Strings and tuning - ten years sleeping
Posted by ivanartesi - 2012/02/28 13:38

Hi everyone, my name is Iván Artesi from Pinamar, Argentina, and i'm glad of having found this page!!!..
At this moment i'm trying, with a friend of mine, to restore a Cucculelli 11 string alto-guitar.
When i've bought it, it came with no tuners and no strings.
I've solved the tuners problem, but i'm not shure about wich strings i should put, specially the low ones.
Can I use the six regular guitar string for the higher part and then 6th string repeted 5 times for the lower part? or should i buy specially made string.
In this case, i would like the know the diameters and the most utilized brands.

Hope hearing news soon!
Iván Artesi
ivanartesi@hotmail.com

Thanks for sharing data!

==========

Re:Strings and tuning - ten years sleeping
Posted by Glen - 2012/02/28 16:24

You use a regular 6-string set for the first six strings and a 6th string from a regular set for all the lower basses. The successively longer string length adds the extra tension required to allow lower and lower bass notes, so you don't need to get thicker and thicker strings.

I order strings from stringsbymail.com

I use D'Addario normal tension sets. You can order the 6th string individually for the extra bass strings. Here is the link to stringsbymail D'Addario normal tension 6th string.

http://www.stringsbymail.com/store/daddario-pro-arte-j4506-6th-string-e-normal-tension-67.html

Glen

==========

Re:Strings and tuning - ten years sleeping
Posted by ivanartesi - 2012/02/29 01:27

Thank you Glen!
you've helped me a lot!

==========

Re:Strings and tuning - ten years sleeping
Posted by Sten - 2012/02/29 06:02

Welcome Iván!

I agree with Glen concerning the strings.
Good luck with your fine alto guitar!

Best regards,
Sten

==========

Re:Strings and tuning - ten years sleeping
Posted by ivanartesi - 2012/02/29 15:01

Thank you Sten,
I'm delighted for having found this page and start being part of this wonderfull community.
As soon as I finished restoring i will upload some photos.

Iván

==========

Re:Strings and tuning - ten years sleeping

Posted by Toffe - 2012/03/01 15:23

Welcome Iván!

The alto guitar has a theorbated that will let you use 6th strings for all lower notes. However, there are some nice alternatives from Hannabach. I use 5 strings of increasing thickness, which gives a very full and rich bass. Also I use the medium tension savarez alliance (the red) for the top six. They add some extra tension, which makes ornamentation a bit harder, but it adds alot of core to the sound. Very warm trebles. I think most of the guys I studied with used Savarez.

But next time I restring the top 6 - I'll try D'addario, for comparison.

==========

Re:Strings and tuning - ten years sleeping

Posted by silvanig - 2012/03/01 18:56

Hi Toffe,

Your description of the Hannabach basses has aroused my curiosity. I'd like to try them out.

Could you please tell me the specification of these strings (string type, ...).

PS: What's the scale of your alto?

==========

Re:Strings and tuning - ten years sleeping

Posted by Monypm - 2012/03/08 00:44

Dear Ivan,

My experience so far has been that using a 6th string for the basses from 7 - 11 is OK but:

1. I find you do need to ensure that the string height at both the nut and saddle is reasonable otherwise some buzzing can occur and the feel is a little "soft"

2. using the smaller diam strings results in a somewhat subdued bass sound. This may be desirable if your trebles are more mellow or you dont want too much Campanella or resonance effect.

3. for a full sound I use the following on the Milagro / Bartolex 11 string Alto's I sell. It gives a full sonourous bass with strong resonance and Campanella effect. (of course this may not suit your playing or desires but thats up to you)
Strings 7 - 10 are nominal 1.27mm diam - Hannabach Silver Special C-8 (8158_MT) or Savarez D-7 (5207R) or La Bella C (NYL028W 0.052) or Aranjuez C-7 (concert silver 7-C)
11 is nominal diam 1.44mm and use B-9 (8159_MT) or Savarez C-8 (5208R) or La Bella A (NYL030W .056)

4. my personal preference which suits how I play or want to sound is:
String 7 - Aranjuez C-7 (concert silver 7-C) - the gold colour is useful as a visual ref marker at 7. PS I am also working on a possible technique to slightly colour normal silver strings - I will let the forum know if I am successful.
Strings 8 - 10 - Hannabach Silver Special C-8 (8158_MT) or Savarez D-7 (5207R)
String 11 - Hannabach Silver Special B-9 (8159_MT) or Savarez C-8

Most bass strings are pretty much similar in sound quality between makes but of course definately not so on the top 3

treble strings. So really any of the above well known brands will be good. The Aranjuez seems to get duller quicker so its life is not as long I find. (also possible that the 7th string tends to be used slightly more than the other basses and occasionally fretted as well - so maybe this affects its life ??) The bass strings 7 - 11 last a long time compared to the 1st 6. Usually the 4th needs replacing long before any of the others then 5 and then the trebles 1, 2, 3 in my experience.

I suppose the only other suggestion is to make sure that the 1st 5 strings intonation is checked right up the fingerboard to Fret 10 at least and proper set-up adjustments to string height / nut / saddle or all are done to get it reasonable. (You will never get it perfect but should be able to maintain a +/- 3 - 7 cent variability from fret 0 - fret 14. I say this because with the shorter strings and higher pitch, intonation irregularities occur more easily and tuning is more sensitive than a 6 string.

