BELL MAINTENANCE

As ringers we often quite willingly take upon ourselves responsibility for looking after the bells we get so much pleasure from ringing and I hope the following notes may be of help and encouragement to take on this worthwhile task.

1. Safety

Don't overlook safety; it's easy to take for granted. Never underestimate the danger that bells can present in the "up" position, e.g. if a person momentarily loses balance on a frame and grabs a wheel to steady oneself!! **Just give it thought and always work with bells down!**
Make sure that the bells cannot be rung, pull up the ropes, leave a notice, etc.
Hard hats are also a necessary for anyone working below, tools do fall or are dropped and a heavy spanner just falling from frame height can be serious. Where possible use proper spanners for tightening nuts, rings are best, adjustables can slip with damaged knuckles as a result (apart from damage they can do to the nuts!); so if it is necessary, make sure its the type that clamps firmly onto the nut.

A few other points:
Don't work alone, or if it's necessary then make sure someone knows where you are and when you will be back.
Make sure you have adequate lighting. Decent lighting in the bell chamber is so often missed and it really is necessary.
Wear a mask if there is a dust issue, i.e. when cleaning up; especially important if birds have got into the tower.
If you need to inspect whilst a bell is being rung, keep well clear and wear ear protection, (or better tie the clapper).
Keep the bell chamber clean; ensure wire mesh fitted over louvers is sound to exclude birds.
If there are intermediate chambers make sure these are kept clean and that external doors and windows are in good condition.

General maintenance items:
Regularly check ropes for wear, particularly at garter hole and adjust sally height when necessary.
Regularly grease or oil moving parts. Run an eye over all the fittings to ensure nothing looks untoward.
Check frame for movement and keep nuts and bolts tight.

2. Bell frame

a) Timber: marvellous material giving a mellow sound to the bells hung in it but lacks stiffness unless really well sized and with careful cross bracing. Movement in a timber frame is often the cause of poor go in a ring.
Ensure tie bolts are kept tight, but always tighten down gradually over the frame, avoid tightening one end or side and then trying to tighten the other end, this will inevitably end up with distortion of the frame.
Keeping all the nuts & bolts lubricated not only stops rusting but makes them easy to tighten without the risk of stripping threads or even breaking the bolts if

undue force is used. Even heavily rusted nuts will respond if treated over a period of weeks with a light penetrating oil.
Watch out for ends of tiebolts being drawn into the timber by over enthusiastic tightening, they do need large spreaders, say 2" square, to prevent this happening (and it will happen under the frame where it's difficult to get to or even see. Sods Law No 2.).

The real killer to timber frames is dampness; this allows both fungi and wood boring beetles to attack the wood. You've all seen the havoc that death watch beetle causes but it needs some moisture to survive.
Look out for rain penetration and timbers up against tower walls, close inspection of timbers where they enter the tower walls is also extremely important.
Excessive movement needs attention, the stresses imparted by bells ringing will cause the frame to move to some extent but real damage can be caused if this movement transfers to the support frame in such a way as to damage the tower walls.
Have you got a frame of historical or special interest? If so this needs additional thought to avoid potential damage.

b) Steel: much less likely to give problem if correctly sized and maintained although I still remember taking hold to the web of a large RSJ supporting a ton ring of 8 to pull myself up and finding the steel web come away in my hand due to rust!
Because there is not the flexing and movement in a steel frame, bolts are much less likely to loosen but still need checking from time to time and keeping tight. However steel frames do need painting from time to time (20 years or so) to keep the paintwork in good condition so as to avoid rusting.
Modern galvanised frames require little maintenance but do look out for areas where the galvanising has been damaged and repair with a zinc rich coating to avoid rusting.

3. Bells

The bells themselves are the real historical components. You probably already know their history and whether any are on the schedule of bells for preservation compiled by the Council for the Care of Churches.

Fortunately they are quite long lasting but a few things to look out for.
a) Crown staples: well into the last century a loop or staple of wrought iron was placed in the bell mould before casting so that the ends are tightly embedded within the crown of the casting. The clapper was then formed to swing on the cross bar of this staple. When an old bell is fitted with a new "independent" crown staple the old cast in staple is usually cut off flush with the crown of the bell. One of the principal causes of a bell becoming cracked is because of the stresses between the iron staple and the surrounding bronze. These can be started by the difference in thermal expansion of the two metals when cast and exacerbated by rusting of the iron. Square section staples increase the possibility of cracks developing. It is normal practice today to cut out any remains of cast-in staples during restoration to prevent any future risk.

