Line focus principle x-ray formula chart pdf

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Because we often have control over magnification in X-ray examinations, it is important to understand the distances that control magnification In the figure below we define the source-object distance (SOD) and the source-image distance (SID) (note that sometimes you can² see that others call it source-detector distance (SDD), refers to the same distance). In the figure below you can see that we can make a triangle with the size of object is the SOD, and another triangle with the size of image is the SID. As shown, these triangles are similar triangles. The SID Ã is proportional to the size the , in the same way that the SOD Ã is proportional to the size of object. Thus, the ratio of the sides Ã is the same, i.e. ³ Image Size/Object Size = SID/SOD. You can² see that this Ã is our definition of magnification, then magnification=SID/SOD. . We can solve this relationship for other variables as well. More¹ we typically want to solve for the size of image or the size of object. For example, if you are doing a chest X-ray and real object Ã9long 10 mm, which will be its length in the plane of image if the SOD Ã¢ of 170 cm and the SID Ã¢ of 180 cm? The size of image= (SID/SOD) *Object size, which will be (180/170) *10 = 10.6mm. From this example you can see that typically the chest X-ray will have a relatively small magnification and the size of object in image plane will be only slightly larger¹ than the actual size. Another example could be an interventional angiography scenario where the SOD Ã950cm and the SOD Ã9100cm, with the same length of 10mm object. In this case the size of image= (SID/SOD) *Object dimension, which (100/50) *10 = 20mm. From this example it can be seen that typically the chest radiography have a relatively small magnification and the size of the object in the plan of the image will be significantly larger than the Della size of the object. At high level these clinical X-ray scenarios have a low magnification as it is typically desirable to have the detector close enough to the patient: Thoracic X-ray Abdominal Mammography On the other hand these clinical scenarios typically have a high magnification: Interventional X-ray Angiography / Catheterization Laboratories Cardiac Enlargement M Mammography Obviously, you can also fix for the size of the object as well as if you know the size of the image. It’s just multiplying by the inverse of the magnification so you can find the true length of the object when measured on the plane of the image. As mentioned above, these presuppose that the object is on a plane parallel to the detector. So far we’ve assumed that the object at the center of the X-ray field (i.e. it’s on the iso ray) is now something that sits right at the ISO ray. If instead of the object right on the iso ray is moved a little higher, would the magnification change or will it remain the same? The answer is that as long as the orientation of this object remains the same and the distance, i.e. the source-to-object distance (SOD) remains the same, the magnification will also remain the same. As shown in the figure above, the dimensions of two images are the same even if the object is moved by the iso ray. The size of the object projected on the plane of the image will not be changed if the object is moved but is still on the same plane. So, if something is moved up or down, it is not as important as if it is moved to/away from the source, or if it is rotated. We will then discuss the effect of rotation on X-ray radiography (i.e. X-ray projection). Is the position of the object the only important factor in image projection? Finally, we wanted to stress that, in addition to the es es ,erid a elaV .X iggar a aifargoidar anu us ottepsa'l etnemetrof onazneulfni chc irtemarap irtla onos ic ,enoisnacs id ovisiv opmac led eb dluow tI ?smetsys yhpargoidar no stops lacof elpitlum ereht era yhW .tops lacof yar-x eht fo tceffe eht no sucof lliw ew ereh oS .noituloser egami fo tnemerusaem ro noitacifitnauq eht dna ,rotceted latigid a ot eud stimil noituloser eht sessucsid hcihw tsop etarapes a evah eW .ssenprahsnu lacirtemoeg sa ot derrefer semitemos si sihT .tops lacof eht ot eud si taht hpargoidar yar-x na ni gnirrulb eht ssucsid lliw ew ereH .ssenprahs egami eht si noitaredisnoc tnatropmi na yhpargoidaR nI gnirrulB topS lacoF .TC ekilnu ,stcejbo eht fo noitator eht no tnedneped ylgnorts osla era snoitcejorp ehT)DOS(/)DIS(sa detaluclac eb nac noitacifingam ehT .)ezis tcejbo(/)ezis egami(eht fo oitar eht sa denifed si noitacifingam ehT stnioP emoH-ekaT daR .llaw eht no noitcejorp eht stceffa ti woh ees ot sregnif ruoy fo noitatneiro dna noitisop eht egnahc dna llaw eht no swodahs nwo ruoy gnikam yb emoh ta