I hope my ramblings are of some help. String choice often comes down to a personal level and I urge you to experiment as many of us have done using suggestions as a guide. Strings By Mail I can highly recomend and they sell strings individually with great friendly service and good prices. Good luck with your project and playing.

Kind Regards from a very wet Sydney in Australia. Peter Mony www.laudarra.com.au

==========

Re:Strings and tuning - ten years sleeping

Posted by silvanig - 2012/03/15 20:08

Hi Peter,

Thank you very much for your detailed description of the alternative stringings for strings 7 to 11 you apply to the altos sold by you. Up to now I have used E6-material for strings 7 to 13. I am eager to try out such an alternative stringing, to experience the difference.

But I have concerns about the additional tension exerted on the bridge.

In order to get an impression of the effective forces I made some approximative calculations based on the formula discussed in thread < A lutenist's approach to string selection >.Hannabach kindly provided me with the tensions for strings 8 to 9 of the 10-string set in standard scale length for classical guitars, which was part of the input needed for these calculations.

I compared Bartolex/Milagro Alto 11c

stringing version 1:
.. Strings 1 to 6: e1, b, g, d, A, E, Hannabach medium tension
.. Strings 7 to 11: E6, E6, E6, E6, E6, Hannabach medium tension
to
stringing version 2:
.. Strings 1 to 6: e1, b, g, d, A, E, Hannabach medium tension
.. Strings 7 to 11: C8, C8, C8, C8, B9, Hannabach medium tension

I am aware, that your favourite choice for string 7 is Aranjuez C-7, but, lacking tension data for this string type, I replaced it in stringing version 2 by one of your other alternatives, namely Hannabach C8.

I took the scordatura with the highest convenient tuning as a basis, namely the scordatura for AA-key signature 5#.

Here are the details of the calculations:

Stringing version 1, strings 1 to 6:

Alto: String no.....1.....2.....3.....4.....5.....6.....1.to.6
Reference tuning: note.....e1.....b.....g.....d.....A.....E
F1: Reference tuning: frequency (in Hz)...329.6..246.9..196.0..146.8..110.0...82.4
L1: Reference string length (in cm).....65.....65.....65.....65.....65.....65
T1: Reference tension (in N).....73.....62.....64.....72.....70.....70
Alto tuning: note.....g1.....d1.....a.....f.....c.....G
F2: Alto tuning: frquency (in Hz).....392....293.7....220....174.6..130.8...98

L2: Alto: string length (in cm).....55.....55.....55.....55.....55.....55
T2: Alto : tension (in N).....74.....63.....58.....73.....71.....71.....410

Stringing version 1, strings 7 to 11:

Alto: String no.....7.....8.....9.....10.....11.....7.to.11
Reference tuning: note.....E.....E.....E.....E.....E
F1: Reference tuning: frequency (in Hz)....82.4...82.4...82.4...82.4...82.4
L1: Reference string length (in cm).....65.....65.....65.....65.....65
T1: Reference tension (in N).....70.....70.....70.....70.....70
Alto tuning: note.....F#.....E.....D.....C#.....B1
F2: Alto tuning: frequency (in Hz).....92.5....82.4...73.4...69.3..61.75
L2: Alto: string length (in cm).....55.....61.8...65.4...69.3..73.3
T2: Alto : tension (in N).....63.....63.....56.....56.....50.....288

Stringing version 2, strings 1 to 6: see stringing version 1, strings 1 to 6.

Stringing version 2, strings 7 to 11:

Alto: String no.....7.....8.....9.....10.....11.....7.to.11
Reference tuning: note.....C.....C.....C.....C.....B1
F1: Reference tuning: frequency (in Hz)....65.4...65.4...65.4...65.4..61.75
L1: Reference string length (in cm).....65.....65.....65.....65.....65
T1: Reference tension (in N).....70.....70.....70.....70.....72
Alto tuning: note.....F#.....E.....D.....C#.....B1
F2: Alto tuning: frequency (in Hz).....92.5....82.4...73.4...69.3..61.75
L2: Alto: string length (in cm).....55.....61.8....65.4...69.3..73.3
T2: Alto : tension (in N).....100.....100.....89.....89.....92.....470

The total tension exerted on the bridge is
.. 698 N for stringing version 1
.. 880 N for stringing version 2.

So there is a 26% increase in tension. This increase is effective on the bridge in an asymmetric way, namely as a 63% increase in the tension of strings 7 to 11.

Obviously the Bartolex/Milagro altos swallow this increase in tension.

I have a 13 string Strömberg alto. I made the same calculation for this instrument (ignoring the tensions for strings 12 and 13 for reason of comparability). As for the total tension exerted on the bridge, the results do not differ significantly from the calculation made for the Bartolex/Milagro altos.

But may I transfer, without thinking twice, the experiences from the Bartolex/Milagro instruments to mine? I'd like to know the opinion of the luthiers of this forum: is this increase in tension harmless in any case?

