Conduit bending guide pdf

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As a result, they can have huge difficulties when trying to bend a larger channel (larger than 1). Even more experienced travel-level electricians rarely have an idea of a variety of possibilities. However, learning how to bend the channel to very almost every angle you want is not difficult. The maths and formulas that make up the simple channel-ding guide are actually quite simple and easily learned. The only tools you need for more sophisticated curves are a corner-seeker and a low-cost scientific hand calculator or a smartphone with a calculator in today's world. Any electrician bending a large channel should already have an angle finder without an arm bender to say the angle is bent at the angle of the finder is necessary. If you don't, there are a few examples at the end of this article. And now that we have smartphones, the calculator is not just cheap; It's free. Recommended for Android phones is the RealCalc Scientific Calculator app, which is available from the Google Play Store for free. Just search the store RealCalc and download. The mathematics used in bending channel math channel-bending that we discuss here comes from two sources. Some of the math has already been built into a common hand bender device, and the rest of it involves a geometry triangle. Note that making concentric bends requires using some additional math not discussed in this article. The mathematics of Hand Benders Deducts, bend radials and repeaters A lot of mathematics is built on a manual bender device. Just some numbers and math surgeries you should remember to make up, saddles and 90 degree curves. Even the repeater and off figures are usually stamped onto the bender device. For more information about using a hand bender, see my comprehensive guide to bending the channel. RadiuDeduct channel size multiplier and moning drawings 90 degrees 1/2453/44 1/2615 3/48Bend multiplier 10 degrees.022 degrees2.630 degrees2.045 degrees1.460 degrees1.2 Math Triangle Triangle Geometry Formulas, which are useful for many channel bends Most channel curves, in addition to a simple 90-bender, can be understood and calculated using the geometry of the right triangle. Using the Triangle to understand offsetoffsetWildernessTube above bent into a offset. In the chart below, the heavy black line represents the bent channel; the green triangle shows some useful lengths and angles. Shift Angles are the angle at which the channel bent. One of the other corners of the triangle is always 90 degrees, while the third angle always depends on the first, being 90 degrees minus the angle d. The sides of the triangle are marked as a, B and C; these letters represent the length of each side. The formulas below allow you to get relationships between these lengths. In real life, of course, the channel is not a one-dimensional line, but rather a three-dimensional object curved, not sharp, in the corners. However, these considerations only affect measurements that you use to a very limited extent; daily work, you can ignore them. Using triangles to understand saddles Saddles are used to route the channel around the obstacle. See the photos below to see how you would use the triangle concept in a three-point saddle (putting the second triangle back-to-back with the first one) and a four-point saddle (putting the second triangle separated by the first length of the straight channel). Three-Point SaddleDan HarmonAding Saddle4-Point SaddleDan Harmon4-point SaddleMamatic Formulas From TrianglesMamatic Formulas We Use is Sine, Cosine and Tanger. These are just relationships between the sides of the right triangle; they depend on the triangle angle(s). The formulas are listed below with algebraic equivalents in any case. Each set of formulas—sine, cosine, and tangy — is just one formula expressed in three different ways. Calculations SineSine(s) = A/C This is the angle substance is the length of side A divided into side Length C.A = sine(s)* C Side Length A is the length(s) of the sine greater than the sine's length(s) the size of the sine C.C = A/sine(s)Side Length C is the side Length A divided by sine(s). Calculation Use of mesons(s) = B/CAng angle cosine(s) is the length of side B divided by side length C.B = cos(d) * CSide B length is the combination of an angle multiplied by the side Length C.C = B/cos(s)The length of side C is the length of the side B angle of co-compatibility(s). Calculations by Tangenttan(s) = A/BAngle tangent(s) divided by side A Divided by side Length B.A = tan(s) * BSide Length A is the angle length(s) greater than the angle B.B = A/tan(s)Length B is the length of the side A divided by angle