Automotive Technology 6th Edition
Chapter 125 ALIGNMENT DIAGNOSIS & SERVICE
Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This Automotive Technology 6th text provides complete coverage of automotive components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and ASEEducation (NATEF) and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Case Studies, Videos, Animations, and ASEEducation (NATEF) Task Sheets.
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 learning objectives to students as listed below: 1. List the various checks that should be performed before aligning a vehicle. 2. Explain the diagnosis of lead, memory steer, and torque steer. 3. Describe alignment specifications and setup procedures. 4. Discuss how to measure camber, caster, SAI, toe, and TOOT. 5. Describe how to perform a pre-alignment inspection. 6. List the types of alignments. 7. Explain how to adjust the rear camber, front camber, SAI, and included angle.
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.

NOTE: Lesson plan is based on 6th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

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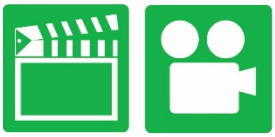
http://www.jameshalderman.com/automotive_principles.html

NOTE: You can use Chapter Images or possibly Power Point files:

ICONS	Chapter 125 Alignment Diagnosis & SVC
	1. SLIDE 1 **CH125 ALIGNMENT DIAGNOSIS & SERVICE**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE IS CONSTANTLY UPDATED** **http://www.jameshalderman.com/automotive_principles.html** **DOWNLOAD** **Crossword Puzzle (Microsoft Word) (PDF)** **Word Search Puzzle (Microsoft Word) (PDF**
	**Videos**
	
	**DISCUSSION: Ask the students to discuss the benefits of correct wheel alignment. What problems may result from improper wheel alignment?**
	**DISCUSSION:** Ask the students to talk about the four basic steps for correcting any automotive problem. How do they relate to wheel alignment problems? Remind the students that a careful inspection of the steering, suspension, and tires should take place prior to aligning a vehicle.
	2. **SLIDES 2 EXPLAIN Figure 125-1** owner of this Honda thought that all it needed was an alignment. Obviously, something more serious than an alignment caused this left rear wheel to angle inward at the top. 3. **SLIDES 3 EXPLAIN FIGURE 125-2** Magnetic bubble-type camber/caster gauge
	**EXPLAIN TECH TIP: *Align and Replace at the Same Time.* Magnetic bubble-type camber/caster gauges can be mounted directly on hub or on an adapter attached to wheel or spindle nut on front-wheel-drive vehicles. • SEE FIGURE 125–2. Besides being used as an alignment setting tool, a magnetic alignment head is a great tool to use whenever replacing suspension components. Any time a suspension component is replaced, wheel alignment should be checked and corrected. An**

easy way to avoid having to make many adjustments is to use a magnetic alignment head on front wheels to check camber with vehicle hoisted in the air before replacing front components, such as new MacPherson struts. Then, before tightening all of fasteners, check front camber readings again to make sure they match original setting. This is best done when vehicle is still off ground. For example, a typical FWD vehicle with a MacPherson strut suspension may have a camber reading of +1/4 degree on ground and +2 degrees while on hoist with wheels off ground. After replacing struts, simply return camber reading to +2 degrees and it should return to same +1/4 degree when lowered to ground. Though checking and adjusting camber before and after suspension service work does not guarantee a proper alignment, it does permit vehicle to be moved around with alignment fairly accurate until a final alignment can be performed.

DEMONSTRATION: Show how to use a magnetic bubble-type camber/ caster gauge for setting alignment: **FIGURE 125-2**

Part of the prealignment check on a truck should include finding out if it normally carries a load. Changing ride height will change alignment.

HANDS-ON TASK: Have the students perform all the necessary **prealignment checks** on a vehicle. Select students to report the results to class. **FIGURE 125-4, 5**

4. **SLIDE 4 EXPLAIN FIGURE 125-3** Typical tire wear chart as found in a service manual.
5. **SLIDE 5 EXPLAIN FIGURE 125-4** Measuring points for ride (trim) height vary by manufacturer
6. **SLIDE 6 EXPLAIN FIGURE 125-5** Measuring to be sure the left and right sides of vehicle are of equal height
7. **SLIDE 7 EXPLAIN Figure 125-6** bulge in this tire was not noticed until it was removed from the vehicle as part of

a routine brake inspection. After replacing this tire, the vehicle stopped pulling and vibrating.