==========

Re:Strings and tuning - ten years sleeping

Posted by Monypm - 2012/03/17 12:40

Dear Silvanig,

Great analysis. Well done. Very interesting. It has spurned me into getting down to the calculations which have been on my "one of those things to do one day" list. I have revisited the spreadsheet I set up a few months ago and have today started measuring and calculating the mass per unit length of the various strings to plug into the standard equation for tension. The initial results more or less confirm what you are saying but also give some interesting indication why somehow the thicker strings may sound better to some people. I just want to double check my measurements and calcs before I post them on the forum for discussion. I prefer to derive the tension from my own “mass per length” measurements because I find some anomalies and confusion in what some of the string manufacturers and/or Strings By Mail claim in regards to tension. I will post my results and comments soon. This is all interesting stuff and hopefully our discussions will be of interest and assistance to forum members. Maybe some will awake from 10 years sleeping?;)

Kind Regards,

Peter Mony

==========

Re:Strings and tuning - ten years sleeping

Posted by ninjasan - 2012/03/17 16:27

Monypm wrote:Maybe some will awake from 10 years sleeping?;)
Kind Regards,
Peter Mony

Hi Peter,
We're not sleeping, but working very hard to buy strings :lol:

Friendly yours,
christophe

==========

Re:Strings and tuning - ten years sleeping

Posted by tenvec - 2012/03/22 13:06

Bruma, Peter,
I would counsel caution over fitting higher tension strings, particularly in the bass. While a bridge is usually well bonded to a soundboard, adhesives do age, and with the passage of time a failure might occur.
Of more immediate musical importance is that fitting higher tension bass strings will affect the balance of the instrument. The higher tension bass strings have greater density, mass per unit length, and the increase in inertia means that they will not dampen as quickly as smaller gauge strings. 6s guitars are prone to being "bass heavy", 10s guitars continue the same problem. An advantage of the Bolin concept is that it uses the same bass strings for seven onwards, i.e., the strings have the same density, and therefore do not have an increasing tendency to"ring on".
When calculating string tension I prefer to use the classical formula, T = 1/2 x d x (lf)^2, where d is line density, mass per unit length, l is scale length, f, frequency in c/s(herz). One has to use consistent dynamical units. This overestimates the tension due to the neglect of elasticity. Depending on material, the overestimate may be too high by 10% or so.
James.

==========

Re:Strings and tuning - ten years sleeping

Posted by tenvec - 2012/03/23 13:49

Bruma, Peter, and anyone who read my last post,
I woke in the early hours this morning realising that the formula I quoted should read: 4 x d x (LF)^2. The pre-factor is 4 not 1/2!
Many apologies.
James.

==========

Re:Strings and tuning - ten years sleeping

Posted by Monypm - 2012/03/24 06:45

Dear contributors to this post.

Its getting interesting for sure and of course such discussions really nut out what various players are doing thus contributing to our overall experience pool. All good stuff I believe.

I have prepared quite a large spreadsheet with some interesting observations. Yes I am using the correct formula as intimated earlier and yes I am incorporating an actual measured "stretch" allowance for the strings as well as measuring

their mass per length. I will convert this to an attachment that forum users can download in a few days. I am busy travelling in Europe at the moment and just need an hour or so to put it into a clear visual display and then will post it.

My comment on the suggestion of sticking to the original E 6 strings for 7 -11 is that using the thicker strings increases bass ringing or "campanella effect" as I call it BUT there is a "value added effect" for the treble strings in terms of the sympathetic resonances. This I find makes a not insignificant difference in their contribution to the overall sound. They are brighter and more powerful. Perhaps this is a separate related subject??

More later. Must go.

Kind Regards, Peter Mony.

==========

Re:Strings and tuning - ten years sleeping

Posted by tenvec - 2012/03/27 14:00

Peter,
I was particularly interested in the your experience that the heavier gauge bass strings do appear to strengthen the response of the treble. As it does not affect the analysis, If we think in terms of the transposed tuning of the alto, viz., e', b, g, d, A, E, D, C, B', A', G', by sympathetic resonance, D, ..., G' through their overtone sequence have most influence on the "white" notes of the treble, as the energy of the overtones does decrease quite noticeably as one goes up through the sequence. It is only in very high overtones that the "black" notes, i.e., the sharps begin to appear. Consequently, notes such as f#', g#', a#', c#", d#", etc., are not effectively supported.
The usual argument by those who use Yepes tuning for the 10s is that it helps even the response of the treble, which is otherwise uneven because the bass tuning of the 6s, and the romantic/baroque tuning of a 10s, only support the non-sharp notes of the treble. Thus, I would expect increased response using heavier gauge strings, but it would not address the unevenness issue, and would tend to increase the tendency of a guitar to be "bass-heavy". I do recognise that personal preferences in tonal structure play a part in string choices.
I have to say that I am not convinced that the usual explanation for the sympathetic resonance effect of Yepes tuning is the complete story. The degree of the effect varies with guitar, which indicates that the frequency response of the instrument, which is governed by the construction, plays a part. Also tension variation during vibration can have an effect.
James.

==========

Re:Strings and tuning - ten years sleeping

Posted by Monypm - 2012/03/28 16:00

Dear forum thread followers.

As promised please find attached my calculations on tensions associated with various string scenarios. The attachment contains this thread as well as the detailed spreadsheets.

Please excuse any error or 'oops's' that may have crept in. I have been on the road travelling in Europe and have put this together in bits and pieces when I have had time and internet connection. Please correct me on anything glaringly an error and I will correct. See the attachment for clearer text and spreadsheet data.

