03-17-2005, 06:21 PM #1

darrell
Gnarly Adventurer
Joined: Jan 2004
Location: Minnesota
Oddometer: 230

Crowsfoot Torque Conversion Formula

Does anyone know how to convert the torque setting when using a crowsfoot? For example, if the suggested torque is 20 Nm how do I determine the torque number when using the crowsfoot?

_____
Darrell

03-17-2005, 06:25 PM #2

Mack
Gone, but never forgotten.
RIP, Mack...

Joined: Sep 2002
Location: Austin, Texas
USA Native Oregonian
Oddometer: 3,797

If your able to torque with the crows foot at a 90deg angle to the head of the torque wrench, you don't have to correct. Sorry can't help you with the formula.

_____
Ã–sterreichische MotorrÃ¤der und deutsche Autos. Wie wundervoll kann das Leben sein

03-17-2005, 08:53 PM #3

Poolside
Syndicated

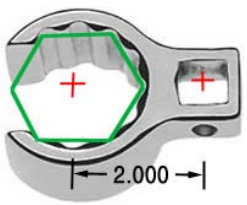
Joined: Apr 2003
Location: Long Beach, CA
Oddometer: 9,935

Quote:

> Originally Posted by **darrell**
> *Does anyone know how to convert the torque setting when using a crowsfoot? For example, if the suggested torque is 20 Nm how do I determine the torque number when using the crowsfoot?*

You are trying to torque the cam tensioner body aren't you Darrell.
If so, the tensioner uses a crush washer, so you can do it by feel.

If not, the conversion formula is fairly simple.



1. Measure the 'distance between centers' on the crowfoot wrench you're using.

2. On your torque wrench, without the crowsfoot, measure the distance between the center of the torque wrench handle, and the center of the square drive.

3. Determine the desired torque, and plug the values into this formula.

desired torque x torque wrench length

torque wrench length + crowfoot length = torque wrench setting to obtain desired torque

The formula will work with all units of measure, just be sure you are consistent. Example, for N·m, either express all measures values in meters, or convert to millimeters.

_____
"The "revolutionary" is in the minds of the marketers..."
-- Mully

Considering that, all hatred driven hence,
The soul recovers radical innocence
-- W.B. Yeats

Poolside screwed with this post 10-15-2010 at 06:17 AM Reason: Corrected the formula and explanation, at least I hope so :-)

03-17-2005, 09:16 PM #4

Zollo
Beastly Adventurer
Joined: Mar 2002
Location: CA
Oddometer: 1,416

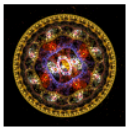
. . .

Great question, darrell, and nicely answered, Poolside. Mack brings up an interesting angle (oh. pun!). Does his rule of twist compute? I'm not 100% certain (another pun!).

Zollo

03-17-2005, 10:40 PM #5

johnjen
Mod-U-Later



Joined: Nov 2001
Location: Seattle
Oddometer: 10,638

This belongs in BS&G... and so it went...

JJ
and now back to the garage.

_____
Originally Posted by Javarilla
referring to my avatar...
That is the illustration of the atomic flux of the lubricant in the semi-hemispherical aebleskiver thermodynamic transfer mechanism under thermostress.

johnjen screwed with this post 10-15-2010 at 09:47 AM

10-14-2010, 06:16 PM #6

EvilClown
Reality show stunt double

Joined: Sep 2006
Location: In the shadow of the Uncanoonucs...
Oddometer: 9,987

Quote:

> Originally Posted by **Mack**
> *If your able to torque with the crows foot at a 90deg angle to the head of the torque wrench, you don't have to correct. Sorry can't help you with the formula.*

Not disagreeing. Just wonder if someone would 'splain it to me.

And, yes. I did drag this up from 2005.

_____
'Ural miles' are kinda like 'dog years'... ~ moi

Without ice cream, there would be darkness and chaos. ~Don Kardong~

Fortunately, we're not in control. ~Willie Nelson~

Quote:

> Originally Posted by **Skibum**
> *...I can give you the secret to doing any job in 10 words and it won't cost the tax payers a dime. Show up, on time, every day and bust your ass.*

10-14-2010, 06:58 PM #7

keiji
Studly Adventurer
Joined: Jun 2008
Oddometer: 576

Quote:

> Originally Posted by **EvilClown**
> *Not disagreeing. Just wonder if someone would 'splain it to me.*
>
> *And, yes. I did drag this up from 2005.*

Torque is r(the lever arm) x F(force) where 'x' is the cross product.