DISCUSS CASE STUDY: *Five-Wheel Alignment*

The steering wheel should always be straight when driving on a straight, level road. If steering wheel is not straight, customer will often think that wheel alignment is not correct. One such customer complained that vehicle pulled to right while driving on a straight road. The service manager test-drove vehicle and everything was perfect, except that steering wheel was not perfectly straight, even though toe setting was correct. Whenever driving on a straight road, customer would "straighten the steering wheel" and, of course, the vehicle went to one side. After adjusting toe with steering wheel straight, the customer and service manager were both satisfied. The technician learned that regardless of how accurate the alignment, steering wheel must be straight; it is "fifth wheel" that customer notices most. Therefore, a five-wheel alignment rule includes a check of the steering wheel.

NOTE: Many vehicle manufactures now include the maximum allowable steering wheel angle variation from straight. This specification is commonly ±3 degrees (plus or minus 3 degrees) or less.

Summary:

- **Complaint—Owner complained that vehicle pulled to one side after an alignment.**
- **Cause—steering wheel was not perfectly straight and when driver straightened wheel, it went to one side.**

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      	• **Correction—technician straightened steering using the tie rod end ends while maintaining the specified toe setting.** **DEMONSTRATION: Show the students tires with shifted belts that could cause a pull** **HANDS-ON TASK: Have students perform steps to diagnose a lead or pull condition. Select a student to report the results of the test to the class.** **DISCUSSION: Ask the students to discuss memory steer & its causes** **HANDS-ON TASK: Have the students perform the steps to test for memory steer.** 8. **SLIDE 8 EXPLAIN Figure 125-7** Equal outer CV joint angles produce equal steer torque (toe-in). If one side receives more engine torque, that side creates more toe-in and result is pull toward one side, during acceleration. 9. **SLIDE 9 EXPLAIN Figure 125-8** Broken or defective engine or transaxle mounts can cause the powertrain to sag, causing unequal drive axle shaft CV joint angles. **EXPLAIN TECH TIP: *Keep the Doors Closed, but the Window Down.* An experienced alignment technician became upset when a beginning technician opened driver's door to lock steering wheel in a straight-ahead position on vehicle being aligned. The weight of the open door caused vehicle to sag. This disturbed th level position of vehicle and changed all alignment angles. The beginning technician learned an important lesson that day: Keep the window down on the driver's door so that steering wheel and brakes can be locked without disturbing vehicle weight balance by opening a door. The brake pedal must be locked with a pedal depressor to prevent wheels from rolling as wheels are turned during a caster sweep.**

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	**The steering must be locked in straight-ahead position when adjusting toe.** **DISCUSSION: Ask the students to talk about the problem of torque steer. What causes torque steer? How do manufacturers attempt to reduce torque steer when designing their vehicles?** **FIGURE 125-7-8** **HANDS-ON TASK: Have the students perform the necessary steps to diagnose a torque steer problem & then suggest ways to correct it FIGURE 125-8**
	**ON-VEHICLE ASEEDUCATION TASK E1:** **Diagnose vehicle wander, drift, pull, hard steering, bump steer, memory steer, torque steer, and steering return concerns; determine needed action.**
	**ON-VEHICLE ASEEDUCATION TASK E2:** **Perform prealignment inspection; measure vehicle ride height; determine needed action.**
	**ON-VEHICLE ASEEDUCATION TASK E3:** **Prepare vehicle for wheel alignment on alignment machine; perform four-wheel alignment by checking and adjusting front and rear wheel caster, camber and toe as required; center steering wheel..** **HANDS-ON TASK: Have the students perform the alignment specifications steps on page 1431 of the Halderman text before beginning wheel alignment.**
	
	**DISCUSSION**: Ask students to compare the two methods used by vehicle and alignment equipment manufacturers to specify alignment angles.
	10. **SLIDE 10 EXPLAIN FIGURE 125–9** This alignment chart indicates the preferred setting with a plus or minus tolerance. 11. **SLIDE 11 EXPLAIN Figure 125-10** Using the alignment rack hydraulic jacks, raise the tires off the rack so that they can be rotated as part of the compensating process.

