A				B				C				D	A	B	C	D
E Valve1																	
	------				-----				-----				-----	-----	-----	------	-----
	A				B				C				D	A	B	C	D
E Valve2																	
	------				-----				-----				-----	-----	-----	------	-----

Intake vlvs	Position				Position				Position				Position				
	A				B				C				D	A	B	C	D
I Valve1																	
	------				-----				-----				-----	-----	-----	------	-----
	A				B				C				D	A	B	C	D
I Valve2																	
	------				-----				-----				-----	-----	-----	------	-----

Cylinder#5

Exhaust valve	Position				Position			
	A	B	C	D	A	B	C	D
E Valve1	------	-----	-----	-----	-----	-----	------	-----
	A	B	C	D	A	B	C	D
E Valve2	------	-----	-----	-----	-----	-----	------	-----

Intake vlvs	Position				Position			
	A	B	C	D	A	B	C	D
I Valve1	------	-----	-----	-----	-----	-----	------	-----
	A	B	C	D	A	B	C	D
I Valve2	------	-----	-----	-----	-----	-----	------	-----

Cylinder#6

Exhaust valve	Position				Position			
	A	B	C	D	A	B	C	D
E Valve1	------	-----	-----	-----	-----	-----	------	-----

	A	B	C	D	A	B	C	D
E Valve2								
	------	-----	-----	-----	-----	-----	------	-----

Intake vlvs	Position	Position	Position	Position				
	A	B	C	D	A	B	C	D
I Valve1								
	------	-----	-----	-----	-----	-----	------	-----
	A	B	C	D	A	B	C	D
I Valve2								
	------	-----	-----	-----	-----	-----	------	-----

Auxiliaries

53. **Oil pump gear clearances**

Inspection of oil pump parts ----------

Recommended replacement of these parts:----------

Shaft to housing clearance---------- Book Spec----------

Gear To housing Clearances---------- Book Spec----------

Gear to gear Clearances ---------- Book Spec----------

Engine balance system

Yes or No does the engine have an active balance system such as balance shafts?

54. Balance shaft bores Diameter

To block		**Inside bearing**	
Bore 1	-----	Bore 1	-----
Bore 2	----	Bore 2	-----
Bore 3	-----	Bore3	-----
Bore 4	-----	Bore 4	-----
Bore 5	-----	Bore 5	-----
Bore 6	----	Bore 6	-----

54.5Balance shaft bearing journal diameter

Bearing 1	-----	Bearing 2	-----
Bearing 3	-----	Bearing 4	-----
Bearing 5	-----	Bearing 6	-----

54.75 Balancer shaft bearing Clearances BOOK SPEC ----------

Bearing 1	-----	Bearing 2	-----
Bearing 3	-----	Bearing 4	-----

Bearing 5 ----- Bearing 6 -----

55. Balancer Shaft end thrust

Book Spec ---------- Recorded----------

Engine gear Train

56. Gear train idler preload

Book Spec ---------- Recorded----------

57. Gear train Backlash

Book spec ---------- Recorded----------

58. Blower end clearances (if applicable)

59. Blower Beater clearances (if Applicable)

60. Turbo axial play

Book speck ---------- Recorded----------

61. Turbo Radial play Dial indicator

Book spec ---------- Recorded----------

Engine Assembly Clearances (As read with Plastigage)

62.Main bearing oil clearances

#1 Main Bearing Clearance	#2 Main Bearing Clearances
# 3 Main Bearing Clearance	#4 Main Bearing Clearances
#5 Main Bearing Clearance	#6 Main Bearing Clearances
#7 Main Bearing Clearances	

63. **Rod bearing Oil clearance (As read with Plastigage)**

#1 Rod Bearing Clearance	#2 Rod Bearing Clearance
#3 Rod Bearing Clearance	#4 Rod Bearing Clearance
#5 Rod Bearing Clearance	#6 Rod Bearing Clearance

64: Crankshaft End play

As per the book ------- Recorded ----------

65: Gear train Backlash

Book spec ---------- Recorded----------