Name: _____ Date: _____

Manual Drive Train & Axles Work Example 1

WorkKey Level: 4
NATEF Automotive Tasks: III.B.2

The distance from the floor to the clutch pedal in the released position is 6 7/8". When the pedal is pushed to the end of its free play range, the distance to the floor measures 5 3/8". The clutch pedal free play should measure one to two inches. What is the free play? Is it within the specs?

Solution

The free play is 6 7/8" – 5 3/8" = 1 4/8" = 1 1/2"

Yes, 1 1/2" is within the specifications of one to two inches.

1" ≤ 1 1/2" ≤ 2"

Manual Drive Train & Axles Work Example 2

WorkKey Level: 4
NATEF Automotive Tasks: III.B.10

We are checking flywheel run-out with a dial indicator and get a reading of 0.003". The specification allows 0.005" run-out. How far out of spec, if any, is this flywheel?

Solution

The flywheel is (0.005"– 0.003") = 0.002" out of spec.

Manual Drive Train & Axles Work Example 3

WorkKey Level: 4
NATEF Automotive Tasks: III.B.10; Engine Repair I.C.8

We are checking crankshaft endplay with a dial indicator and get a reading of 0.005". The specification reads 0.003" ± 0.001" endplay. Is the crankshaft endplay within spec? If not, how far out of spec?

Solution

The acceptable range is as follows:
0.003" + 0.001" = 0.004"

0.003" – 0.001" = 0.002"
0.002" ≤ endplay ≤ 0.004"

A reading of 0.005" is out of spec by (0.005" – 0.004") = 0.001".

Manual Drive Train & Axles Work Example 4

WorkKey Level: 4
NATEF Automotive Tasks: III.C.10

With selective thrust washer C installed, transmission output shaft endplay is found to be 0.019". The specifications call for 0.008" ± 0.005". Which selective thrust washer do you need to install to correct the transmission output shaft endplay?

Selective thrust washer	Thickness
A	0.045
B	0.055
C	0.065
D	0.075

Solution

The range according to specs is as follows:
0.008" + 0.005" = 0.013"
0.008" – 0.005" = 0.003"
0.003" ≤ endplay ≤ 0.013"

0.019" – 0.013" = 0.006"
Select washer B.

Manual Drive Train & Axles Work Example 5

WorkKey Level: 4
NATEF Automotive Tasks: III.E.1.6

We are measuring the final drive pinion gear with a go-no-go gauge. The go gauge reads 0.030" and the no-go gauge reads 0.037". Both gauges fit; however, a 0.040" will not fit. The current spacer measures 0.060" and they increase in 0.005" increments.

1. Find the minimum and maximum clearance.
2. What size spacer do you need?

Solution

1. Minimum:
   0.040" – 0.037" = 0.003"
   Maximum:
   0.040" – 0.030" = 0.010"
2. 0.060" + 0.005" = 0.065", which is within spec

Manual Drive Train & Axles Work Example 6

WorkKey Level: 4
NATEF Automotive Tasks: III.E.1.4

We are checking ring gear run-out with a dial indicator and get a reading of 0.0015". The specification reads 0.002" ± 0.0005" run-out. Is the ring gear run-out within spec? If not, how far out of spec is it?

Solution

The range according to specs is as follows:
0.002" + 0.0005" = 0.0025"
0.002" – 0.0005" = 0.0015"
0.0015" ≤ run-out ≤ 0.0025"

The gear run-out is within specs.

Manual Drive Train & Axles Work Example 7

WorkKey Level: 4
NATEF Automotive Tasks: III.E.1.8

You are checking backlash in four spots on the ring gear and you find the following four measurements: 0.004", 0.006", 0.008", and 0.004". What is the variation in the backlash readings? If the backlash spec is 0.005" to 0.008", are your readings within specifications? If they are not within specs, how far out are they?

Solution

The variation in backlash is the range (difference between the highest and lowest readings):
0.008" – 0.004" = 0.004" variation

The readings are not within specs.

They are out of specs by (0.005" – 0.004") = 0.001".