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	12. **SLIDE 12 EXPLAIN FIGURE 125–11** An optical-type wheel sensor. Compensation is achieved by simply rolling the vehicle backward and forward.
	DISCUSS CHART 125-1 Conversion chart for switching from fractional inches to decimal degrees or minutes and seconds.
QUESTION	**DISCUSSION: Ask the students to talk about the units of measure used in alignment specs & how to convert from minutes to degrees**
DEMO	**DEMONSTRATION: Show the students how to determine the midpoint of a manufacturer's alignment specification:**
	13. **SLIDE 13 EXPLAIN Figure 125-12** If toe for an oversize tire is set by distance, the toe angle will be too small. Toe angle is the same regardless of tire size.
QUESTION	**DISCUSSION: Ask the students to talk about how to determine toe. Why is toe angle more accurate than center-to-center distance? FIGURE 125-11**
	14. **SLIDE 14 EXPLAIN Figure 120-13** protractor scale on the front turn plates allows the technician to test the turning radius by turning one wheel to an angle specified by the manufacturer and observing the angle of the other front wheel. Most newer alignment machines can display turning angle based on sensor readings, and therefore the protractor scale on the turn plate is not needed or used.
	Wheel Alignment, Adjust Toe (View) (Download) Wheel Alignment, Align Steering Wheel 1 (View) (Download) Wheel Alignment, Align Steering Wheel 2 (View) (Download) Wheel Alignment, Camber Adjust, SLA (View) (Download) Wheel Alignment, Camber Adjust, Strut (View) (Download) Wheel Alignment, Caster Adjust, SLA (View) (Download)
QUESTION	**DISCUSSION: Ask the students to discuss the meaning of term "camber" and how to measure it. Ask the students to talk about how caster is measured & discuss meaning of "caster sweep." FIGURE 125-13**

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	**Be sure to check for clearance on front of alignment when doing a caster sweep. Sometimes the sensors will collide. Check this while doing setup to save time later.**
	**HANDS-ON TASK:** Have the students perform the procedures to set up an alignment
	**DISCUSSION: Ask the students to discuss how to measure toe-out on turns (TOOT). Why is this diagnostic procedure recommended as part of a total alignment check? If the TOOT is not correct, what are symptoms and likely causes?**
	**HANDS-ON TASK: to make a card for each angle (correct, < specs, > specs). Put all SAI cards in one box and make a similar box for camber & included angle. Have students draw a card from each box and match card they drew to the diagnosis. You may want to place the diagnosis choices on a board visible to the whole class**
	**DISCUSSION: Ask the students to talk about how to check frame alignment of FWD vehicles. How do FWD designs affect SAI, included angle, & camber?**
	EXPLAIN TECH TIP: *Damage Analysis Tips.* To check if a vehicle has been in a collision, technicians should look for following: **1. Drive vehicle through a water puddle to see if the tire marks are wider than the tires. If they are, then the front and rear wheels are not tracking correctly.** **2. If setback is out of specifications, then front of the vehicle may be damaged.** **3. If thrust angle is out of specifications, then rear suspension damage is likely.**
	**15. SLIDE 15 EXPLAIN FIGURE 125–14** By checking the SAI, camber, and included angle, a damaged suspension component can be determined by using this chart. **16. SLIDE 16 EXPLAIN FIGURE 125-15** In this example, both SAI and camber are far from being equal side-to-side. However, both sides have the same included angle, indicating that the frame may be out of alignment.

An attempt to align this vehicle by adjusting the camber on both sides with either factory or aftermarket kits would result in a totally incorrect alignment.

17. **SLIDE 17 EXPLAIN Figure 125-16** This is the same vehicle as shown in Figure 125–15 , except now the frame (cradle) has been shifted over and correctly positioned. Notice how both the SAI and camber become equal without any other adjustments necessary.

DISCUSSION: Ask the students to discuss the steps involved in performing a four-wheel alignment. Why is four-wheel alignment the most accurate alignment method?

18. **SLIDE 18 EXPLAIN Figure 125-17** Geometric-centerline-type alignment sets the front toe readings based on the geometric centerline of the vehicle and does not consider the thrust line of the rear wheel toe angles
19. **SLIDE 19 EXPLAIN Figure 125-18** Thrust line alignment sets front toe parallel with the rear-wheel toe
20. **SLIDE 20 EXPLAIN Figure 125-19** Four-wheel alignment corrects for any rear-wheel toe to make the thrust line and geometric centerline of vehicle both same

EXPLAIN TECH TIP: *Ask Yourself These Three Questions:* An older technician told a beginning technician that key to success in doing a proper alignment is to ask yourself 3 questions about alignment angles:

QUESTION 1. "Is it within specifications?" For example, if specification reads 1° ±1/2°, any reading between +1/2° and 1 1/2° is within specifications. All vehicles should be aligned within this range. Individual opinions and experience can assist technician as to whether actual setting should be at one extreme or the other or held to the center of the specification range.