This is useful if you are working in 3 dimensional space, but is somewhat difficult to understand for most people.

In 2D space, torque is **r**(lever arm) multiplied by the force acting perpendicular to the lever arm. You may be familiar with it as rFsin (theta), where theta is the angle between the lever arm and the force vector.

Anyway, the lever arm r is the straight line distance between the point where the force is exerted, and the point of rotation (the bolt). This means **r**=sqrt[(length of torque wrench)^2+(length of crows foot)^2]

Since the length of the torque wrench is very large compared to the length of the crows foot, **r** ends up being very close to the length of the torque wrench (but slightly bigger).

The angle that the force is acting on has changed too, but if think about it carefully, the sin of the angle can be easily calculated. Since the direction you are applying the force, and the length of the crow's foot are parallel to each other, you can imagine the lever arm, **r** as a line intersecting two parallel lines. This means the angle between the lever arm and the force is the same as the angle between the length of the crow's foot and the lever arm(Parallel line theorem).

How does this help? Well, if you remember your trig, then for right triangles, Sin(theta)=("length of the triangle opposite of theta"/"length of the hypotenuse"). The hypotenuse is the length of the lever arm, **r**. Previously, we found out that **r** is a tiny bit bigger than the length of the torque wrench. When you divide the two, you get approximately 1.

So you have T=**r*F***sin(theta)=(~lever arm)*F*(~1)

So the error introduced by the crowsfoot at a 90 degree angle to the torque wrench is very small(negligible) compared to the calibration error of the torque wrench, which can be as much as 10%.

Did that make sense? I'd draw a picture, but I'm terrible at paint.

10-15-2010, 02:22 AM #8

EvilClown
Reality show stunt double

Joined: Sep 2006
Location: In the shadow of the Uncanoonucs...
Oddometer: 9,987

Quote:

> Originally Posted by **keiji**
> *Torque is r(the lever arm) x F(force) where 'x' is the cross product.*
>
> *This is useful if you are working in 3 dimensional space, but is somewhat difficult to understand for most people.*
>
> *In 2D space, torque is **r**(lever arm) multiplied by the force acting perpendicular to the lever arm. You may be familiar with it as rFsin (theta), where theta is the angle between the lever arm and the force vector.*
>
> *Anyway, the lever arm r is the straight line distance between the point where the force is exerted, and the point of rotation (the bolt). This means **r**=sqrt[(length of torque wrench)^2+(length of crows foot)^2]*
>
> *Since the length of the torque wrench is very large compared to the length of the crows foot, **r** ends up being very close to the length of the torque wrench (but slightly bigger).*
>
> *The angle that the force is acting on has changed too, but if think about it carefully, the sin of the angle can be easily calculated. Since the direction you are applying the force, and the length of the crow's foot are parallel to each other, you can imagine the lever arm, **r** as a line intersecting two parallel lines. This means the angle between the lever arm and the force is the same as the angle between the length of the crow's foot and the lever arm(Parallel line theorem).*
>
> *How does this help? Well, if you remember your trig, then for right triangles, Sin(theta)=("length of the triangle opposite of theta"/"length of the hypotenuse"). The hypotenuse is the length of the lever arm, **r**. Previously, we found out that **r** is a tiny bit bigger than the length of the torque wrench. When you divide the two, you get approximately 1.*

> *So you have T=**r*F***sin(theta)=(~lever arm)*F*(~1)*
>
> *So the error introduced by the crowsfoot at a 90 degree angle to the torque wrench is very small(negligible) compared to the calibration error of the torque wrench, which can be as much as 10%.*
>
> *Did that make sense? I'd draw a picture, but I'm terrible at paint.*

Very helpful - in a 'that makes my hair hurt' sort of way.

What brought this all up was this excellent 'how to' guide. About 2/3's down the page you'll find this:

And this:

It's a little longer than your typical crow's foot but I'd guess the math would bring you to well within that 10% calibration figger you speak of. One day when I'm really stuck for things to do I'll actually do the measuring and the math.

If you're not familiar with this particular 'tool' it comes in the KTM tool kit on the 950, 640 and prolly others.

MeRide photo

It's also sold as a:

As cpmodem points out, a 3/8" drive fits nicely in the slot.

I love it when people think outside the box.