tangent(s). Calculator will give you any corner of sys, coy and tangy. Because different calculators want you to press the keys in different sequences to get results, you need to read the instructions for your specific calculator and understand that the trigonometric functions in it are used. In particular, you need to know how to get inverse functions on your calculator; these functions change the shape of the sysy, the co-compatibility or the tangent shape to the desired bend degree. And make sure your calculator is set to describe angles in degrees, not radians; Radians are useless to the electrician. Examples using Math Bend Channel To expect that we need 2 shift 3 1/2 channel. Normally it would be impossible using 10º flexibility, because two turns can not make such a close -(12)) channel so large. Using the syte formulas on the outside, let's try to bend 2º. We know that half A is 2. Calculator shows that the 2-degree angle siculate is 0.0349. Two inches divided by 0.0349 = 57. It's a little far from our curves, so let's try to bend again using 5º. The sius 5 degrees is 0.087 and 2/087 = 22.98, or about 23. This is a more reasonable length offset of 3 1/2 tubes, so it can be used if the 10º offset cannot. As an exercise, consider the 12-shift using two 22º curves. Again, C = / sy mesy (22º). Please note that it can also be written in C = * (1 / si mes (22º)). Si contained 22º = 0.3846 and 1 / 0.3846 = 2.6, which is a familiar repeater 22º offset. This kind of math is where these repeaters come from! Let's say we need a 4-shift, and that it has to happen exactly 15. What is the angle to use? We know that A = 4 and B = 15. We also know that tan(s) = 4/15 or 0.2666. Calculator tells us that inverse tangent 0.2666 = 15º. At the same time, we find a 15º bend repeater, dividing one 15º sy by sys; the answer comes back to the repeater 15º is 3.86. Let's say we need 4 3-point saddles, and that we use 45º as a middle bend with 22.5º angle bends at both ends. What is the contraction of the wire - that is the amount by which the middle of the curve is closer to the end of the canal than the measured pipe length? We know that A = 4 and angle d = 22,5º. What is B and C? Side C = 4 / sy mes (22.4º) or 10.45. Side B = 4 / tan(22,5º) or 9,65. The difference between B and C is our contraction; the center of our three-point saddle moves just below 1. Most electricians forget or ignore this contraction of three-point saddles, and as a result, the center of their bend is not focused over the obstacle they cross. Bend every angle of you these formulas allow the electrician to bend very much to almost every angle he wants. As an electrician myself, I have often found myself trying to bend a large channel into odd angles and dimensions to match the demands of the building or get the look people want. Bending 3 or 4 channel into odd corners of trial and error becomes very expensive very quickly. Remembering these simple formulas can make it much easier to bend a large channel. My own memory help is this: Sine(s) = reverse / hypotenuseCosine(s) = contiguous / hypotenuseAddi touch(s) = reverse / side where hypotenuse is the longest side, the opposite is the side opposite angle, and the adjacent is the side that touches the corner but is not hypotenuse. SOH-CAH-TOA is an abbreviation that you can hear for this memory help. Or simply record formulas on the back of your calculator; Believe it or not, I grew up before there were calculators and I had to remember. Last note: this article is just one of several written by electricians. If you can't find what you're looking for among my other articles, leave a comment and I'll consider addressing your question in future articles; the whole series is a work in progress. Electricians and TrigonometryAngle Finders on AmazonTwo examples of angle finders from Amazon are shown below. One is considerably cheaper, but the other is more accurate and easier to use. Do work, just make sure that the one you choose has a magnet on at least one side to keep it on the tube. This article is accurate and true to the best author's knowledge. Content is for informational or entertainment only and does not replace personal counseling or professional advice in business, financial, legal or technical matters. Questions and AnswersQuestionmik: How can I understand how to match 90 degree bends to a different size pipe? Answer: The only way to do this is to concentric bends, where the curves are equal, not concentric. The problem is that the radius of the bend varies by the size of the pipe so instead of using a bender to determine the radius it must meet that largest channel. Question: Is there a formula for concentric conjunctation bending? Answer: Not in the sense of the formulas given here. But the article on concentric bending does not show the mathematics used in the calculations: Emt Electric duct pipe bending instructions for making concentric Bends.Question: I have 10 piece 3/4 aluminum electric channel. I need 80 in the middle, 90° at each end. What is the loss of length in a 90° bend? Answer: Assuming your brand bender uses a minimum radius of bends (most do) the NEC shows that this number is 4.5 3/4 tube. The length of the bend is then 4.5, but the length of the pipe used to bend is 3.14* 4.5/2, or 7. The loss is then 7-4.5 or 2.5. This all assumes that the tube is a pencil line, not a 3-dimensional object, which we know is not true. You check in practice, but I suspect that the NEC indicator is inside the bend, which means that the loss is 3/4 less than what is calculated: the length of the completed bend is 3/4 more than the minimum radius. Why not use the star as a drunk rather than an arrow? Question: I try to bend the 10'stick 4 EMT to the center line of the channel so I can get equal lengths at both ends. Is there a formula for that? Answer: There is no real formula, but it can be calculated with fair accuracy. Multiply the bend radius you want to do by 6.28, then by degrees, bend and share by 360. Tie two more, measure the center of the pipe so far then set that sign to the front edge of the bending shoe. The center of the curve should be very close to the center of the pipe. If you use the NEC codebook to find your bend with a minimum radius, remember that the number given there is the center of the pipe, not the edge, and according to the correct one. Question: What is formula 2 45 = 90? How to measure and position bend signs of it? Answer: The instructions can be found here: What is the formula that shows when to start your kick 90 and lose? Answer: Given that 90 is already bent, the same calculations as the shift provides a pretty close answer. Referring to the article charts, C length A is divided by angle si si si D. Measurements are taken from the back of 90. The figures are not accurate because of the difference in pipe thickness, but is quite close to contraction can be calculated as C -B, B = cosine d* C. But it's all thought that 90 already bent. I suspect you will ask where to put that 90 as well, and it becomes a very different proposition because different pipes have a different radius of bend. The best that could realistically be done is an indicator where 90 should be bent as if there were no kick, then add a shrinking value to that number. Once bent, treat it as if it were a shift, using the same times as you would be bending the shift. Again, it is not accurate, but may be close enough to the practical application of the field. Question: how do I figure out the evolution of a 15 degree saddle bend when the center line radius is 25? I need to know how to figure this out. Answer: I'm not positive about what you mean by a centerline radius of 25, but here's a link to the article bending both 3 and 4 point saddles: What exact measurements of the triangle bent wires pipes? Answer: If you ask what the angles are, they can be something that adds up to 180 degrees. Remember, these are interior corners. Question: How do I determine the radial length of the deflection channel or the electrical pipe for the deflection? Answer: Minimums are the function of bender used and cannot Reduced. The maximums are as high as you want. I once made a 180-degree bend that was almost 100 meters across. It was more straightforward than a bend!© 2010 Dan HarmonCommentsDan Harmon (author) in Boise, Idaho on May 18, 2020:@Andrew: Sorry, there is no link to give on paper. But you can block it and print it like that. Okonkwo Andrew on May 17, 2020:It's great and wow... I like it very educational. Okonkwo Andrew on May 17, 2020:I I am so pleased and happy when I found this site or sincerity, I was delighted. Please, sir, could you do me a favor by providing a link where I can print and have your lessons on paper. I want to learn more to find out more. ThanksAndrewWoody nyc lu 3 December 15, 2019: Great info is going to tell a lot of trainees to do this site tough teaching young boysNate on May 04, 2019:Who needs memory if you have Dan Harmon at dengarden lol. I'm kidding. Im 3rd yr electrician and this website is my go for bending my entire apprenticeship. Most of all are converted to memory. But I still find myself coming back. Thanks for this easy to understand site. He helped me succeed in my career making me more valuable and successful in my life. Dan Harmon (author) from Boise, Idaho on July 15, 2018:@ninmmkmfdmNot sure I understand. Measure the channel and make the same turns. You can even measure the protractor.ninmmkmfdm@aol.com on July 15, 2018: How do I figure out bends and degrees on an existing channel to match the unremoving emt or stiff? Otis Mullins on June 17, 2018:Excellent info. So glad I found this center. Thank you. Your center is my friend! 