b) Clapper damage: the action of the clapper gradually makes an indentation in the soundbow which if allowed to become too deep could cause a crack to develop from the lip. If wear is greater than around 10-15% of soundbow thickness at this point 1/4 turning to present a fresh part of the bell should be undertaken. Wear at the clapper pivot will also allow the clapper to strike lower on the bell than designed, ie. lower than the thickest part of the soundbow and this is also a potential cause for damage. The other effect is roll on the surface of the bell causing a wide indentation.
Look out also for badly adjusted clock or chiming hammers which are not clearing the bell after striking. Usually the spring under the hammer is poorly adjusted or could be due to loose bolts holding the assembly to the frame.

4. Clapper assemblies

Old clappers are of wrought iron forged into shape. The "fibrous" structure of the grain running down the length of the clapper giving it strength and resistance to shock. Wrought iron is now virtually impossible to get and modern clappers are made from a form of ductile cast iron known as S.G. (spherical graphite). There is an opinion that especially in bells over the ton, S.G. clappers do not bring out the tone of the bell as well as the older wrought iron clappers, so if you've got old clappers look after them!
Even into the last century, clappers were quite often suspended by an iron strap bolted to the stem of the clapper and passing round the crown staple with a leather strap or "baldrick" inside to reduce friction and provide insulation. There are other variants but in all cases the leather is subject to heavy wear and needs frequent attention. Clapper roll is almost impossible to prevent and the accuracy of the bells striking is also variable.
Modern clappers are usually hung on plain bearings with a hardened steel pin held in an independent crown staple and fitted with grease reservoir or nipple to enable regular lubrication or in more recent times a self lubricating nylon (tufnol) bush. Both types should be checked at regular intervals for wear and checked to ensure the pin and lock nut has not worked loose.
The clapper staple is insulated from the bell by a leather or fibre pad and this does get compressed over the years causing the clapper to become loose and this will need replacing at some time. Regular checking of all the clapper staple nuts is another essential part of bell maintenance.
Check for up and down and sideways movement in the clapper, this indicates a worn clapper bush and if significant (>1mm upwards) the need to have the clapper rebushed.
Clappers are a major cause of “odd-struckness”. Make sure the clapper hangs dead centre in the bell, not just in the line of swing but also that it swings at 90° to the headstock. (I have found occasions where this latter fault has gone uncorrected for years as the clapper is central and strikes the bell where it has “worn” a mark and was never considered that it had become out of line when tightened.)
With a tape, carefully measure from the frame to the clapper when held against the bell and repeat with clapper on opposite side. Measurements should be equal. Check also the distance from strike point to clapper is equal on both sides.

5. Headstocks

Traditionally these were made from oak or elm with slots cut in the underside to accept the bell's canons. Iron straps passing through the canons secured the bell to the headstock. The gudgeon pins are usually secured by "U" bolts through the headstock. It is essential to maintain the tightness of the nuts as any slack will cause rapid wear of the headstock allowing the bell to become even looser making it difficult and unsafe to ring.

Modern headstocks are usually of cast iron or steel with the bell, either cast with a flat top or having had the canons removed, secured by bolts through the crown. An insulation pad will normally be placed between the bell and the headstock. Where restoration of older bells has been carried out the headstock may have been fabricated or cast to fit on the crown of the bell around the canons (canon retaining headstocks).

6. Bearings

a) Plain bearings: these are essentially a half-round cup made usually of brass in which the steel gudgeon pin rests. Good lubrication is essential and some bearings have a reservoir from which oil is picked up as the bell turns thus maintaining the oil film between the metal surfaces or supplied from felt pads in the bearing caps above the brass. Regular cleaning and maintenance is necessary to keep bells hung on plain bearings running smoothly and to avoid wear of the bearing surfaces.

Castor oil is best for this (and its "ecofriendly") but quite probably a mineral oil will have been used in the past.

b) Ball bearings: "a ring of hardened steel balls running in between a hardened steel track clamped to the gudgeon pin and one held in the bearing housing"; usually "self-aligning" bearings are used as they will allow for slight sideways movement in the pins as well as rotation. Lubrication is in theory not needed but is essential to prevent rust forming on the balls or tracks. Housings are therefore packed with non-acid grease and sealed, the grease filling should last for 10-15 years in normal circumstances. Thickening of the grease through oxidation or loss of more volatile components will eventually necessitate repacking. Deterioration or damage to the grease seals will also cause drying out. Many ball bearing assemblies are fitted with grease nipples and care needs taking to avoid over pressuring of the bearing and damaging the grease seal. Modern general purpose grease, eg. Energrease LS3, (the lighter LS2 is better for pulley blocks) is well suited for this purpose but check that the bearing housing is not full of old hard congealed grease before repacking, simply pumping it through the grease nipple does not always mean its reaching the bearing surfaces!