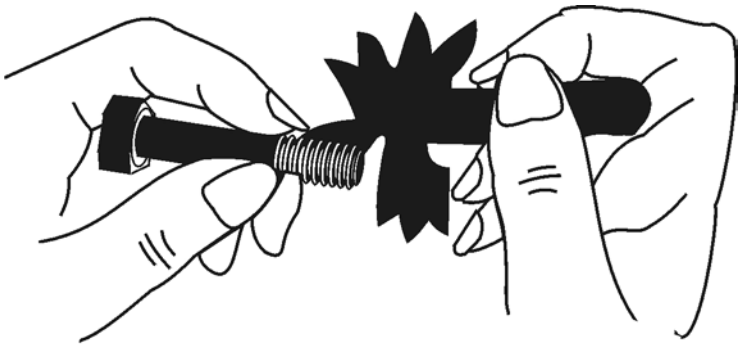
Manual Drive Train & Axles Work Example 8

WorkKey Level: 3
NATEF Automotive Tasks: Background

(Universal problem for thread pitch)

1. Based on the thread pitch gauge in the illustration and given the chart below, what bolt size should be ordered?
2. What is the drill size for a 1/4×20 bolt?
3. What is the decimal equivalent of 5/8?
4. What is the outside diameter at screw of drill size F?

13 threads per inch



American National Screw Thread Pitches
COARSE STANDARD THREAD (N.C.)
Formerly U.S. Standard Thread

Bolt or tap size	Threads per inch	Outside diameter at screw	Drill sizes	Decimal equivalent of drill
1	64	0.073	53	0.0595
2	56	0.086	50	0.0700
3	48	0.099	47	0.0785
4	40	0.112	43	0.0890
5	40	0.125	38	0.1015
6	32	0.138	36	0.1065
8	32	0.164	29	0.1360
10	24	0.190	25	0.1495
12	24	0.216	16	0.1770
1/4	20	0.250	7	0.2010

5/16	18	0.3125	F	0.2570
3/8	16	0.375	5/16	0.3125
7/16	14	0.4375	U	0.3680
1/2	13	0.500	27/64	0.4219
9/16	12	0.5625	31/64	0.4843
5/8	11	0.625	17/32	0.5312
3/4	10	0.750	21/32	0.6562
7/8	9	0.875	49/64	0.7656
1	8	1.000	7/8	0.8750
1 1/8	7	1.125	63/64	0.9843
1 1/4	7	1.250	1 7/64	1.1093

FINE STANDARD THREAD (N.F.)
Formerly S.A.E. Thread

Bolt or tap size	Threads per inch	Outside diameter at screw	Drill sizes	Decimal equivalent of drill
0	80	0.060	3/64	0.0469
1	72	0.073	53	0.0595
2	64	0.086	50	0.0700
3	56	0.099	45	0.0820
4	48	0.112	42	0.0935
5	44	0.125	37	0.1040
6	40	0.138	33	0.1130
8	36	0.164	29	0.1360
10	32	0.190	21	0.1590
12	28	0.216	14	0.1820
1/4	28	0.250	3	0.2130
5/16	24	0.3125	I	0.2720
3/8	24	0.375	Q	0.3320
7/17	20	0.4375	25/64	0.3906
1/2	20	0.500	29/64	0.4531
9/16	18	0.5625	0.5062	0.5602
5/8	18	0.625	0.5687	0.5687
3/4	16	0.750	11/16	0.6875
7/8	14	0.875	0.8020	0.8020
1	14	1.000	0.9274	0.9274
1 1/8	12	1.125	1 3/64	1.0468