QUESTION 2. "Is it within 1/2° of the other side of vehicle?" Not only should the alignment be within specifications, but it should also be as equal as possible from one side to the other. *The difference between camber from one side to the other side is called cross camber.* Cross-caster is the difference between the caster angle from one side to another.

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	**Some manufacturers and technicians recommend that this side-to side difference be limited to just 1/4 degree!** **QUESTION 3. "If camber and caster cannot be exactly equal side to side in front, is there more camber on left and more caster on right to help compensate for road crown?" Seldom, if ever, are alignment angles perfectly equal. Sometimes one side of the vehicle is more difficult to adjust than other side. Regardless of reasons, if there has to be a difference in front camber and/or caster angle, follow this advice to avoid a possible lead or drift problem even if the answers to first two questions are "yes."** **DISCUSS FREQUENTLY ASKED QUESTION:** ***How Does Normal Wear Affect the Alignment Angles?*** **As a vehicle ages, springs sag and steering and suspension components wear.** • **When springs sag, ride height changes and camber usually is reduced and often becomes negative compared to slightly positive when the vehicle was new in most cases.** • **When tie rod ends and other steering components wear, front wheels tend to toe out.** • **Worn suspension components can cause excessive play making vehicle unstable and cause the tires to wear abnormally.** • **Alignment alone cannot take place of worn parts. All an alignment can do is try to compensate for the worn parts. Toe is most common angle that needs to be adjusted because any wear in steering or suspension systems affect toe.**
	**SEARCH INTERNET: Have students search the Internet to research wheel alignment services. Ask them to prepare to DISCUSS the types of wheel**

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	alignment available, their advantages & disadvantages, and their prices. Ask students to indicate, based on their research, which service they would recommend and why.
	**DISCUSSION: Ask students to discuss why camber has a greater pull effect than caster.**
	21. **SLIDE 19 EXPLAIN Figure 125-20** rear camber is adjustable on this vehicle by rotating the eccentric cam and watching the alignment machine display. 22. **SLIDE 22 EXPLAIN Figure 125-21** Some vehicles use a threaded fastener similar to a tie rod to adjust camber on the rear suspension. 23. **SLIDE 23 EXPLAIN Figure 125-22** Aftermarket alignment parts or kits are available to change the rear camber.
	**HANDS-ON TASK: Have students first check a vehicle for accident damage & then perform the necessary steps to check the rear camber.**
	**DISCUSSION:** Ask the students to talk about the procedures for **adjusting rear toe** on a vehicle. Does the vehicle on which they are working require an aftermarket kit to adjust rear toe?
	**FIGURE 125-21** **EXPLAIN TECH TIP: *Gritty Solution.* Many times it is difficult to loosen a Torx bolt, especially those used to hold backing plate onto rear axle on many GM vehicles. • SEE FIGURE 125–23. A technique that always seems to work is to place some valve grinding compound on the fastener. The gritty compound keeps Torx socket from slipping up and out of fastener, and more force can be exerted to break loose a tight bolt. Valve grinding compound can also be used on Phillips head screws as well as other types of bolts, nuts, and sockets.**
	24. **SLIDE 24 EXPLAIN FIGURE 125-23** Full-contact plastic or metal shims can be placed between the axle housing and the brake backing plate to change rear camber, toe, or both.