30, 2017:Great! Stuff. I'm going to start a new job tomorrow with a lot of plumbing. I don't have much experience with it under my belt, so feeding off your hub is very nutritious. I'm grateful to you and your work here in Canada. Now I'm more confident that I'm more competent in my work. The information provided here is gold for each electrician. I recommend it to any electrician on the ground who tries to either learn, or just improve their skills and efficiency. Jim on April 07, 2017:Learn'd more 3 days will learn your post than 3 weeks in several books.100% THANKS! Scott on February 26, 2017:Amazing. Thank you! I brought memories. It's useful for that!!! Dan Harmon (author) from Boise, Idaho on November 15, 2016:Thank you, Jeffery. It's always nice to hear that my writing has been valuable. Jeffery K Murray on November 14, 2016:I enjoyed your article, especially in the comments. I am in EC Cook and DuPage counties in Illinois. All wires must be metal racing, so bending the channel is one of the first things any apprentice learns. My bachelor's degree is applied mathematics and I often make the mistake of assuming that my new hires are equally familiar with trigonometry. I found your explanations calculations easy to follow and I sent links to your articles to all my employees. I'm sure they'll find them helpful. Dan Harmon (author) from Boise, Idaho on April 8, 2016: If you want to get 22 degrees 2 1/8, the distance between the characters is 4 1/4 (2 1/8 X 2). There is no deductible, except when we make a 90 degree hand bender. There will be some contraction that can be found in the math formula Shrink=4.25-4.25*cos(22) = 0.31 for you. Adam Mygrants on April 08, 2016: Point out to me how we unravel the curve. I thought 5 1 / 8 drop 22° bends 2 1 / 8 ... If it's right, don't write it down when you do ... but I'm not sure what to add into the damage bend. (3/4 channel). This is my first non-90 curve, and I'm winged in seconds. I'd watch 90 on the right, but I need a bat at starting height. Ralph Schwartz from Idaho Falls, Idaho on March 31, 2016: Excellent/even us amateurs may get some knowledge of it. SPARKY March 04, 2016: By the time you've done reading this, you're a better Electrician. Good to write it down!!! Asher Socrates in Los Angeles, CA on February 21, 2016: This is a very detailed and excellent sign up! I've always wondered how some of these tubes were bent so accurately. It was the formula of all this time. You're learning something new every day! Thank you JD Curtin from Brighton, Colorado December 02, 2015:Wow this is great! My husband is an electrician and he has tried to show me how he calculates all this, but it's just been outside of me. Your easy to follow explanations, pictures and images really helped make sense. Thank you: o)Dan Harmon (author) from Boise, Idaho, October 14, 2015: Good for you, Jane. I hope the information has helped you. Thanks for the comment – it's nice to know I was able to be helpful. January 14, 2015:Thank you! I've taught it in class and doubted I would ever approach the channel bending with trigonometry but after some difficulty bending the big channel today here I am!argin on July 14, 2015:How Do I Know Different Take Off Rate Pipe Using TangentDan Harmon (author) boise, Idaho on April 13, 2015:LOL – that's how it goes, John. I've never had to build bizarre shifts into a cable tray, but have made a lot of big pipe and have more than a few coming back later and asking if I could teach them how to avoid costly mistakes. Yes, the word (mathematics) scares a lot of people out, but it really isn't hard. John A. Joslin on April 13, 2015:Interesting and very valuable information here!! I often use trig features to design pipe work & I've pretty lost otherwise. By contrast, a few months ago my partner warned me that he was definitely not going to have anything with the cable tray shift we were about to build if I wasn't going to use any math along the way. Then, sez I,... If you want to design a thing & tell me what to do ... is it. Looks like you're different/ better continue as I do. I'm ready to learn something new. A long pause ensued. And it took a little longer... He finally decided to weather the terrible process of my math use, and sunnuva'gun, if he didn't ask me later if I would go over some fine points with him, etc. of course it was all about basic trig, which many learned to fear way back, than in