_____

'Ural miles' are kinda like 'dog years'... ~ moi

Without ice cream, there would be darkness and chaos. ~Don Kardong~

Fortunately, we're not in control. ~Willie Nelson~

Quote:

> Originally Posted by **Skibum**
> *...I can give you the secret to doing any job in 10 words and it won't cost the tax payers a dime. Show up, on time, every day and bust your ass.*

10-15-2010, 05:04 AM #9

Poolside
Syndicated

Joined: Apr 2003
Location: Long Beach, CA
Oddometer: 9,935

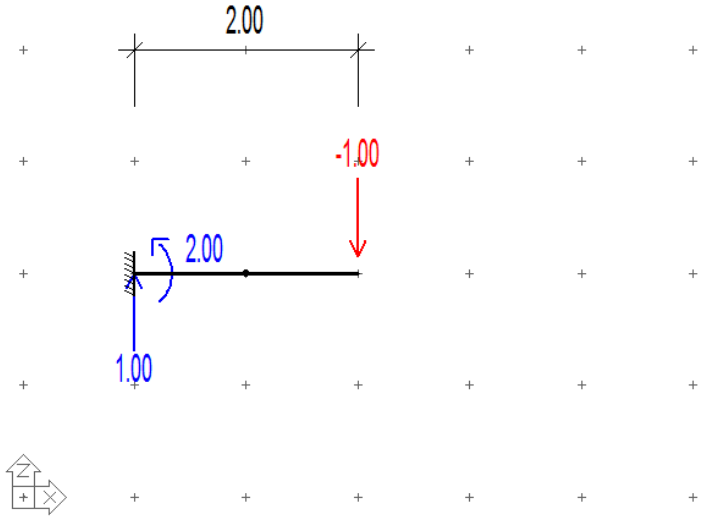
Quote:

> Originally Posted by **EvilClown**
> *What brought this all up was this excellent 'how to' guide.*

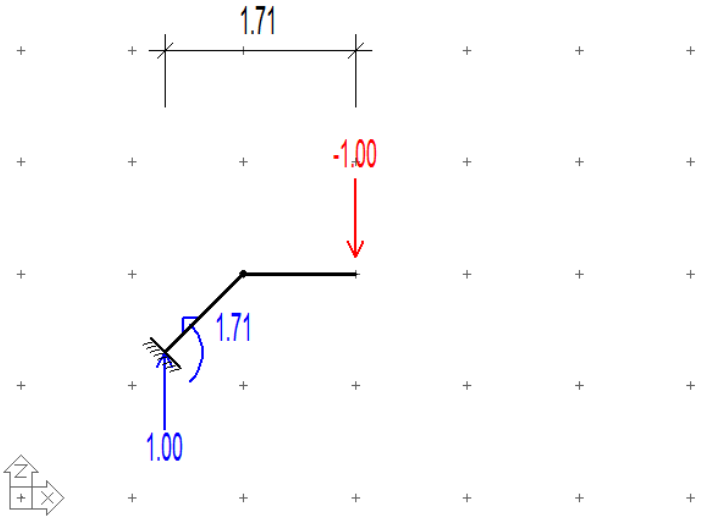
I tell you what, that trick with the KTM bottle opener is in a lot of ways more worthwhile than the calculations! Neat trick.

But here they are anyway. The units are 'normalized to 1' to make it easier to see what's going on.

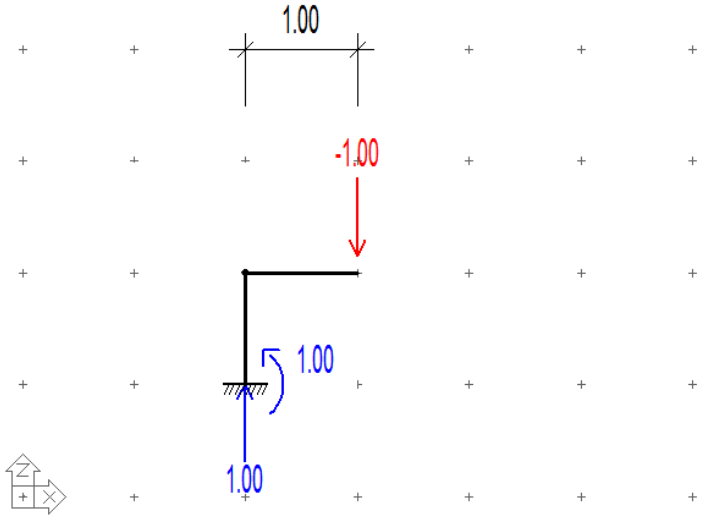
1.00 unit of down 'action', across lever arm of 2.00, equals 2.00 units of torque 'reaction', and 1.00 unit of up 'reaction'.