7. Wheels

As these are of timber, inspection for beetle damage is necessary from time to time; the sole on which the rope runs and the shroud (the two cheeks which prevent the rope coming off sideways) are more prone to damage due to their thin section. The tightness of the wheel onto the headstock also needs checking.

Another area to watch is wear or damage at the garter hole through which the rope passes, it is at this point that the rope flexes through 180° every time the

bell swings and its a good practice to fit a small half round block of wood to the sole either side of the garter hole to minimise the sharpness of the bend.

8. Stay and Slider

I always think a suitable name for a ringers pub would be the "Stay and Slider" !
Stays are intended not only as a convenient way of enabling a bell to be set but also as a "safety-valve" which will break first if the bell is over pulled. It is very important to use ash as this wood has the right combination of flexibility and strength. It has a really long straight grain. Other woods have been found to be too brittle or unpredictable in performance. Bolts are normally used to secure the stay to the headstock and again need regular inspection and tightening.
Older rings are often found with a double curved stay which is considerably more difficult to replace than the more modern straight stay. With both types it is important to keep to the correct section and length when replacing. Too short and it will miss the slider and too long and it may catch on the frame. Also ensure the stay is vertical as otherwise it may rub against the frame causing the bell to be difficult to ring.
Another pattern of stay one may come across are "Hastings" stays. These are fitted into a socket in the headstock and tapered from the socket section to the toggle assembly on the outer end. Length is critical as the toggle is quite short and must engage with the slider quadrant without jamming. Both the toggle and the metal shoe need to be kept lubricated and clean for efficient operation. If the toggle does not switch over then there is effectively no stay or the toggle may be broken off!
Traditional sliders are also normally of ash and either straight section or curved to avoid the clapper. The stops at the moving end need correctly setting to prevent the bell setting over too far and putting severe strain on the stay or being very light set and causing difficulty in ringing and easily standing. The pivot of the slider should be in line with the stay when the bell is "up" and at the balance.
Regular waxing of the slider runner with candle wax helps it to slide across easily and again avoids friction. Check also that the slider pin is lubricated occasionally.

9. Ground pulleys

Immediately below the bell is a pulley or pair of pulleys to change the direction of the rope as the bell revolves, there may also be additional pulleys further down the tower for drawing the rope into the rope circle of the ringing chamber. They have to withstand the heavy pull on the rope when the bell is when ringing up or down and yet offer minimal resistance when the bell and rope is moving at maximum speed whilst ringing. They also need to be large enough in diameter so that the rope bends smoothly, yet light enough to avoid absorbing a lot of energy when their direction is rapidly reversed during full-circle ringing. They also often have to suffer being forgotten!
Hardwood is the normal material but nylon pulleys are now commonly found. The pulleys are mounted on steel spindles rotating either in ball races or plain bearings. Some older pulleys will be found mounted on large wooden pins or rotating on a steel axle. Check that the pulley rotates freely and that it is not rotating on the shaft when in fact the shaft should be rotating in the bearings.

Again regular lubrication and cleaning will avoid a lot of troubles. Pulleys that have become loose on their shaft can quite often be repaired by use of epoxy adhesive but make sure the bearings are cleaned out and regreased first. Stiff, jammed or worn pulleys absorb a lot of effort and are often the cause of complaints that the bells "go badly". Pulleys are not that expensive, around £75-£100ea, so it's well worth considering replacing badly worn ones.

10. Ropes

Fact of life: ropes will wear, one weak point is where the rope constantly flexes going through the garter hole onto the wheel, the rope life can be extended by moving this an inch or so at a time before the wear gets too bad, but move it into the wheel thus shortening the rope. When the time comes for a splice, make sure the splice is away from the flex point by 2-3 feet if possible. Normally the garter hole is too small to allow a splice to pass through and in any case you need unused rope at this point. Use of a long splice will enable this to pass through ground pulleys better than with a short splice.
Another wear point is where the rope hits the floor; again a splice can be effective but keep it at least 1 ft. from the bottom of sally so that a new rope may be machine spliced at some future time. Polyester tops do last much longer and are not affected by humidity so less rope adjustment when the weather changes.