1 1/4	12	1.250	1 11/64	1.1718

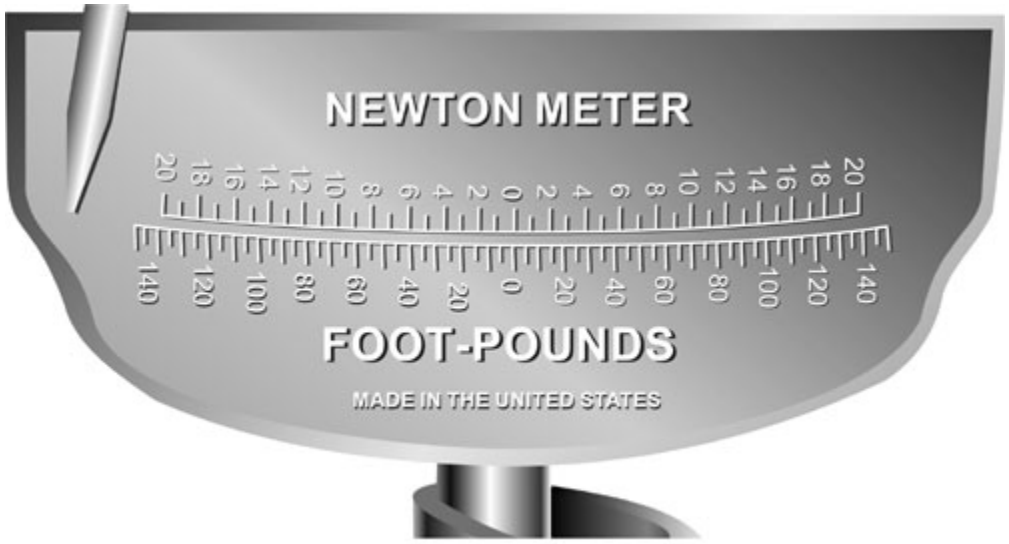
Solution

1. You need to order a 1/2" bolt × 13 tpi.
2. 7
3. 0.625
4. 0.3125

Manual Drive Train & Axles Work Example 9

WorkKey Level: 3
NATEF Automotive Tasks: III.D.3, III.D.4, Background

You have to torque the axle shaft nut to 130 ft-lbs. Mark on the gauge where this would be.



Solution

The students should draw an arrow to 130 ft-lbs on the right side.

Manual Drive Train & Axles Work Example 10

WorkKey Level: 4
NATEF Automotive Tasks: III.D.3, III.D.4, Background

Your torque wrench has a maximum read of 100 ft-lbs. You have to torque the axle shaft nut to 180 ft-lbs. How can you do this?

Solution

Torque = (Force)(Length)
Therefore, if you double the length, you cut the force in half.

You will need to move 90 ft-lbs.

Manual Drive Train & Axles Work Example 11

WorkKey Level: 3
NATEF Automotive Tasks: III.E.1.1, III.E.3.1

Using the following information, determine whether there could be a vibration problem in each of the three vehicles based on the measurements taken by an inclinometer of their driveline angles. A difference greater than 0.5 degree is too large and will cause vibration.

Vehicle	Front working angle	Rear working angle	Difference between front and rear angle	Could there be a vibration problem?
1	16.5 degrees	16 degrees		
2	10 degrees	13 degrees		
3	15.5 degrees	14.5 degrees		

Solution

Vehicle	Front working angle	Rear working angle	Difference between front and rear angle	Could there be a vibration problem?
1	16.5 degrees	16 degrees	16.5 – 16 0.5 degree	No
2	10 degrees	13 degrees	13 – 10 3 degrees	Yes
3	15.5 degrees	14.5 degrees	15.5 – 14.5 1 degree	Yes

Manual Drive Train & Axles Work Example 12

WorkKey Level: 4
NATEF Automotive Tasks: III.E.1.1, III.E.3.1

You have modified your car and are having a vibration problem. You measure the transmission angle and the rear axle differential angle of your car. The transmission angle is 5/8 degree and the differential angle is 1 3/8 degree. A difference greater than 1/2 degree is too large and will cause vibration. You will use shims to correct the angle problem. One shim will change the transmission angle 1/8 degree.

1. What is the difference in the measurement of the transmission angle and differential angle?
2. How many shims should you use to correct the problem?

Solution

1. Difference = 1 3/8 – 5/8
   Difference = 6/8 or 3/4 degree
2. 3/4 – 1/2 = 1/4
   The difference is between 1/4 and 3/4 degrees.
   If each shim changes the transmission angle by 1/8 degree, then:
   (1/4)/(1/8) = 2 and (3/4)/(1/8) = 6
   You should use between 2 and 6 shims to correct the problem.

Manual Drive Train & Axles Work Example 13

WorkKey Level: 7
NATEF Automotive Tasks:

How fast will a car be traveling at 3000 rpm in

a) 3rd gear?
b) 4th gear?
c) 5th gear?

Given:		
	3rd-gear ratio:	1.25 : 1
	4th-gear ratio:	1:1
	5th-gear ratio:	0.7 : 1
	Rear axle:	3.73 : 1
	Tire diameter:	25 inches
	1 mile:	5280 feet

Solution

Engine-to-transmission ratio is 1.25 : 1.

So, $\frac{1}{1.25} = \frac{t}{3000}$, $3000 = 1.25t$, or $\frac{3000}{1.25} = t = 2400$ rpm transmission.

Transmission-to-rear-axle ratio is 3.73 : 1.

So, $\frac{1}{3.73} = \frac{RA}{2400}$, $2400 = 3.73\ RA$ or $\frac{2400}{3.73} = RA = 643$ rpm rear axle.

Revolutions/hr: 643 rpm × 60min/hr = 38,580 rev/hr

Tire circumference: 25 inches × 3.14 = 78.5 inches

Speed: 38,580 rev/hr × 78.5 = 3,028,530 inches/hr

Speed: 3,028,530 inches/hr ÷ 12 in/ft = 252,377.50 ft/hr

Speed: 252,377.50 ft/hr ÷ 5280 ft/mile = 47.8 miles/hr
4th gear: 59.8 mph
5th gear: 85.4 mph