The calculations use the generally accepted formula which I have modified to encompass actual stretch at the open note.:

T = (4*Ls*Ls*G*F)/9.81 is the tension in newtons

Where,
- Ls= length of string between two fixed points (scale length)
- G = string mass per unit length at the fundamental frequency tension
- F = 1st mode fundamental frequency of the vibrating string

G is actual string measurements and determined as follows with a string stretch allowance:

G = m/((1+(Lt/Ls))*Lm)

Where,

m= “out of the packet” measured mass of string in grams with overall length = Lm
Lt = string length difference from slack to full tension measured over scale length in mm
Ls = scale length of string in mm

Notes:
- Lt/Ls reduces to a % and then applied to Lm to give an overall length under tension
- Mass measured on a scale with 0.1g accuracy
- String measured over guitar scale to an accuracy of ~ 0.5mm
- String overall length measured to accuracy ~1mm
- From calcs the average difference for stretch allowance is ~ -4.1%

SUMMARY OF RESULTS
TotT = total tension. Trbl ave = 3 non wound treble strings average tension.
Bass av = wound bass strings average tension. AveT/str = overall average tension per string.

6 String guitar. (scale) - as a basis for reference and variation of tensions
Milagro(651) Han Goldin T, 200 MHT B:- Tot T= 487N. Trbl av= 85 , Bass av= 78 AveT/str= 81N Milagro(651) Sav Alliance MHT set:- Tot T= 450N. Trbl av= 79 , Bass av= 71 AveT/str= 75N
Milagro(651) Han 200/900 set:- Tot T= 437N. Trbl av= 71 , Bass av= 78 AveT/str= 73N
Milagro(651) Han black med T set:- Tot T= 446N. Trbl av= 77 , Bass av= 69 AveT/str= 74N
Milagro(651) Han green low T set:- Tot T= 426N. Trbl av= 73 , Bass av= 69 AveT/str= 71N
Ramirez1a(664) Han Goldin T& 200 MHT B:- Tot T= 506N. Trbl av= 88 , Bass av= 81 AveT/str= 84N

Comments / observations:
These 6 string results are shown as a basis for comparison and are without any string stretch compensation in the calculations. Presented as a basis for relative comparison across different guitars / strings. If you apply the stretch involved the actual tensions will be reduced by approximately 3 - 4%. Two different guitars Milagro (scale 651) and 1973 Ramirez 1a (scale 664) and various strings were analysed in the spread sheet.
The highest tension is always the 1st string and that also has the highest stretch ~ 6%
The string manufacturers classification low, med within a similar string material seems to be more directed at the bass strings than the trebles (eg Han black and green sets).

OK now on to the Alto 11.

11 String Milagro Alto guitar with varying scale.

Worst case Goldin on trebles 1-3 & Hann 200/900 MHT set for 4 - 6
Hann C string 7-10 & Sav C for 11:- Tot T= 867N. Trbl av= 82 , Bass av= 78 AveT/str= 79N

Hann 200/900 MHT set for 1 – 6 and as shown for others
E string for 7-11:- Tot T= 683N. Trbl av= 63 , Bass av= 63 AveT/str= 62N
Hann D string for 7 – 11: - Tot T= 707N. Trbl av= 63 , Bass av= 65 AveT/str= 64N
Hann C string 7-10 & Sav C for 11:- Tot T= 811N. Trbl av= 63 , Bass av= 78 AveT/str= 74N

Comments:
The scenario using E strings on 7 – 11 shows really low tensions compared to the 6 string scenario.
The scenario of using a bigger diam D string on 7 – 11 is somewhat better and maybe a good compromise?
The last scenario that at the moment I prefer is definitely much higher tension but certainly within the norms of a 6 string scenario.

What this possibly shows is that in terms of normal tension the concern of a bridge coming un-glued shouldn’t really be an issue because an average tension per string for MHT scenarios is similar to a 6 string scenario. Assuming of course that the luthier in their design and construction considerations would design around an average tension per string multiplied by the number of strings. I am not sure of course whether they even considered this too seriously as most bridges on multi-strings are very similar in size to 6 string guitars. I have also just spent 3 days with the luthier Neris Gonzalez who probably has made more multi-string guitars than anyone else some of them now coming up to 5 years old since he started specialising in multi-strings. When questioned about this he says with modern adhesives problems of bridges coming unstuck are extremely rare and even with older instruments this was not a common problem. I also had the opportunity yesterday of spending some time at the Ramirez workshop and asked the same question of their chief luthier as well as Amelia Ramirez. Their comment was that with their 10 string (some dating back to mid/late 60’s) they have never had bridges coming unstuck and have never been concerned about it or what strings players use. What I did notice which was very interesting was in comparing the Ramirez and Bernabe 10 string guitar the bridge was significantly longer on the Bernabe than the Ramirez by about 50mm. (by the way this particular Bernabe was one of Yepes’s instruments bequeathed to his prodigy Ismael Barambio with whom I recently had the honour of spending an evening talking, playing and being immersed in 10 string guitar for the research for my multi-string study guide). Ramirez’s bridge

is a similar size to their 6 string bridge (as is Neris Gonzalez and Lance Litchfield) and I assume they have tried to keep the bridge mass as low as possible so as not to affect the tops performance. The Bernabe is a magnificent sounding instrument and extremely light in weight so I suppose that old Bernabe perhaps was possibly concerned about his thin top's stability under a much higher tension and hence made his bridge somewhat bigger to achieve a greater contact surface area with the top. Looking at it the bridge certainly lends much more to top stability than a conventional bridge. It sort of throws out the theory around keeping the bridge small and compact but I suppose such is the nature of innovation and pushing the envelope. Smallman and most Australian luthiers being prime examples of changing the goal posts.

I showed these calculations to Neris, in particular the scenario where I use Hannabach 1.27mm 'C' strings for 7-10 and a Savarez 1.44mm 'C' string for 11, and he reckons that one could even consider using a Savarez 1.44mm C string for 10 as well to get the tension up a bit as that seemed a bit on the low side. Personally it feels OK to me but there's no harm in trying I suppose.