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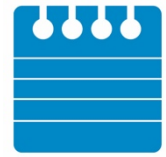
	25. SLIDE 25 EXPLAIN Figure 125-24 The rear toe was easily set on this vehicle. The adjusting nuts were easy to get to and turn. Adjusting rear toe is not this easy on every vehicle.
	26. SLIDE 26 EXPLAIN Figure 125-25 By moving various rear suspension members, the rear toe can be changed.
	27. SLIDE 27 EXPLAIN Figure 125-26 The use of these plastic or metal shims requires that the rear wheel as well as the hub assembly and/or backing plate be removed. Proper torque during reassembly is critical to avoid damage to the shims.
	**28. SLIDE 28 EXPLAIN Figure 125-27** Many struts allow camber adjustment at the strut-to-knuckle fasteners. Here a special tool is being used to hold and move the strut into alignment with the fasteners loosened. Once the desired camber angle is achieved, the strut nuts are tightened and the tool is removed.
	29. SLIDE 29 EXPLAIN Figure 125-28 Some struts require modification of the upper mount for camber adjustment.
	**Include a check point for removal of all tools in your alignment routine. Tool is easy to forget if an effort to remove it has not been made.**
	**30. SLIDE 30 EXPLAIN Figure 125-29** example of the many methods that are commonly used to adjust front caster and camber
	**DISCUSSION: Have the students review and comment on the caster and camber adjustment methods illustrated in Figure 125–27**
	**31. SLIDE 31 EXPLAIN Figure 125-30** If there is a nut on both sides of the strut rod bushing, then the length of the rod can be adjusted to change caster.
	32. SLIDE 32 EXPLAIN Figure 125-31 Placing shims between frame and the upper control arm pivot shaft is a popular method of alignment for many SLA suspensions. Both camber and caster can be easily changed by adding or removing shims.
	33. SLIDE 33 EXPLAIN Figure 125-32 The general rule of thumb is that a 1/8-in. shim added or removed from

both shim locations changes the camber angle about 1/2 degree. Adding or removing a 1/8-in. shim from one shim location changes the caster by about 1/4 degree.

34. **SLIDE 34 EXPLAIN Figure 125-33** Some SLA-type suspensions use slotted holes for alignment angle adjustments. When the pivot shaft bolts are loosened, the pivot shaft is free to move unless held by special clamps as shown. By turning the threaded portion of the clamps, the camber and caster can be set and checked before tightening the pivot shaft bolts.
35. **SLIDE 35 EXPLAIN Figure 125-34** When the nut is loosened and the bolt on the eccentric cam is rotated, the upper control arm moves in and out. By adjusting both eccentric cams, both camber and caster can be adjusted.
36. **SLIDE 36 EXPLAIN FIGURE 125–35** Many procedures for setting toe specify that steering wheel be held in straight-ahead position using a steering wheel lock, as shown. One method recommended by Hunter Engineering sets toe without using a steering wheel lock.



DISCUSSION: Ask the students to talk about the procedures for adjusting caster & camber by using shims. Why should they adjust caster & camber before adjusting toe?

One or two shims will stay in place better than a stack the same thickness. A small magnet (taken from a bad wheel speed sensor) will hold shim stack in place until the nut is tightened.

EXPLAIN TECH TIP*: Autocross Vehicle Alignment*

Vehicles used in autocrossing (individual timed runs through cones in a parking lot) or road racing usually perform best if following alignment steps are followed:

1. **Increase caster (+). Not only will the caster provide good solid feel for driver during high speed on a straight section of course, but it will also provide some lean into the corners due to camber change during cornering. A setting of 5 to 9 degrees positive caster is typical depending on type of vehicle and the type of course.**
2. **Adjust for 1 to 2 degrees of negative camber. As a race vehicle corners, body and chassis**

lean. As chassis leans, top of tire also leans outward. By setting camber to 1 to 2 degrees negative, the tires will be neutral while cornering, thereby having as much rubber contacting the road as possible.

3. Set toe to a slight toe-out position. When front toe is set negative (toe-out), the vehicle is more responsive to steering commands from the driver. With a slight toe-out setting, one wheel is already pointed in direction of a corner or curve. Set the toe-out to −3/8 to −1/2 degree depending on type of vehicle and type of race course.

NOTE: Though setting negative camber on a street-driven vehicle will decrease tire life, negative setting on a race vehicle is used to increase cornering speeds, and tire life is not a primary consideration.

37. **SLIDE 37 EXPLAIN FIGURE 125–36** Adjusting toe by rotating the tie rod on a vehicle equipped with rack-and-pinion steering..
38. **SLIDE 38 EXPLAIN FIGURE 125–37** Toe is adjusted on a parallelogram type steering linkage by turning adjustable tie rod sleeves. Special tie rod sleeve adjusting tools should be used that grip the slot in the sleeve and will not crush the sleeve while it is being rotated.
39. **SLIDE 39 EXPLAIN FIGURE 125–38** Special tie rod adjusting tools should be used to rotate the tie rod adjusting sleeves. The tool grips the slot in the sleeve and allows the service technician to rotate the sleeve without squeezing or damaging the sleeve**.**
40. **SLIDE 40 EXPLAIN FIGURE 125–39** The toe-in on the right wheel creates a turning force toward the right.