11. Tower structure

Keep an eye on the tower, look out for signs of dampness and water entering, make sure birds are kept out and that any wire mesh screen is replaced when necessary. Where frame supports enter the wall look out for loose masonry or cement indicating movement of the support frame. If you do find signs of movement then at least get further opinion and its worth advising your church architect. Steel work does need painting every 10-20 years depending on conditions.

12. Other comments

It helps to have methodical approach to inspection and maintenance as this avoids missing pointers, keep a record of what you've seen and any work carried out.

Do also keep your Churchwardens up to date with what is required. It can also be quite helpful to know your church architect so that any observations or comments he may have can be informally discussed. Remember, even minor work affecting the fabric of the church has to be considered and agreed by the PCC, and could quite possibly require a faculty, so prior discussion with the Churchwardens and architect is more than just courtesy.

13. Other useful items

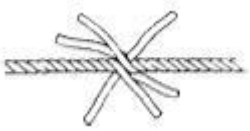
Muffles: Make sure these are in good condition, not a panic the morning of Remembrance day!
One normally muffles for the backstroke.
Rule to remember is "side (of clapper) away from the rope".

Broken stay: the rope could now be the wrong side of the bell so to correct will need pulling right up and dropping down again or if this is a problem with rope chutes and extra floors, untying and then retying on the correct side of the wheel.
Make sure the new stay is same length and cross-section and does not rub on the side of the frame when the bell is rung.

Rope height: a good guide for correct height when changing or adjusting a rope is to have the bottom of the sally at "nose" height, need to be under tension as slack in the rope can add 3" or more.

Odd- struckness: a major cause is the clapper not being exactly centred in the bell. Check that the distance from clapper ball strike point to the bell strike point is the same on both sides and adjust as appropriate. On modern bells there are bolts on either side of the headstock which are used to centralise the clapper assembly in the headstock. (On earlier fittings one has to resort to tapered leather washers to achieve anything).

Rope splicing: Just a short note to describe the technique, really needs demonstrating!



Step 1 - First unlay both ropes for a short distance and bring them together so that the main bodies of the ropes fit snugly and the unlayed strands mesh; alternating a strand of one with a strand of the other. Sealing or taping the strand-ends of ropes will prevent their unraveling. It is helpful to temporarily tie the strands of one rope to the body of the other rope.

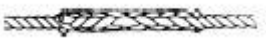
Step 2

Tuck one of the unlaid strands over and under a strand of the opposite rope, working against the twist. Take the unlaid strand, next to the strand just tucked, and tuck it over and under the next strand in the opposite rope. Do the same thing with the remaining unlaid strand. Now, take one more tuck with each strand**.** Keep a reverse twist on the strand.

Step 3

Remove the temporary tie and make two tucks with the other three strands. You now have the strands of each rope tucked two times through the strands of the other rope. Now, go back and make at least three more tucks with each of the six strands . . . four additional tucks are recommended for synthetic ropes.
To get a neat splice you need to taper the strands after 3 or 4 tucks, carefully cut out two strings and then tuck in. Reduce to about half the strings as you go.

Step 4



Roll the splice under your foot, or a board and clip off the ends of the protruding strands.
(Do not clip the ends too close to the splice).

(If one is considering splicing polyester onto hemp then same rules above apply except you need to melt the ends of each string within a strand together to stop unravelling.
You also need pre-stretched rope. Marlow ropes make a 3 strand 10mm polyester prestretched; i.e with a stretch of 6% at 60% of breaking strain. This ensures there will be no stretch under normal ringing conditions. Specify this and you should be OK!)

14. Maintenance check list

Not exhaustive, but just a reminder of things to do.

Monthly

Check ropes for wear, around garter holes, at pulleys, intermediate floors, other wear points.
Check stays for cracks or looseness. Check sliders are free running.

Three monthly

Check that all pulleys are running freely, grease or oil if appropriate.
Look for any excessive looseness on the shaft.

Six monthly

Check wheels, check nuts/bolts for tightness particularly onto the headstock.

Check clapper pin securing nut is tight.
Lubricate clapper if appropriate.
Check clapper for excessive movement.
Check nut securing clapper on headstock for tightness.

Annually

Check headstock/gudgeon nuts where appropriate
Check also that bell/headstock frame is not out of alignment with frame – indication of broken gudgeon.

Check frame bolts & ties for tightness.

Keep nuts and bolts oiled to prevent rusting and makes for easy tightening.

Watch for signs of corrosion, water entry, birds getting in, damage to mesh over louvers, etc. and correct as necessary.

Updated May 2016