In terms of the issue raised of greater ringing on or increased "campanella effect" as I call it, this is more complex and possibly gets down to a more personal taste level. It is a perfectly valid point that James / Tenvec makes and of course must be taken into consideration dependant on ones playing technique. I certainly find that one has to be a lot more gentle on the bass strings using the low tension E string scenario otherwise they can easily buzz and hence one of the reasons I experimented with higher tensions. However as I have already pointed out in an earlier thread, I think the overall treble string response and timbre is enhanced with these extra and/or exaggerated resonances. One's dampening technique may need to be enhanced or even some of 'Yepes's techniques' learned if one opts for the higher tension / greater resonance string scenario. What I can say, having been a 10 string guitar player using Yepes tuning longer than an 11 string alto player which is only recent, is that I did not find this issue too much of a problem as with Yepes tuning its inherent basis is sympathetic resonance on all 12 semitones. However I do find that the 11 string is somewhat lob-sided as there are some sympathetic resonances absent but others that are exaggerated due to having double resonating strings 4/7 and 5/9. So far in my limited experience this may be a characteristic that is somehow "inherently" taken into account in lute based compositions particularly from Renaissance and Baroque era's. The lutes of the day possibly displayed similar lob- sided sympathetic resonances and perhaps this is what makes it well - "sound like a lute" and the way composers either took of advantage of it or circumvented it. ?? Again another whole sub topic and certainly most interesting.

I hope all this information is not overload / over the top and that it is of use for members or to stimulate further discussion. The attachment contains this thread as well as the detailed spreadsheets. It has been interesting for me to do the analysis and at least satisfy myself that on a more a more rigorous level I am aware of the tensions involved and their ramifications good and bad. I will certainly be asking any luthiers and players I come into contact with for their experiences. Perhaps some of the luthiers might give us their wisdom on the subject. Please correct or debate other experiences – its all good for the soul!

Best Regards, Peter Mony. Laudarra Guitars www.laudarra.com.au monypm@laudarra.com.au
http://altoguitar.com/images/fbfiles/files/Thread_alto_forum___string_tensions.pdf

==========

Re:Strings and tuning - ten years sleeping

Posted by tenvec - 2012/03/29 14:38

Peter,
I agree, bridge separation is unlikely, provided one stays within the limits of proven total working loads, but not a remote possibility. I do have a 1982 10s Ramirez and there are no signs of separation. Unwise experiments on classical guitars using steel/bronze strings intended for relevant acoustic guitars do lead to damage. Also, low humidity countries, e.g., winters in the northern states of the US, Canada and Scandinavia will test the resilience of both wood and adhesive bonding. Thus, in Canada, I found that guitars made in Spain did show a tendency to cracking, unless care was taken over humidity. Guitars made from local woods tended to fare rather better. In any case, if the shear bond stresses of the adhesives typically used for bridge attachment were known, questions over bridge separation with a change of stringing could be settled very easily.
While heavier bass strings will tend to increase the the lack of uniformity in treble response, my main concern was the balance of the alto. As a fair general rule, 6s and 10s guitars are bass heavy and treble light. Lutes, especially renaissance tuned instruments, have good trebles and "weak" basses. The alto guitar, although still somewhat bass heavy, is less so than other guitars, in part because it uses lighter gauge strings in the bass, than say a 10s in romantic tuning. Yepes 10s tuning although intended to address uniform response, does not address the question of balance. Personally, I prefer an instrument with a treble bias, though it is clear that most guitarists do not notice that they are playing an unbalanced instrument; indeed, many love a "bassy" sound. Lutenists have less trouble over damping than guitarists, mostly because they use much lighter gauge strings in the bass, so, the inherent damping of the material causes bass notes to die more quickly than is the case with typical guitar bass strings. As in all things, there is no

replacement for personal experience with a string choice.
Thank you for your lengthy effort over the tension "calculator". Unless I am misreading, the formula you quote in your post has a couple of typos. The frequency should be squared, and one only needs to divide by the result by 9.81 to convert Newtons to kilograms force(kgf). A minor point, S. I. units are familiar to the European members of the alto group. Although the US signed up to using S. I. units, there has been little penetration of these units. FPS units are what most US citizens understand. In the academic world, electrical engineers use S. I. units, but FPS are still popular in mechanical contexts, and CGS units still appear in many physics texts. So, having got to kgf, by dividing by 9.81, a further division by 2.2 will get one to pounds force(lbf).
James.

==========

Re:Strings and tuning - ten years sleeping

Posted by Monypm - 2012/03/29 19:13

Corrections.

Thanks James for pointing out the typos. Indeed the F term should be squared and the result should not be divided by 9.8 to get a result in newtons. However my formulae are correct in the spreadsheet calcs - the typos crept in stealthily whilst I wasnt looking in writing it up!

The formula should read:

T = (4*Ls*Ls*G*F*F)is the tension in newtons

Corrected pdf file also attached.

All in all a good discussion I belive. Thank you James for diligent feedback and insights.

Regards, Peter Mony www.laudarra.com.au
http://altoguitar.com/images/fbfiles/files/Thread_alto_forum___string_tensions___ver_2.pdf

==========

Re:Strings and tuning - ten years sleeping

Posted by tenvec - 2012/03/30 17:32

Peter,
I fear errors dog us all, particularly when trying to do many other things!
Keep up the good work!
James.