some classroom or other. - Joslin (Detroit)Dan Harmon (author) from Boise, Idaho 02, 2015: Well, that made sense to me, too. And thank you for the compliment; If you're happy with the hub it must be of some use to you. It's always good to hear that. Don February 02, 2015: Thanks for the explanation, this makes sense. And yes this is an example of ugly's from the 2011 edition of pg. 160 (they also point to the wrong page, which brings you hand signals, ha, ha). I'm glad I found your blog! Dan Harmon (author) from Boise, Idaho in 2015. I can only guess, but I strongly suspect it is, because the pipe is three-dimensional, not two-dimensional. This means that 1.25 inches is pretty close to the side of the OD 2 tube; they are probably measuring the minimum radius in the middle of the pipe instead of choosing either inside or outside it. While it doesn't usually matter to a smaller channel, it certainly needs to be in the game of bigger stuff. Or if the radius is looked at in the middle, adding that 1.25 leads to a measurement outward. If you're doing another pipe to fit onto the rack next to the 2 pipe, it must have a radius of that figure plus distance tubes (plus half it's own diameter, of course). Don february 02, 2015: Hey Dan, I'm curious why you should add 1.25 to set a minimum radius of 2 channel (as used for an ugly multi-shot: 90 degree bending exampleDan Harmon (author) in Boise, Idaho on January 30, 2015: Thank you, Steven. Somehow I missed this comment, but you performed nicely. Steven on January 30, 2015: Mack, What you're referring to is called a parallel shift. You'd make a mark on your first tot where the launch silencer starts. The character of your second tube will be moved based on the distance between your pipes and the diameter of your other pipe. The formula is (distance pipe + diameter tube) x tan (half displacement). For example, if you had a left-to-right, 1/2 pipe and 3/4 pipe, a shift to your 1/2 starts at 24 and you were bending 30 degrees bends to 6 offset, and you wanted 1 between the tubes, you'd do the following characters by measuring the bottom up. 1/2 pipe Mark 1 24, Mark 2 36 (shift height, which is a 6 x shift factor, which is a cosecant bending angle that is csc(30), which is 2, for that purpose between 12 marks) Now, 3/4 tube, we take the OD tube, which we say is inch and eighth, and we add this distance we want between the pipes that are 1. That gives us 2.125. Now we have it's 2,125 by tangens half the displacement angle, which happens to be 30 degrees, so the side is 15 degrees. So, we have 2.125 x tan (15) or 2.125 x 0.268, which gives us 0.5695. To hide it from inches, we multiplied to 16, which gives us 9,122, so we now know 0.5695 is very close to 9/16. Finally, on September 16, 2016, we will subtract it from 24 to get 23 and 7/16. This is our first sign on the 3/4 tube. Our second mark is 120 35 and 7/16. It's much easier to understand if you control your pipes first, so you can visualize how your characters move with each subsequent pipe. Joys can be drawn from unfinished drywall.metoo on October 02, 2014: shrink = hypotenuse (offset bend marks) - because angle X hypotenuseDan Harmon (author) boise, Idaho on September 15, 2014: It depends on what you do. Shrinkage, if examples are given in a 3-point ssaduli, are given in the section on examples. The contraction of the offset is in the first chart b and c. Jose on September 15, 2014: How to find shrinkDan Harmon (author) from Boise, Idaho on September 10, 2014:1 shared in sine angle. Jose on September 10, 2014: How to find a repeater at degreeDan Harmon (author) from Boise, Idaho on February 25, 2014: It would depend on the desired angle of ascent and which angle center bender to be bent at. Look ... full instructions on saddles. Michael bryant on February 25, 2014: If bending 3 bend the saddle, my sign A is 30 inches and im crossing a 3 inch object then what are my measurements of the sign B and CDan Harmon (author) Boise, Idaho on February 23, 2014:10 a.m. degrees increase in inches = 0.08. 