Automotive Engines
Chapter 33 BALANCING & BLUEPRINTING
Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class provides complete coverage of the components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and NATEF and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Real World Fixes, Videos, Animations, and NATEF Task Sheet references.
Motivate Learners	Explain how the knowledge of how something works translates into the ability to use that knowledge to figure why the engine does not work correctly and how this saves diagnosis time, which translates into more money.
State the learning objectives for the chapter or course you are about to cover and explain this is what they should be able to do as a result of attending this session or class.	Explain the chapter learning objectives to the students as listed on the NEXT SLIDE. 1. Prepare for ASE Engine Repair (A1) certification test content areas "B" (Engine Cylinder Head Diagnosis and Repair) and "C" (Engine Block Diagnosis and Repair). 2. Explain the causes of primary and secondary engine vibration. 3. Describe why balance shafts are used. 4. Explain what parts are rotating weight and what parts are reciprocating weight. 5. List the steps needed to balance an engine. 6. Explain why and how to measure combustion chamber volume. 7. List the steps needed to degree a camshaft. 8. Explain why it may be necessary to determine the valve lifter travel.
Establish the Mood or Climate	Provide a ***WELCOME,*** Avoid put downs and bad jokes.
Complete Essentials	Restrooms, breaks, registration, tests, etc.
Clarify and Establish Knowledge Base	Do a round robin of the class by going around the room and having each student give their backgrounds, years of experience, family, hobbies, career goals, or anything they want to share.

ICONS	Chapter 33 Balancing & Blueprinting
	1. SLIDE 1 CH33 BALANCING & BLUEPRINTING 2. SLIDES 2-3 EXPLAIN **Objectives & KEY TERMS**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE IS UPDATED REGULARLY**
	4. SLIDES 4-6 EXPLAIN **BALANCING AN ENGINE** 7. **SLIDE 7** EXPLAIN **Figure 33-1** Weighing the big end of a connecting rod on a scale that keeps it perfectly horizontal so that each end can be weighed separatel
	**DISCUSSION: Have students discuss why it is so important to keep engines clean when assembling.** **(Answer: One example is valve stem clearance. Valve stem clearance is only 0.0015" to 0.003." It would not take a very large piece of dust or lint to stop oil flow.)**
	**Show ANIMATION: LOWER END ENGINE COMPONENTS www.myautomotivelab.com** http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/A1_Animation/Chapter30_Fig_30_12/index.htmhttp://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/A1_Animation/Chapter30_Fig_30_12/index.htm
	**"Tolerance stacking" is one concern that needs to be checked during trial assembly. One example of this is in the valve guide. If the guide is at the smallest specified diameter and valve stem is at the largest specified diameter, they may not fit. They are both within specification, but valve may not fit in guide.**
	8. **SLIDE 8** EXPLAIN **FIGURE 33–2** Removing material from the balancing pad on the small end of the rod to match it to the weight of the small end of the lightest rod being used in the engine
	9. **SLIDE 9** EXPLAIN BALANCING AN ENGINE & **FIGURE 33–3** A crankshaft with bob weights attached as well as the flexplate and the harmonic balancer
	**DEMONSTRATION: Show students a crankshaft with bob weights**

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	**10. SLIDE 10 EXPLAIN FIGURE 33–4** The display of a crankshaft balancer showing where weight needs to be removed to achieve a balanced assembly
	**11. SLIDE 11 EXPLAIN FIGURE 33–5** A drill is often used to remove weight from the crankshaft to achieve proper balance
	**12. SLIDE 12 EXPLAIN FREQUENTLY ASKED QUESTION**
	**13. SLIDE 13 EXPLAIN FREQUENTLY ASKED QUESTION FIGURE 33–6** Heavy metal installed and welded in place
	**14. SLIDE 14 EXPLAIN BLUEPRINTING PROCESS** **15. SLIDE 15 EXPLAIN CHART 33-1** **16. SLIDE 16 EXPLAIN CHART 33-2** **17. SLIDE 17 EXPLAIN BLUEPRINTING PROCESS** **18. SLIDE 18 EXPLAIN COMBUSTION CHAMBER VOLUME**
	**19. SLIDE 19 EXPLAIN FIGURE 33–7** Setup needed to measure the combustion chamber volume in cubic centimeters (cc). **20. SLIDE 20 EXPLAIN FLOW TESTING CYLINDER HEADS & FIGURE 33–8** Cylinder head setup for flow testing. Note the weak valve springs that are strong enough to keep the valves shut, yet weak enough to permit the flow bench operator to vary the intake valve opening amount
	**DEMONSTRATION: SHOW STUDENT HOW TO FLOW TEST A CYLINDER HEAD**
	**21. SLIDE 21 EXPLAIN FIGURE 33–9** Modeling clay is installed around the port to duplicate the flow improvement characteristics of an intake manifold
	22. SLIDE 22 EXPLAIN FIGURE 33–10 A flow bench that can measure and record the airflow through the intake and exhaust ports of each cylinder

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	**23. SLIDE 23** EXPLAIN DEGREEING THE CAMSHAFT
	**HANDS-ON TASK:** have the students degree a camshaft on an engine stand
	**DISCUSSION: host a discussion on the reasons for degreeing a camshaft.**
	**24. SLIDE 24** EXPLAIN **FIGURE 33–11** A piston stop is used to help determine top dead center
	**25. SLIDE 25** EXPLAIN **FIGURE 33–12** The degree wheel indicates where piston stopped near top dead center. By splitting the difference between two readings, true TDC (28 degrees) can be located on degree wheel
	26. SLIDE 26 EXPLAIN **FIGURE 33–13** Note the setup required to degree a camshaft. The pointer, degree wheel, and piston stop are used to find exact top dead center
	27. SLIDE 27 EXPLAIN **FIGURE 33–14** Typical valve timing diagram showing the intake lobe centerline at 106 degrees ATDC
	**28. SLIDE 28** EXPLAIN TECH TIP
	**29. SLIDE 29** EXPLAIN **DETERMINING PROPER PUSHROD LENGTH & FIGURE 33–15** A side view of a small block Chevrolet engine showing that the rocker arm is contacting the top of the valve stem. A roller-tipped rocker arm will show a more definite line of contact than a stamped steel rocker
	30. SLIDE 30 EXPLAIN **FIGURE 33–16** Checking where on the valve stem the marker has been worn off by the rocker arm, is the method to use to check for proper pushrod length
	31. SLIDE 31 EXPLAIN **FIGURE 33–17** An adjustable pushrod is adjustable for length compared to a conventional stock pushrod.
	**32. SLIDE 32** EXPLAIN short block blueprinting

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	**SEARCH INTERNET:** search the internet for samples of the blueprinting process
	**HANDS-ON TASK:** have the students go through the blueprinting process on a project engine
	**Talk through SUMMARY and questions**
	**HOMEWORK:** complete Ch33 crossword puzzle: http://www.jameshalderman.com/links/book_engine_theory_serv_7/cw/crossword_ch_33.pdf