==========

Re:Strings and tuning - ten years sleeping

Posted by tenvec - 2012/03/30 18:01

Peter,
I forgot to say in my last post that it is possible to do a theoretical calculation of reduced line density using a Young's Modulus for the nylon strings. I note that manufacturers do not, to the best of my knowledge, publish such data. Lengthy searching produced values of YM, i.e., E, for nylon strings with likely values, 4.5, 5, 5.5, all times 10^9 N/m^2. The values for the metal wound strings have to be found experimentally. I guess careful "kitchen technology", e.g., suspending weights and measuring extension, would be adequate.
The results I got for nylon strings, mostly, D'Addario, were in the range: 5 to 10%, clustering around 7%. However, a discussion some time ago had a couple of investigators getting 10 to 15%. I think 15% is probably too high. My impression of manufacturer's stated tension levels is that they are not installed values, but ones based on the classical formula. Measuring installed tension is simple in principle, but requires very good technique to get plausible results.
James.

==========

Re:Strings and tuning - ten years sleeping
Posted by tenvec - 2012/03/30 18:06

I should have made it clear in the last paragraph, that I was talking about the reduction in tension due to string extension.
James

==========

Re:Strings and tuning - ten years sleeping
Posted by silvanig - 2012/04/09 15:07

A most interesting thread.

Becoming independent of string manufacturers's data

Peter, thank you for sharing the details of your string measurements and calculations. Great conceptual and practical work.

Your approach to derive tension data from your own measurements allows to become independent of data from the string manufacturers or suppliers, which may be non-uniform / questionable / inconsistent / incomplete / missing.

Further below I will add an example for such an inconsistency.

Something like this was in my mind since I started grappling with manufacturers's data, in order to get an impression of the tensions for different stringing scenarios for altos.

Based on these measurements, taken on neutral ground, one might finally be enabled to define for each alto string, what very low, low, medium, high, very high tension means and establish a data base, where strings from the market are ranked accordingly.

Differences of our results

The results of our calculations differ more or less. This is partly due to the fact that we use different tunings as a basis. After harmonizing the basis, there remain some significant differences on string level. I started compiling these differences, in order to get some further insights and maybe ideas for improvements. I'll post the results, when I have finished this analysis.

Inconsistencies in manufacturers's string tension data: An example

On the Hannabach internet site MHT (Medium High Tension) is defined as follows:
E/1st: 7.5 daN (i.e. 75 N) (*1a)
H/2nd: 6.5 daN (i.e. 65 N) (*1a)
G/3rd: 6.8 daN (i.e. 68 N) (*1a)
D/4th: 7.5 daN (i.e. 75 N) (*1b)
A/5th: 7.4 daN (i.e. 74 N) (*1b)
E/6th: 7.4 daN (i.e. 74 N) (*1b)

Series 725 (Goldin)
Tension: Medium/High

E725 MHT	Set	(*2)
E7251 MHTC	E/1	(*3a)
E7252 MHTC	H/2	(*3a)
E7253 MHTC	G/3	(*3a)
E7254 MHT	D/4	(*3b)
E7255 MHT	A/5	(*3b)
E7256 MHT	E/6	(*3b)

Comments:

- (*1a), (*1b), (*2), (*3a) and (*3b) have been added by me for reason of reference

-It would be logical to deduce from *2, that the tensions for the strings are according to *1a/*1b

-This contradicts with as a tension code at the *3a-entries. The definition of this code is missing.

-Furthermore, the package leaflet contains the following data:
E-1: kp 8.0 (i.e. 78.5 N) (*4a)
H-2: kp 6.8 (i.e. 66.7 N) (*4a)
G-3: kp 6.8 (i.e. 66.7 N) (*4a)
D-4: kp 8.0 (i.e. 78.5 N) (*4b)
A-5: kp 7.8 (i.e. 76.5 N) (*4b)
E-6: kp 7.5 (i.e. 73.5 N) (*4b)
Comparing the *4b-entries to the*1b-entries reveals another inconsistency.

Unevenness of frequency response

As James stated, in terms of transposed tuning, the overtones of standard tuning of the alto basses primarily support the
.

But IMO this statement cannot be generalized to the other convenient tunings.
As tunings of the alto guitar mostly are key-conform, the ringing alto basses together with their overtones mostly emphasize tones of the musical scale of the key of a piece. I.e. if a musical scale contains , then these are emphasized by the ringing basses, too.

I wonder whether it is desirable to achieve total evenness of frequency response (in terms of supporting every note equally independent of the music played) by using reentrant tuning, if we have the chance to create a variety of differentiated spaces of frequency response, each tailor-made for a key signature (by means of scordatura).

These spaces of frequency response have a little deficiency, though, if generated by an 11 string alto. The bass sequence of an 11 string alto is incomplete in so far, as one note of the musical scale is missing. A 12 stringer eliminates this deficiency. This is one more argument to go for a 12 or 13 string alto.

By the way: Does anybody know factors representing the felt intensity of say the first 10 overtones? My internet research was not yet successful in this respect.

Weak lute basses

In Michel Cardin's treatise we find some interesting details about stringing of the baroque lute. Here are some citations from this treatise:

.
.

< ...it is quite clear that Weiss and his Germanic contemporaries were to favour the models in the style of Johann Christian Hoffmann's ...>.
< The preponderance of this particular model was possibly due, like the change of musical style, to the wound metal strings ...>.
.

.

I deduce from these statements, that during the baroque period there was a tendency for lutes to become less bass-weak.

