

Name: _____

Date: _____

Suspension & Steering Work Example 1

WorkKey Level: 6

NATEF Automotive Tasks: IV.D.2, IV.D.5, IV.D.6, IV.D.7, IV.D.8

Use the following readings and specifications to answer the eight questions below.

Readings

	Left front	Right front
Caster	3.25°	4.25°
Camber	1°	-0.25
Toe	0"	0"

Specifications

	Limits
Caster	3° + 1°
Camber	0.5° + 1/2°
Toe	1/16 – 3/16 inch toe in

1. Since the vehicle pulls toward the side with the most negative caster, which way will the caster make this vehicle pull?
2. Since the vehicle pulls toward the side with the most positive camber, which way will the camber make this vehicle pull?
3. How many degrees and in which direction does the left wheel have to move in order to correct caster?
4. How many degrees and in which direction does the left wheel have to move in order to correct camber?
5. How many degrees and in which direction does the right wheel have to move in order to correct caster?
6. How many degrees and in which direction does the right wheel have to move in order to correct camber?
7. How far and in which direction does the left wheel have to move in order to correct toe?
8. How far and in which direction does the right wheel have to move in order to correct toe?

Solutions

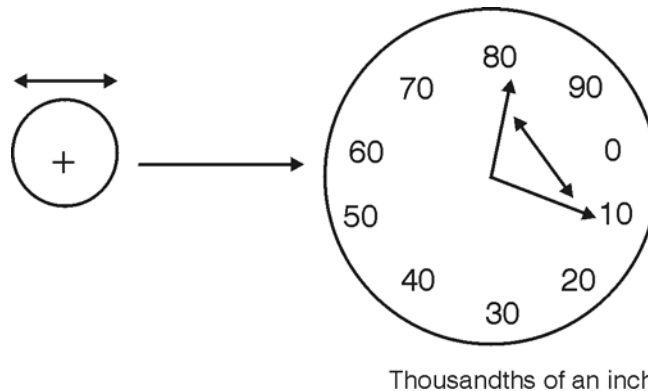
1. Most negative is the one closest to the negative number on the number line. Left

2. Left. Only one positive number
3. Don't move. It is in specs.
4. Don't move. It is in specs.
5. 0.25° less (negative). Range: 2–4 degrees. $4.25 - 4.00 = 0.25$
6. 0.25° more (positive)
7. $1/16$ " (positive)
8. $1/16$ " (positive)

Suspension & Steering Work Example 2

WorkKey Level: 4

NATEF Automotive Tasks: IV.B.4, IV.B.5, IV.B.18, IV.C.1.5, IV.C.3.2, IV.E.3, IV.E.5



- a. When checking a ball joint the dial moves between these two points. The tolerance is 0.024 ". Is this in spec? If not, how much is it out of tolerance?
- b. The tolerance is $1/64$ ". Is this in spec? If not, how much is it out of tolerance?

Solutions

- a. The dial moved 0.030 " and the tolerance is 0.024 ".
It is out of spec by $(0.030 - 0.024) = 0.006 = 0.006$ "
- b. A tolerance of $1/64$ " equals 0.015625 ".
It is out of spec by $(0.030000 - 0.015625) = 0.014375$ "

Suspension & Steering Work Example 3

WorkKey Level: 3

NATEF Automotive Tasks: Background



On a beam-type torque wrench draw an arrow where the measurement should be tightened to 60 foot-pounds.

Solution

Draw an arrow to 60 at the right side.

Suspension & Steering Work Example 4

WorkKey Level: 4

NATEF Automotive Tasks: IV.D.2, IV.D.3, IV.D.5, IV.D.6, IV.D.7

Manufacturer's specs give the information needed to make decisions about camber adjustment.

Camber angle tolerance is given as a range of acceptable values. This range can be written as an inequality. A mathematical inequality is a statement that uses the symbols $<$, \leq , $>$, and \geq .