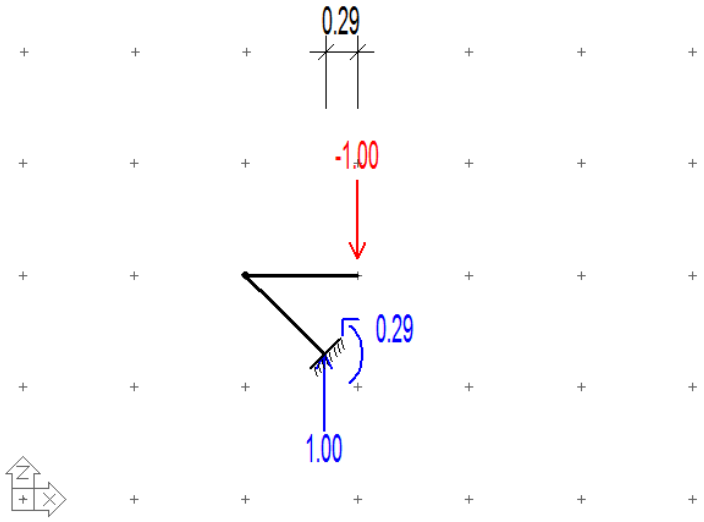
Bend the lever arm 45° in the middle, and it looks like this.
The lever arm is shortened to 1.71 units, and the torque reaction is also 1.71 units.
A lever arm of 1.00, plus the cosine of 45°, equals 1.71



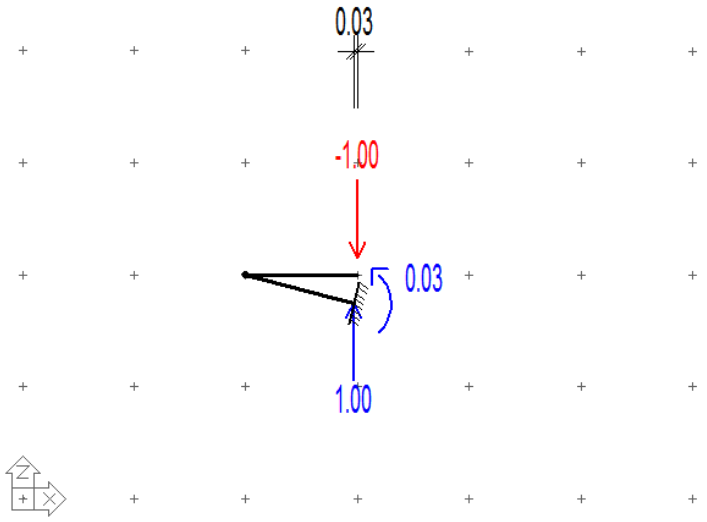
At 90 degrees, the up reaction exactly counters the force input.
The two forces are directly opposed, and do not contribute to the torque.
A lever arm of 1.00, plus the cosine of 90°, equals 1 unit of torque reaction.
(The cosine of 90° is 0.00)



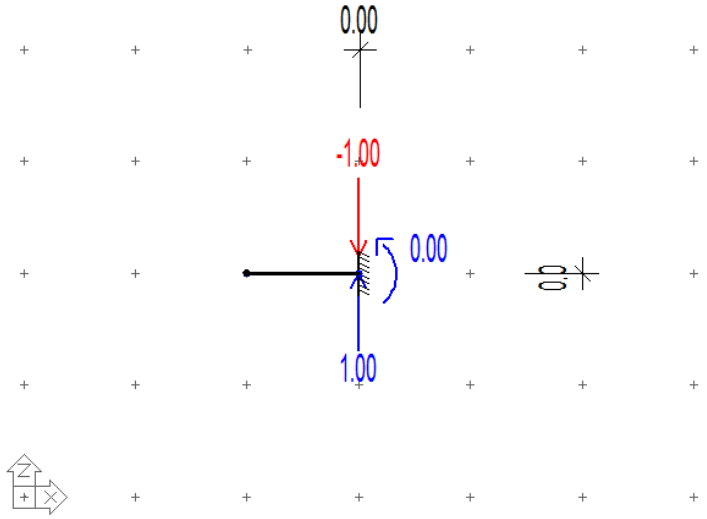
Swing past 90 degrees and the torque starts to subtract. At 135° the torque is only 29%
A lever arm of 1.00, plus the cosine of 135°, equals 0.29
(The cosine of 135° is -0.71)