ÂÂÃ¢ydutsÂÂÂ¢ ot eerf leef ,oS .sregnif ruoy htiw llaw eht no steppup wodahs gnikam fo tesno eht ta denoitnem ew taht elpmaxe eht ot ralimis era stceffe esehT .steffe noitator dna noitacifingam gnidulcni yhpargoidar yar-x ni stceffe cirtemoeg dessucsid evah ew edulcnoc oT .erusopxe yar-x hcae rof pu gnittes era uoy sa dnim ni steffe cirtemoeg eseht peek ot tnatropmi si ti os yhpargoidar yar-x fo sesac esu ynam era erehT .snoitatneiro tnereffid morf stnemerusaem ynam era ereht esuaceb detanimile eb nac stcafitra noitator eseht yhpargoidar yar-x fo daetsni desu si TC ekil ytiladom cihpargomot a fI .noitator eht fo noitcerid eht no gnidneped yltnereffid yrev ro emas eht rehtie tcejorp dluoc yeht ,detator era stcejbo owt fi erugif eht morf ees nac uoy sA .gnignellahc erom noitaterpretni egami sekam stcejbo eht fo noitator eht no hpargoidar eht fo ecnedneped eht ,yllanoitiddA .serutcurts tsartnoc wol gnihsiugnitsid ytluciffid dna ymotana gnippalrevo gnidulcni tluciffid shpargoidar gnidaer ekam hcihw srotcaf lareves era erehT .snoitcejorp tnereffid yltnacifingis eb lliw ereht detator if we could use a focal point for all the anatomies, unfortunately, we would have to choose the best focal point to use for any x-ray exposure. The reason is that there are always compromises in physical systems and while ÂÂwe would like the focal point to be as small as possible¹ for clear (sharp) images there is also the need to obtain enough X-rays through the patient to obtain correct exposure to the detector. The width of the effective focal area Ã is different depending on the angle of the anode as shown in this figure. But if the focal point is very small, ÂÂ Ã is possible that ÂÂwe do not have enough X-rays to cross the patient, and so ÂÂ get a good picture. So, for every anatomy and clinical indication (that's what we're trying to see in the image) there will be an optimum focal point. That's why© Ã© Ã is important to be aware of the compromise you are making when selecting the focal point for a given exposure. In both cases (small or large point), we are using what Ã is called the principle Ã½Â ÂLine FocusÂÂ, which we discuss in more detail¹ later. But briefly here: electrons are emitted from the cathode and accidents on the anode over a given region and then the outgoing X-rays have a narrower width¹ based on the angle of the anode (target). The patient will see a smaller cross section¹ here and this helps because we want to spread the heat on the target so ÂÂ melt the target. Rad Take Home Point We would like the effective point to be small, but if ÂÂwe do not get enough X-ray flow to cross the patient, thenÂÂwe will have to use a larger point¹. A perfect world (this is an ideal point X-ray source) Imagine first an ideal point source, even if Â we can Â actually make it. In this case, our X-rays come from one place. And then imagine an object in the body that we would like to photograph as Who. Since our X-rays travel in a straight line if the edge of the object is well defined, the edge of the image will also be emoH-ekaT0daR.arbmu, het demerit si tcjbo, het dnib, dickcolb, ylluf, si under noiger, hta dna, maib yar-x, ehf arbmunep, dellaclacipyt, si noiger, gnirlb tahT.egde prahs, enecin gnieb, nahrthegde eht noitisnart laudarg a si erehterehtneidarg a eb gniog sRaAAAAATTATATATTTT ucco llew under gnirrulb erom hh, siSS tops for lacof eht regral ehT .tops lacof eht fusIsHet nopu sdnepped tceffe gnirrulb siht tops lacof eht fo noiger elohh hmurf gnimoc era tneitap ehhguerht gnissap syar-x ehecniS. Noitisnart prahs, Naht Rehtar, Noitisnart, Lauderg, A, A, Llew, Egami, Aht Esuaceb, Psirc, Yeltcefrep, Up, Gnyog, TaAaAa, Nsei Egde, Taht, Na Egami, Ot Tnaw, Ew, Fe, Oy, Swohs, HT., Mottop, Eht, Eht. Emad relaxed us... A link to I smell neercs... 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Like the object the object ot tnortcele erot erom Elbane ot ot ot ot ot elpicnirp sucof eht eht eht eht eht ekilt lufesu rehtona he is .) edona eht tlem ot ton to os(edona eht fo sarae tsom nI .)ffo gniliob era snortcele eht erehw(tnemalif eht fo ezis eht yb ylegral denimreted si maeb nortcele eht fo ezis eht erehw metsys TC ro yar-x na no stops lacof lacisyhp elpitlum yllacipyt era ereht evoba dessucsid sA .)pVk eht . E.I(laitnettop ebut eht yb eht ot ot ot ehtac ehtac morp dellup dna edohtac a morf ffo delitcele eht.) Last yvaeh otni Nn detalecca snortcele .i (Noita rof sserh sserh sserh sserh sser-x Lacisyhp eht EHT EVCSED ew Erehw tsop tsop tarapepes EW EW ,Ebut Yar-x Lacidem Detaregeneg Era Sir-x woh Htiw Railaf ton ro weiver a deen uoy fi . 