Playing Weiss on my alto with E6-basses, and comparing the sound to some Barto interpretations on lute, I sometimes felt, that it would be fortunate, if some of the basses of my alto had more brilliance.

A compromise

Peter, thanks for discussing bridge stability with the luthiers you meet. The answers of the luthiers you have already interviewed and the fact that I don't live in one of the critical regions mentioned by James, have dispelled my concerns to a certain degree. The fact, that with Ramirez guitars the extent of the contact area with the top is not increased proportionally to the number of strings and that they have never had bridges coming unstuck, indicates that that there

must be a considerable safety margin.

But as my Hannabach Goldin trebles possibly have more tension than I assumed and I have a 13 stringer (i.e. with 2 more strings that pull) with a 57 scale, I decided to start with a bass stringing with total tension somewhere between E6-stringing and your favourite stringing:

String 7: E6
String 8: Hannabach Black D7 (Medium Tension)
String 9: Hannabach Black D7 (Medium Tension)
String 10: Hannabach Black C8 (Medium Tension)
String 11: Hannabach Black C8 (Medium Tension)
String 12: Hannabach Black H9 (Medium Tension)
String 13: Hannabach Black H9 (Medium Tension)

==========

Re:Strings and tuning - ten years sleeping

Posted by tenvec - 2012/04/11 14:03

Silvanig,
Just a couple of points.
1) Although supporters of Yepes re-entrant tuning are usually enthusiastic, sometimes to the point of fanaticism, over this system intended to achieve uniform response in the treble, the effect is variable with guitar. In any case, most "well-made" guitars are not seriously non-uniform in treble response.
You make a valid point about the effect of the tuning of the alto diapasons. A change of tuning of half a tone will reinforce that semitone. Supporters of Yepes would, of course, point out that it will primarily affect only that semi-tone. Even without any Yepes tuning, fretting , e.g., c# on the 5th string, will support not only c#', but also g#'. Only in music where there are a large number of unsupported accidentals is the tuning of potentially general value. Thus, it is probably appropriate for atonal music for those guitars that can be noticeably improved with this tuning.
2) There is some evidence that at least some bass strings for lutes in the early 17th century may have been "loaded" to increase their density. In a number of paintings they are shown coloured. When made from pure gut, they had to be quite thick, which resulted in a dull tone. Doubling the bass string with an octave higher one lightened the tone but created voice confusion. This strategy was condemned by Dowland, Ballard, etc. One answer was to lengthen the fret board, but then the tension needed to tune the top course to g', even half a tone lower than modern g', could result in breakage. Consequently, it would be necessary to lower pitch. Hence, lute music for 10c lute, depending on bass strings and length of fret board, may well have sounded in some cases nearer to modern E or F, rather than F#. Another alternative was to lengthen the bass strings, but keep the treble at original lengths. This latter strategy eventually led to the archlute.
I seem to recall hearing at one Lute Society meeting that wound strings were being made in some places in the early 17th century, i.e., earlier than Cardin states, but I have no special knowledge on this subject.
3) The energy in the overtones/harmonics does drop off quite quickly. The distribution of energy over the modes depends on where the string is plucked. Thus, plucking near the bridge puts more energy into the higher modes and decreases that in the lower modes resulting in a "thinner" tone. There is a formula for the modal energy based on the classical theory of a vibrating string.
James.

==========

Re:Strings and tuning - ten years sleeping

Posted by Monypm - 2012/04/12 00:41

;) James.
In the limited time I have been a member of the forum you always offer excellent points to ponder and rigorous tech argument to back them up. As we say in Australia, "Good on ya!" I am going to wade back in a bit here and hopefully I wont be toppled mercilessly into the cold water. :S

Point 1 raised. Hmmm... most 'fanatics' of the Yepes tuning would not agree that even 'well made' 6 string guitars have an even treble response. I have had the luxury of being able to compare side by side two superb hand made guitars on exactly this basis. One a 10 string Yepes tuned and the other a 6 string. Both guitars made at approximately the same time almost side by side by the same luthier using pretty much same materials (probably cut from the same log) and exactly the same body, top and bracing - only the neck, headstock and fingerboard differing. I talk of course about the fine Australian luthier Lance Litchfield. This was not purposeful but the circumstances just perchance happened when he made my 10 string for me late last year and I had access to two of his 6 strings. I have had one of his recent 6 strings