At 165° it's down to 3%
A lever arm of 1.00, plus the cosine of 165°, equals 0.03
(The cosine of 165° is -0.97)

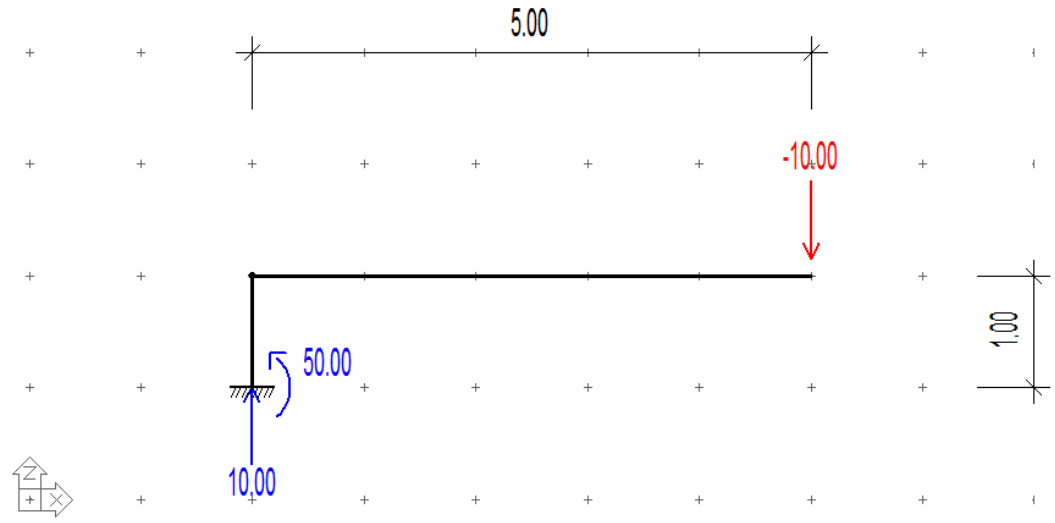


At a bend of 180 degrees, the bar is folded in half, and the handle is directly over the fastener. The torque reaction is zero.
A lever arm of 1.00, plus the cosine of 180°, equals 0.00
(The cosine of 180° is -1.00)

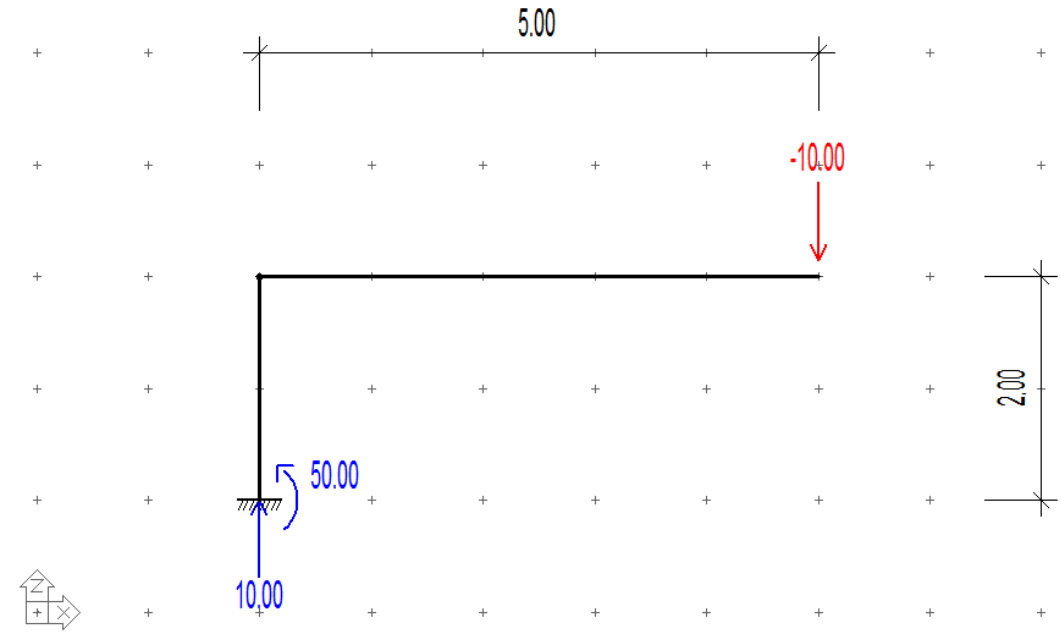


If the offset is oriented at a right angle to the wrench handle it never adds any torque, regardless of the ratio of the arms.