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The purpose of the focus principle of the Ã¢ line is to allow a larger exposure (i.e. ³ pi¹ x-rays) while having a small focal. In the following figure you can see that the size of the actual focal point Ã is controlled by the size of the electron beam coming from the cathode and the target angle. In the following figure you can see that the width of the electron beam may be greater than the width of the X-ray. Remember that the electrons come from a two-dimensional surface and in this figure, we only show a cut through the tube where the electrons come from a line. The other dimension that we can think of as being in the screen. In that dimension the focus principle of the line has no impact and the size of the electron radius Ã is equal to the size of the X-ray radius. Therefore, if this figure shows the length of the focal point, the other size in the Ã screen is the width of the focal point. The main point here is that the length of the actual focal point and the actual size of the point while traveling through the patient and Ã is incident on the detector are different and therefore an effective length greater puÃ² can be used to spread the heat of the electron beam over a larger surface¹. Equation of the line focus principle. The effective focal point and effective focal point are related by the line focus principle equation: effective spot = sin (theta)*real point. If we remember from the geometry of middle/high schools that the definition of sin Ã is the opposite side to the hypotenuse. Then the sin of the target angle Ã is equal to the actual point divided by the real point. If we want to solve the effective point, we see that Ã is the real point multiplied by the sin of the target angle. In practice the corners of the tube are generally 6 and 20 degrees for an X-ray tube. Then, the breast of Theta Ã is between 0.1 and 0.34. CiÃ² means the maximum difference between the length of the actual focal point and the length of the actual focal point Having a factor of 0.1 (i.e. the actual focal point is 10 times more than the actual focal point). Then for the tubes with the most large corners the difference is about 1/3 (that is, the actual focal point is 3 times the size of the actual focal point). What is the loading gain of the tube and how is it related to the destination angle? Another term used to refer to this same effect is the load gain. The load gain quantifies how much more energy can be deposited in the tube thanks to the principle of focusing the line. In the figure below you can see that we begin with the same identical equation. The only difference is that now we solve the effective size of the spot divided by the effective size of the spot, which quantifies the factor of spreading the heat or load of the tube activated by the focus principle of the line. If we solve the load gain we find that it is equal to 1 on the sin of the destination angle. This is only another way of seeing the same effect and from the range of target corners that we calculated above reminds that the sin of the target corner varied from 0.1 to 0.34. Therefore, then 1 on the breast of the Objective angle Varier's 3 to 10. In this way, the principle of focusing the line allows an additional load of the tube (i.e. greater heat via but or kvp most high) of a factor from 3 to 10 depending on the destination angle. This ability to deposit heat means that we can get more flow without melt the tube. A disadvantage or a negative effect of having very low corners is something called the Heel effect or the Heal effect of the anode. It worsens with more small angles, because the smallest is the destination angle, more long is the path of the destination material that must be crossed on the anode side. This is discussed more in detail in a separate post that we have on the heel effect. As mentioned there are multiple focal points on most systems that allow you to select the best focal point for a given clinical task. Each of the focal points on the system will advantage from the line focus principle in the same becauseÃ© the target angle Ãsame for multiple focal points. In clinical exposures, when limb (e.g. hand or foot) is imaged, it is recommended to use a small focal point, as thereÃ² can be as high as possible and does not normally require very high exposure. On other hand if you need X-rays to get more attenuating anatomy¹ like a large abdomen, you will need to use the largest focal point¹. So, depending on the clinical task, you will use the fact that there are several cathodes on the system to generate the best images for your patients. Rad Take Home Points: The principle of line focus allows a higher valvular load¹ (i.e., greater mA/kVp) while maintaining a small focal point size. The load factor for X-ray tubes describes how much more¹ heat can be deposited due to the line focus principle and ranges from 3 to 10 for X-ray tubes.

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