For example, if the camber angle tolerance is given as $1.0^\circ \pm 0.5^\circ$, then the inequality is written as $0.5^\circ \leq c \leq 1.5^\circ$. This statement is read as "camber angle c is greater than or equal to 0.5° and less than or equal to 1.5° ."

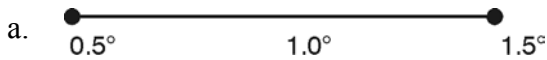
For a 2002 Mitsubishi Eclipse, the camber angle tolerance in degrees is $0.75^\circ \pm 0.5^\circ$. You measure the right rear wheel camber of your customer's Eclipse. It measures 1.4° .

- a. Label and shade the number line below to show the given camber angle tolerance.



- b. Determine the tolerance interval graph and indicate the optimal value.
 c. Determine the adjustment for the optimal or preferred setting.
 d. Determine the minimum and maximum adjustment for an acceptable measure.
 e. Write a mathematical inequality and tolerance interval of camber, c , you have determined.

Solutions



- b. 0.25 through 1.25



- c. 0.15° less
 (1.4 – 1.25 = 0.15)
 d. 0.15° through 1.15°
 e. $0.15^\circ \leq c \leq 1.15^\circ$

Suspension & Steering Work Example 5

WorkKey Level: 4

NATEF Automotive Tasks: IV.D.2, IV.D.3, IV.D.5, IV.D.6, IV.D.7

The camber of a front wheel of a 2002 Mitsubishi Diamante is -0.29° and the tolerance is $0.31^\circ \pm 0.50^\circ$.

- a. Determine the tolerance interval graph and indicate the optimal value.



- b. Determine the adjustment for the optimal or preferred setting.
 c. Determine the minimum and maximum adjustment for an acceptable measure.
 d. Write a mathematical inequality and tolerance interval of camber, c , you have determined.

- c. According to manufacturer's specifications, for this vehicle the difference between front and rear ride height is $5/8$ ". Is this in specs?

Solutions

- a. Front is out of specs by $1/4$ ". (spec: $25" - 3/4" = 24\ 1/4"$ actual: $24\ 1/2"$)
Rear is out of spec by $2\ 1/2$ ". (spec: $25" - 3/4" = 24\ 1/4"$ actual: $21\ 3/4"$)
- b. Yes
- c. Yes $5/8" \leq 3/4"$

Suspension & Steering Work Example 7

WorkKey Level: 6

NATEF Automotive Tasks: IV.D.2, IV.D.5, IV.D.6, IV.D.7, IV.D.8

Use the following readings and specifications to answer the eight questions below.

Readings

	Left front	Right front
Caster	3.25°	4.25°
Camber	1°	-0.25°
Toe	$1/16$ " toe out	$3/16$ " toe out

Specifications

	Limits
Caster	$1^\circ + 1^\circ$
Camber	$0.25^\circ + 1/4^\circ$
Toe	$1/16$ – $3/16$ inch toe in

- a. Since the vehicle pulls toward the side with the most negative caster, which way will the caster make this vehicle pull?
- b. Since the vehicle pulls toward the side with the most positive camber, which way will the camber make this vehicle pull?
- c. How many degrees and in which direction does the left wheel have to move in order to correct caster?
- d. How many degrees and in which direction does the left wheel have to move in order to correct camber?
- e. How many degrees and in which direction does the right wheel have to move in order to correct caster?

- f. How many degrees and in which direction does the right wheel have to move in order to correct camber?
- g. How far and in which direction does the left wheel have to move in order to correct toe?
- h. How far and in which direction does the right wheel have to move in order to correct toe?