60 degree increase per inch = 0.571/(sin(10))-1/(tan(10))=.0844 example shows this. Kelly on February 23, 2014: What is shrinking one inch of elevation to 10 and 60 degree bends? Dan Harmon (author) of Boise, Idaho on December 14, 2013: Not bad, although some additions need to be made. The 2.5 inch increase applies only to the 22/45 saddle, not 10/22 or 30/60 degrees in the saddle. The B bend is not the same moment as the bender, but in the middle of the selected degree in the middle of the ding. A and C bends must be made to curl the opposite. And when the curve sequence is A, B, C, the bender has to be reversed after the first turn - i usually bend B,A,C and turn the bend back after the A-turn. This is also covered by Article McKee December 14, 2013: Contraction of inches rising : 22 degrees - 3/16 30 degrees - 1/445 degrees - 3/83 point saddle: Mark center line A after adding contraction- first bendThen mark line B after adding 2.5 inches per rising mid-to-late line. Line C shall then be marked using the same measurement as row B, but indicate on the opposite side of centre line A. Tnen bend the channel order A, B, C.Multipliers :10 degrees - 6.022 degrees - 2,630 degrees - 2,045 degrees - 1,460 degrees - Harmon (author) in Boise, Idaho on October 14, 2013: Thanks Ron. I've done a lot of great EMT (rarely rigid) and that's what prompted this article. Bugs do not get very expensive very quickly when you are dealing with 4 channel, either rigid or EMT. Now is not the time to make assumptions and experiment. Ron Stewart from Knoxville, Tennessee on October 13, 2013:I electrical works for about 35 years. Started wiring houses, then passed on to schools, hospitals, grocery stores and now working as a lineman at utility substations. I really enjoy the information you have shared here and find it not only useful but needed to do a professional job. Working with a large rigid channel with a false bend is not easy to fix, and also expensive. Dan Harmon (author) in Boise, Idaho on September 23, 2013: Knowing the electrical codes is huge. You may not need to know how to bend the channel, depending on your choice of fields. Wires in homes, for example, have little or no channel bending. It is important to learn to read drawings and sometimes diagrams. Depending on the country you live in, you may be required to go to school to learn a lot about it, as well as the work of an intern studying trade. Check your state and local laws for what he needs to be an electrician. Eddie on September 22, 2013:I I want to be an electrician. In my understanding I'm going to learn about electric tools, wiring, how to wire up engines, PLC n control, electrical distribution, electrical codes, drawings diagrams, electronic component circuits, little construction, and how to bend the channel. Is there anything else I should learn and that's the hardest thing to learn. I've heard ppl say that ac theory n channel bending is a slut. Dan Harmon (author) of Boise, Idaho on May 3, 2013: You're probably right that we use 22.5 degrees because it's 1/4 of 90. Or 1/2 of 45 (which in turn is half 90), take your choice. Interestingly, you use 60 shared angel, and it doesn't work quite well. Within 1/8th inch is almost always good enough; if you need to be closer than that you probably have to tweak it some anyway.khaki ninja on May 03, 2013:@wilderness, the angle is 22.5 is because it is 1/4th 90. Making concentric curves easier. I also wanted to add, as a general rule, I find that if you need to make an occasional degree shift (like 17°), your multiple times the degree goes to 60. So, 60\17 = 3.5. I applied it to bend the stiff ocal, and it got me pretty darn close. During the 1/8th.david on March 09, 2013:I believe what jerome meant to take up is the amount that you loosen your entire length pipe by bending 90. (not to confuse the contraction you get with the shift) it's helpful to know if you want to cut and pipe the pipe before bending it. Dan Harmon (author) in Boise, Idaho on November 19, 2012:@Mike: yes to a repeater of 30 degrees to offset 2, that's what's on the chart Have you picked up an error elsewhere in the article that I missed when correcting? You're right that 22 degrees is about 2.4, but the sign of an arm bender is 22.5 degrees (for some unknown reason), which makes the repeater 2.6.mike on November 19, 2012: Your multiple of 6 is wrong when you use a 30 degree angle on your mutiplier at 2. 22 degrees is about 2.4Dan Harmon (author) in Boise, Idaho on October 14, 2012:LOL There's probably about as much memory aids as there are people. I'd have more trouble remembering Sohcahtoa than I would because of the formulas! History buff could use it, though - thanks tip.ttx336 on October 13, 2012:memory help: Chief Sohcahtoa ... S = O/ H C = A/H T = O/Aprobably works for me because I'm Cherokee ;-)Dan Harmon (author) in Boise, Idaho on June 05, 2012: Thank you, cablemanagements. This bending tube is actually a practical use of trigonometry not commonly known. I just got curious one day and put some of my college math to work - it's been helpful ever since. Dan Harmon (author) in Boise, Idaho on May 09, 2012: You're more than welcome, and thanks for the comment. This is always appreciated.shiloh Morgan on May 09, 2012: Very intense information. It takes days to understand and experience I'm sure. But thanks to all the sameDan Harmon (author) in Boise, Idaho on May 01, 2012: That's my guess, as I said - you just over-bent it just a little bit. And you think it was the accounts of the polluter back being quite likely correct - it's terribly easy to do, especially with a small amount of bends. Looks like you're doing great. A little more experience uses that bender and you can pro! Croakerchoker on May 01, 2012: Many thanks for the quick response and long information! I use a bender standing upright it's a stand and the little plate thing he slips along his is bent. There's a little roofer in our store that I use to find corners. I think I over bent the pipe when I was actually trying to compensate for the spring effect when released. I think these benders should be done more accurately, as I said the thing that keeps the pipe shoe and shoe is too much to play for and ends up bending the pipe where you didn't expect. I'm trying to use these formulas and keep my calculator in my car. We just got this bender about 6 months ago and I'm always the one running a shop to bend the pipe, When I get it down to the science that I know it is, I'm b happy :)I'm still having a little trouble understanding the calculations probably because when in high school I finished all my math early and picked against a stripe so I could talk to all the babes in the business of math, now see where I am! HahahahahDan Harmon (author) in Boise, Idaho on April 30, 2012:@ Brian: If you have a 6.5 shift with marks of 28.75 you have a 13 degree bend. It doesn't matter what size of the pipe it is, nor what bender it is - trig works any and all size or bender.6.5/28.75=.226 This is the sy. Inverse 0.226 = 13 degreesIt is not difficult to make large benders. I also use a Greenlee bender with a larger pipe and it always is. Some thoughts here: I always use a bender to stand up, which requires someone to keep it from falling. This leaves the pipe horizontal, with the end bent upwards. It is important that the pipe is really horizontal, 0 degrees; control the level. I do not remember 3 tube, but often different shoe works very well set under the end of the channel leveled. The protractors are then used to measure the bend produced; I overbend about 2 degrees, relax the pressure and re-check. It is very important to get two marks in exactly the same place as bender, and it is not always easy for a big pipe. The hook that the pipe fits through sometimes do not want to come all the way back to the shoe, the lower shoe may not be fully back, etc. and all these things need to be carefully checked. Finally, it's very easy to over or down the bend tube ten degrees. The 3 degree variance you want is 30%, while you make a 30 degree bend and go above 3 degrees, which is only 10%. Many protractors are very difficult to read exactly what you want, and 1 or 2 degrees out is very common. You're on the right track here, and your math is right - you even caught that repeater at 10 degrees not 6, but actually 5.75 (6 is an easy-to-work figure that's easy to work with). I'm sure the problem is the bending process - the wrong angle (do you use a bender it's a side and measuring rod that comes out of the show bend?), notes a little out (although 10 off would be creepy!), inaccurate or poorly placed protractor, etc. every job I've been bending a big pipe is with a greenlee bender, but they've probably made improvements over the old models I've used. Brian on April 30, 2012: Sorry I left out a few words, can be confusing so.. After I bent the first 22, then I tried 10 degrees, but it seems the repeater (6) is too big. Then I tried 5.75 intervals at 28.75 and came out with a 6.5 shiftSo ... Sine(10)=.1746.5/.174= 37I no room for my bends 37 as I said they were 28.75. My boss said there's no formula, but I know it is. Perhaps greenlee are the repeaters used for certain benders. I think my almost perfect tube can get outfitted with a nice new coupling lol :) At least it wasn't too small. Brian April 30, 2012:I have tried to use these calculations to restore the results I had at work today. I needed 5-5 1/2 shift 3 inch channel. I tried 22 degrees as close as possible, it was over 9 inches. I previously tried my repeater 6, and had failed, today I tried 5.75 with a spacing of 28.75. I'm resulting in a 6.5 shift. Please check if my calculations are off or if I have something missing, I have never taken trig but calculator did and I can restore my results on paper with it, but the repeaters do not seem to work.. Dan Harmon (author) in Boise, Idaho on March 06, 2012:? I'm not sure what you're referring to - the down numbers are different for each size channel. Although it is stamped with every bender I have ever seen, as you say. John