here with me for about 2 months as a favour so that prospective purchasers in Sydney can assess the instrument. The rare ideal opportunity for a highly relevant comparison. The 6 string is a very good instrument and I recently had the opportunity of a concert by the superb New Zealand guitarist and educator Prof Mathew Marshall playing a similar model. Sitting at the back of the hall it was the equal of Smallmans in prior concerts by other superb guitarists. In particular the bass response and resonance of the Litchfield was somewhat superior whilst the 3rd string response of the Smallman 3rd string was marginally crisper than the Litchfield. Clearly a fine 6 string instrument and comparable to the best.
Back in my studio playing the 6 and 10 string instruments side by side with the same strings fitted (Goldin on the trebles and Hannabach 200's on the basses) the difference in the sound (volume, projection, clarity, bass / treble response, resonance etc) of the two instruments hits you square on in no uncertain terms. There is no doubt what "the Yepes fanatics" are on about! As much as I have done the tech analysis and produced resonance map comparisons etc, there is nothing like a side by side comparison actually playing a variety of genres. The difference is certainly marked and complex in that its not just volume or projection but timbre in its truest sense and manifestation. One could get all technical and actually dissect this but in short the difference is significant enough for one to simply concede.
Interestingly I also have the opportunity of comparing different 10 string tunings on the same model Milagro 10 string guitars made by Neris Gonzalez as I have a few of these in stock. Comparing the Yepes tuning with the "Baroque or Romantic" tuning as its commonly called, is also chalk and cheese. The Baroque tuning is similar to the Alto 11 but a minor 3rd lower in pitch. A side by side comparison in this way is really a 'no brainer'(sorry another Aussie expression) playing a wide variety of styles Renaissance to Modern. Overall the Yepes tuning ensures a much more even response and easier attainment of required timbre. However in some pieces particularly Renaissance and Baroque, the ability for added diatonic bass accompaniment is somewhat of an advantage using the Baroque tuning. Personally I don't like the Baroque 10 string guitar tuning as I think its too uneven with a dissonant mix of deficient and exaggerated sympathetic resonances. It is interesting however (and I have no rigorous reasoning for it other than pure gut feel (no pun intended)) that I absolutely love and relish the Alto 11 tuning just a minor 3rd up. At this pitch it somehow JUST works as a delightful mixture between guitar and lute. The Baroque tuning on 10 string guitar doesn't! So I love both 10 string Yepes and 11 string Alto with the occasional playing of my beloved 1972 Ramirez 1a 6 string. As an aside somewhat relevant in context and another topic for another day - there is in my opinion a very distinct difference in "the traditional Spanish sound" and the modern powerful "Smallman sound" of a 6 string - both different and both pleasing in different ways without needing to say one is better than the other.
Just as an after-thought, some fellow guitarists when listening to me playing the 10 string reckon there is a difference in its sound as one moves further and further away (back in the audience). The "Yepes tuning" effect as it were seems to decrease the further away one is from the player. Certainly one is very aware up front and playing but it stands to reason as the fuller more complete overtones / harmonics and sympathetic resonances are more subtle than struck notes, the effect will decrease the further away one is. This is aptly backed up when one records and the 10 string Yepes seems to have its own magical reverb without having to add any artificial means.

Points 2 and 3
This is very interesting history. Thank you these insights. Certainly on your point 3 I have found that in our ensemble we have one good fellow that unconsciously insists on plucking notes way up close to the fingerboard when we are tuning to each other. This often results not being able to clearly hear whether he is in-tune with the ref guitar or not. The "out of tune" error is much more difficult to hear than the fuller sound if plucked at the edge of the rosette. It of course stands to reason and supports what you are saying about the distribution of energy across the modes.

Regards, Peter. www.laudarra.com.au.

==========

Re:Strings and tuning - ten years sleeping
Posted by tenvec - 2012/04/12 14:00

Peter,
In previous posts in the alto forum I have made a more general assessment of Yepes tuning. To repeat, while most 10s guitars show some improvement, with some it is dramatic, with others it is barely detectable. Consequently, construction plays a part. I am working on a theoretical model that may help explain why this is so. However, it has to compete for my time with that spent on my musical interests.
I do not use Yepes tuning for the simple reason that it is inappropriate for the repertoire I play. I do not play anything resembling standard repertoire. I have only one 10s in E, a respectable Chinese instrument, other ms instruments range from D to A. However, when talking to any guitarist considering taking up a 10s instrument, I always encourage them to try Yepes tuning, along with romantic tuning. I find most just want extra bass strings, even though this may add to the imbalance of the instrument.
I agree that the trebles in a standard 6s instrument are not uniform, but the lack of uniformity is not so obvious as to render the instrument seriously defective, certainly as judged by an audience.
My Ramirez in E arrived in Yepes tuning. After about three days experience, I concluded that it was essentially a 7s instrument with some optional extras. I therefore viewed it as suitable for standard repertoire plus. I was not overwhelmed by the 'enhanced' response, and put it in romantic tuning. In this tuning it was bass heavy, but with a sweet

treble. I subsequently loaned the instrument to Graham Divine to play the Ohana cycle in recital, having put it in Yepes tuning. When returned, having been played extensively for some months, it was a different instrument. I had previously wondered whether I should put it in D, as it was so bass heavy. On an impulse, and with some misgivings, I put it a tone up in F#, to simulate renaissance G tuning. (Strings from Hannabach.) The balance and projection were both better than those achieved with either romantic or Yepes tuning. So, the frequency response spectrum of the instrument plays a part. I have kept it in F# tuning ever since.
The total energy-kinetic plus potential- of an overtone depends inversely on the square of the number of the overtone, so, energy does fall off quite quickly. A small counterbalance to this is a term, (sin(npia/l))^2 in the numerator. Here, n is the number of the overtone, l is the vibrating length, a the distance from the nut or pressed fret to the point of plucking. As a increases, so does this term. To appreciate the overall effect, it is better to work out the total energy of the overtones in successive octaves, with different values of a. When this is done, one can see that as the overtones begin to cluster into successive notes in the higher octaves, increasing a, i.e., playing nearer the bridge, does increase the total energy going into the overtones at the expense of the fundamental.
James.

==========

Re:Strings and tuning - ten years sleeping

Posted by silvanig - 2012/07/21 15:34

Peter,

meanwhile I have done my homework:
.. Repeating my approximative calculations for the tuning used by you, in order to have the same base
.. Comparing our results

Here are the details: http://altoguitar.com/images/fbfiles/files/Monypm_basses2_teil2_pdf.pdf

==========