An example of a 5 unit lever arm, and a 1 unit offset 'crowsfoot'.
10 units of force, over a 5 unit lever arm.



The same applies with a 2 unit offset 'crowsfoot'.
At 90° the forces are directly opposed, and do not contribute to torque.



"The "revolutionary" is in the minds of the marketers..."
-- Mully

Considering that, all hatred driven hence,
The soul recovers radical innocence
-- W.B. Yeats

Poolside screwed with this post 10-20-2010 at 05:28 AM

10-15-2010, 07:57 AM #10

keiji
Studly Adventurer
Joined: Jun 2008
Oddometer: 576

Silly me. I've done a ton of statics too. and completely neglected to look at the problem like that. Poolside is completely right in that it will never matter.

10-15-2010, 01:53 PM #11

EvilClown
Reality show stunt double

Joined: Sep 2006
Location: In the shadow of the Uncanoonucs...
Oddometer: 9,987

Thanks, Poolside.

'Ural miles' are kinda like 'dog years'... ~ moi

Without ice cream, there would be darkness and chaos. ~Don Kardong~

Fortunately, we're not in control. ~Willie Nelson~

Quote:

> Originally Posted by **Skibum**
> *...I can give you the secret to doing any job in 10 words and it won't cost the tax payers a dime. Show up, on time, every day and bust your ass.*

10-17-2010, 01:39 AM #12

Mulligan
Neighborhood Adventurer
Joined: Nov 2009
Location: Pacific NW
Oddometer: 4

Quote:

> Originally Posted by **Poolside**
>
> *1. Measure the 'distance between centers' on the crowfoot wrench you're using.*
>
> *2. On your torque wrench, without the crowsfoot, measure the distance between the center of the torque wrench handle, and the center of the square drive.*
>
> *3. Determine the desired torque, and plug the values into this formula.*
>
> $$\frac{\text{desired torque} \times \text{torque wrench length}}{\text{torque wrench length} + \text{crowfoot length}} = \text{torque wrench setting to obtain desired torque}$$

It's important to emphasize that the value "crowfoot length" in the above equation refers to the component of the crowfoot length that is parallel to the torque wrench.

Examples:
(1) If the crowfoot is parallel to the torque wrench, this value is just the length of the crowfoot.
(2) If the crowfoot is at a right angle to the torque wrench, this value is 0.
(3) If the crowfoot is at 45 deg relative to the torque wrench, this value is .71 * the length of the crowfoot.

This is implicit in Poolside's illustrations, but I think it's worthwhile to say it explicitly.

10-17-2010, 01:50 AM #13

Poolside
Syndicated

Joined: Apr 2003
Location: Long Beach, CA
Oddometer: 9,935

Quote:

> Originally Posted by **Mulligan**
> *This is implicit in Poolside's illustrations, but I think it's worthwhile to say it explicitly.*

Indubitably.

"The "revolutionary" is in the minds of the marketers..."
-- Mully

Considering that, all hatred driven hence,
The soul recovers radical innocence
-- W.B. Yeats

10-19-2010, 11:10 PM #14

ultane
sqeezin the bag

Joined: Feb 2008
Location: the dry side of the blood brain barrier in SW Id
Oddometer: 420

DANG... That guy ^^^^^^ sure is smart...

I might be wrong, just ask my X...

10-22-2010, 03:42 PM #15

Z50R
Not lost yet
Joined: May 2009
Location: Boston Mass.
Oddometer: 488

Quote:

> Originally Posted by **keiji**
> *Silly me. I've done a ton of statics too. and completely neglected to look at the problem like that. Poolside is completely right in that it will never matter.*

All of what Poolside has said is correct but the kicker is that you have to apply the force in the same direction regardless of the length of the crowsfoot. This becomes increasingly difficult to do as the length of the crowsfoot becomes large.

The tendency will be to rotate the wrench around the fastener as opposed to around the end of the torque wrench; if you do this, all of those calculations are wrong.

Quote:

> Originally Posted by **duck**
> *Arghhhh. Abandon ship, maties!*

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