on March 06, 2012:off 6 inches for 90. If your using the hand, dunno why do you cuz it looks like a mess, but it is stamped on the side. Dan Harmon (author) of Boise, Idaho on November 28, 2011:I'm not sure I'm understanding your question, but let me try. Bending shifts and such requires the use of decimals to make calculations (or at least it's much easier in that way), but then use the result tape to measure the use of fractions. My solution was to remember the decimal fractions equivalents of every 1/8 inch. 1/8=.125, 2/8 (or 1/4)=.25, 3/8=.375 and so on. You can find them in a calculator by dividing 1 to 8 for example, which is 1/8 or 0.125.If the calculated result does not match one of the remembered eighth inch numbers (and it very rarely does) I will just choose the nearest one. I never considered it necessary to measure closer than 1/8 field so it works well there. I understand that in a class that may not be close enough, and you could go the extra distance and remember every 1/16, but it's not usually a game exactly, either. In the final analysis, you always need to round and simply select the nearest fraction equal to the calculated decimal number. If I've misunderstood or just didn't come up with anything that can be used, please let me know and I'll try again.scott on November 28, 2011:Going to a school channel bending the union and learning to shrink and get. I just passed ac theory and im having trouble exchanging decimal places and fractions. They say that all the time with my answers. But I know I wouldn't use them in the field. I only bent the channel with an eye and a yardstick. Would you give me some advice? Dan Harmon (author) of Boise, Idaho on October 03, 2011:I'm not familiar with that term - it's not used in my area. Are you referring to the 90th? It would depend on the intoxication used. None of the multiples used in netting depends on the material, nor do they depend on the size of the channel. I'm sorry about that. Many local terms are just this - local, and not used in state wide.jerome October 03, 2011: hey, which is taken rigid channel 3/4, 1" 1 1/2, 2" and 3" asap need information for a fast rigid pipe not imcDan Harmon (author) boise, Idaho on December 31, 2010: The current is indeed one of the most useful corners and can save additional turns if done properly. Hard to describe, but easily learned the biggest problem is just how to measure the necessary shift. And yes, math and related topics (reading tape measure perhaps) are very important and no one that not training in mathematics at all even simple addition or subtraction of fractional figures can be difficult. As you say, start easy and go from there and math in this hub is not where to start. Learn how to use off 90 and worry about trigonometry with big channel shifts later. Michael Willis from Arkansas on December 31, 2010: One of the hardest things to teach beginners can be channel bending when they don't understand math sometimes. I always start with the main curves. After they've acquired them, I'll show them more bending techniques and formulas. The one I use all the time is the rolling shift. Dan Harmon (author) in Boise, Idaho on November 03, 2010:You are very welcome. I actually enjoy sharing my knowledge and work tips with others. I'm glad you find it useful. ABANG RAYMOND OJONG on November 14, 2010:Thanks for sharing knowledge and teaching othersDan Harmon (author) from Boise, Idaho on October 14, 2010: You're more than welcome. It is a pleasure to share what I have learned over the years, and I will always be glad when someone finds it useful. How are you doing? October 13, 2010: Thank you so much for sharing your knowledge. It's very appreciated. Dan Harmon (author) of Boise, Idaho on October 05, 2010:Indeed it is, although few electricians understand it or use it. Most of the time mathematics is built on the tools we use, but as I'm sure you understand, mathematics is behind a lot of things that we take for granted. You're right - it can help students understand the importance of learning and understanding math - it really is a exercise in everyday life. Julie Burke from Alaska on October 04, 2010:I did not know that trig is appropriate to bend the channel! I'm going to use this new message when I'm teaching my reluctant math students. Dan Harmon (author) in Boise, Idaho on August 21, 2010:Thanks for the comment and compliment. I'm glad you liked it - it's information that some electricians know something about, but can definitely learn. SEOshortcuts from San Francisco CA on August 21, 2010:Holy moly – you are an artist of this hub! Great content links, very appropriate to watch, and as a former electrician, good information to boot! Boot!