Solutions

- a. Most negative is the one closest to the negative number on number line. Left
- b. Left. Only one positive number
- c. 1.250° less ($2.00^\circ - 3.25^\circ = -1.25^\circ$)
- d. 0.500° less ($0.50^\circ - 1^\circ = -0.50^\circ$)
- e. 2.250° less ($2.00^\circ - 4.25^\circ = -2.25^\circ$)
- f. 0.250° more ($0^\circ - -0.25^\circ = 0.25^\circ$)
- g. $1/8$ " positive ($-1/16$ " to $1/16$ " = $2/16$ " = $1/8$ ")
- h. $1/4$ " positive ($-3/16$ " to $1/16$ " = $4/16$ " = $1/4$ ")

Suspension & Steering Work Example 8

WorkKey Level: 6

NATEF Automotive Tasks: IV.D.5, IV.D.6

Caster Camber Adjustment Using Shims

You have an automobile with a shim adjustment system for setting caster and camber.

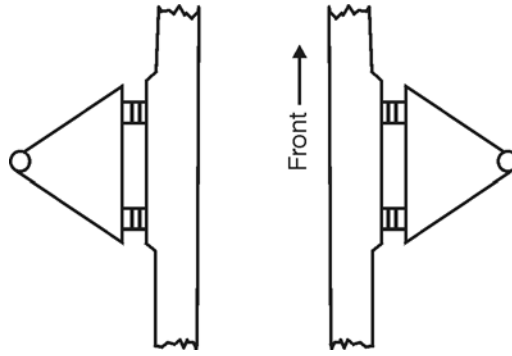
These are the facts for this car.

Readings

	Left front	Right front
Caster	1.75	2.25
Camber	0.5	-0.5

Specifications

	Limits	Preferred
Caster	2.5–3.5 degrees	3
Camber	0–1 degrees	0.5



Shims used in above diagram

Left front: One 1/16" shim and two 1/8" shims

Left back: One 1/16" shim and two 1/8" shims

Right front: Three 1/16" shims and one 1/8" shim

Right back: Eight 1/16" shims and no 1/8" shims

Each 1/8-inch shim changes caster and camber 0.5 degree.

Do you add or subtract shims to move in the direction you wish?

What is the difference between readings and preferred?

	Left	Right
Caster	_____	_____
Camber	_____	_____

Solutions

Remember: You need to add to go more positive and subtract to go more negative.

Caster: Do the opposite on the top and bottom.

Camber: Do the same on the top and bottom.

	Left	Right
Caster	+3/4 degree	+1/4 degree
	$\frac{+2}{-2}$	$\frac{+1}{-1}$
Camber	Good!	+1/2 degree
	$\frac{0}{0}$	$\frac{+1}{+1}$
Final answer:	$\frac{2}{-2}$	$\frac{2}{0}$

Suspension & Steering Work Example 9

WorkKey Level: 5

NATEF Automotive Tasks: IV.D.7, IV.D.11

You are doing a four-wheel alignment on a customer's vehicle. During the alignment, you made the following toe measurements.

Tire	Distance from centerline of vehicle to		Calculate tire toe
	Centerline of the tire at the front of the tire (A)	Centerline of the tire at the rear of the tire (B)	A – B
Right front	71.3079 cm	71.8921 cm	
Left front	71.8413 cm	71.3587 cm	
Right rear	71.9048 cm	71.2952 cm	
Left rear	71.4984 cm	71.7016 cm	

- Complete the table by calculating the toe on each tire. Express answers in millimeters.
- Calculate the total toe on the front end by finding the sum of the right front toe and the left front toe.
- Calculate the total toe on the rear end by finding the sum of the right rear toe and the left rear toe.

Solutions

a.	Calculate tire toe
	A – B
	–5.842 mm
	4.826 mm
	6.096 mm
	–2.032 mm

- Total toe on front end = $-5.842 \text{ mm} + 4.826 \text{ mm}$
Total toe on front end = -1.016 mm
- Total toe on rear end = $6.096 \text{ mm} + (-2.032 \text{ mm})$
Total toe on rear end = 4.064 mm

Source: AYES