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	**EXPLAIN TECH TIP:** ***Tire Temperature Diagnosis*** **The temperature of tires should be performed after vehicle has been driven and for about 10 miles (16 km) and over a variety of driving conditions such as driving straight ahead as well as cornering. After completing test-drive, measure all 4 tires each in center of tread as well as both outside edges. Compare temperatures to following chart to see if an alignment angle or inflation pressure may need to be changed. • SEE CHART 125–2.**
	**DISCUSS CHART 125-2 Tire temperatures and possible cause.**
	**41. SLIDE 41 EXPLAIN FIGURE 125–40** An Aftermarket camber shim can be added to change front camber on this Honda.
	**DISCUSS CASE STUDY:** ***Left Thrust Line, but a Pull to the Right!*** **A new four-door sport sedan had been aligned several times at dealership in an attempt to solve a pull to right. The car had FWD and 4-wheel independent suspension. The dealer rotated tires, and it made no difference. The alignment angles of all 4 wheels were in center of specifications. The dealer even switched all four tires from another car in an attempt to solve problem. In frustration, the owner took car to an alignment shop. Almost immediately alignment technician discovered that right rear wheel was slightly toed-in. This caused a pull to the right. • SEE FIGURE 125–41.** **The alignment technician adjusted toe on right rear wheel and reset front toe. The car drove beautifully. The owner was puzzled about why new car dealer was unable to correct problem. It was later discovered that alignment machine at dealership was out of calibration by exact**

amount that right rear wheel was out of specification. The car pulled to right because independent suspension created a rear steering force toward left that caused front to pull to right. Alignment equipment manufacturers recommend that alignment equipment be calibrated regularly.

Summary:

- **Complaint—Owner complained that the vehicle pulled to the right after an alignment.**
- **Cause—rear toe on the right was toed in and out of specification.**
- **Correction—technician adjusted the rear toe on right rear to factory specifications.**

42. **SLIDE 42 EXPLAIN FIGURE 125–41** An aftermarket kit for this Ford is installed at the top of the strut tower and allows more camber and caster adjustment than is possible with the factory adjustment.

43. **SLIDE 43 EXPLAINFIGURE 125–42** A typical tire temperature pyrometer. The probe used is a needle that penetrates about 1/4 inch (7 mm) into tread of the tire for most accurate readings.

EXPLAIN TECH TIP: ***TSBs Can Save Time.***

TSBs are issued by vehicle and aftermarket manufacturers to inform technicians of a situation or technical problem and give corrective steps and a list of parts needed to solve the problem.

TSBs are often released by OEMS to dealership service department. They usually concern current-year vehicle of a particular model. While many of these TSBs concern minor problems covering few vehicles, others contain very helpful solutions to hard-to-find problems. Most TSBs can be purchased directly from the manufacturer, but the cost is usually very high. TSBs can also be purchased through aftermarket companies that are licensed and available on a web site. Go to the National Automotive Service Task Force (NASTF)

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	web site (www.NASTF.org) for a list of the web addresses for all vehicle manufacturer's sites where TSBs can be purchased directly. Factory TSBs can often save the technician many hours of troubleshooting.
	**44. SLIDE 44 EXPLAIN Figure 125-43** Jig holes used at the assembly plant to locate suspension and drivetrain components. Check service information for the exact place to measure and the specified dimensions when checking for body or frame damage. **45. SLIDE 45 EXPLAIN FIGURE 125–44** typical analog-type steering angle sensor that uses a variable voltage as the steering wheel is rotated. **46. SLIDE 46 EXPLAIN FIGURE 125–45** The output of a typical digital steering angle sensor.
	47 SLIDES 47-64 OPTIONAL EXPLAIN ALIGNMENT
 	**ON-VEHICLE ASEEDUCATION TASK E4:** **Check toe-out-on-turns (turning radius); determine needed action.**
 	**ON-VEHICLE ASEEDUCATION TASK E5:** **Check steering axis inclination (SAI) and included angle; determine needed action..**
 	**ON-VEHICLE ASEEDUCATION TASK E8:.** **Check front and/or rear cradle (subframe) alignment; determine needed action.**
 	**ON-VEHICLE ASEEDUCATION TASK E9:** **Reset steering angle sensor.**