Punch Your Own Organ Rolls
(with Computer Help)

Mike Knudsen

Punching your own rolls adds a new dimension to your enjoyment of organ grinding—and to your listeners' pleasure as well. Here I describe my method whereby the computer does the "thinking" so you can do the work.

Why arrange and punch your own music?

> •Perhaps none of the professional noteurs has your desired tune available, in time, at a decent price, for your model of organ.
> •You prefer your own style, especially if it's your own composition.
> •You get the extra satisfaction of putting something of yourself into the organ besides turning the crank and changing stops.
> •You're a budding musical composer or arranger looking for an outlet for your talents.
> •And some of your listeners will be quite impressed with your own contribution when you tell them about it. They see you as a musician, not just a cranker. People like to see something you've made yourself.

Can I Do It, and What Do I Need?

Of course you must be able to make musical arrangements, or at least to modify existing ones (such as piano sheet music) to fit your organ's scale. Granted that you are, and can notate your arrangement on sheet music paper or a computer composition program (or can get someone else do it), let's consider what you must do to make a roll.

The time-honored method used draftsman's tools to lay out the roll on a drawing table. Past experts learned to think in terms of such layouts, but for a beginner this is difficult and prone to mistakes, which are hard to correct. But, this does introduce t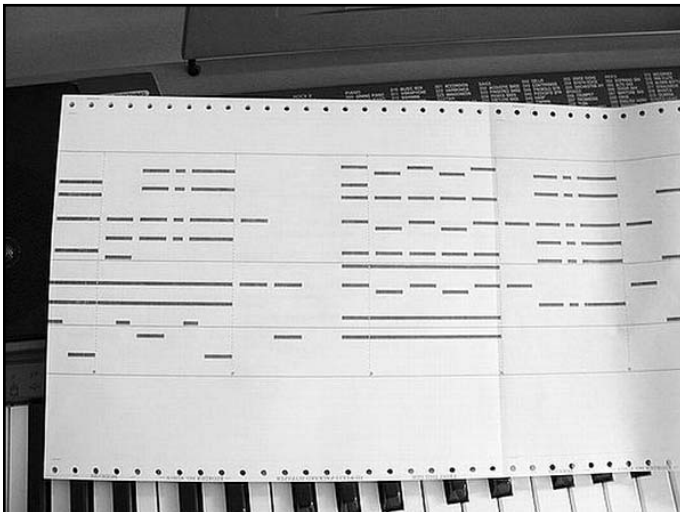he concept of marking the roll paper with pencil or ink before cutting the holes, which is the basis of my computerized method. And if you do dodge the computer and lay out your music by hand, you'll find most of this article useful.

In my scheme, you enter the music into a computer program in a form you prefer—sheet music score notation, MIDI sequences, and/or "Piano Roll View" editing. You edit the notes as needed to fit your organ's range and scale, letting the software check for any "illegal" [*wrong—Ed*] notes not on your organ. Meanwhile you audit the music by ear, playing your arrangement thru the computer's sound card, until it sounds right (if you don't like it, why should your audience?).

When you're satisfied, the computer prints out an image of the roll onto continuous fan-fold printer paper (**Figure 1**). Do the zig-zag paper folds remind you of Dutch street organ book music? Good, but we'll be rolling it up later. After trimming the paper to width and reinforcing the folds, you punch and cut out the printed portions, and voila! Ready to crank and enjoy!

Figure 2. Sheet music notation visible on the computer screen.

Computer Software

I'll be talking in terms of my own program, *UltiMusE*, which I started writing in 1985 and continue to upgrade to this day. It runs under Linux. You may prefer to use a different program, such as Cakewalk(tm), probably under MacOS or Windows.

Whatever composition program you use, it should allow you to:

> •Enter the music in a form natural to you, or import it from a MIDI file. Mine supports standard sheet music notation (**Figure 2**).
> •Transpose it to different keys, to find one that best fits your organ's scale.
> •Easily add, delete, and change notes, especially their length.

Figure 1. The computer print-out on a folded length of paper.

•Listen to the score via your computer's sound card or an external synthesizer.

•Audit to find "illegal" notes that are not equipped on your organ (like B-naturals on Raffin 31er).

•Print it out on a dot-matrix printer in organ roll format.

Every decent music program allows all of the above except the last step. I have built the printout function into *UltiMusE*, but for you the easiest way to do this may be to convince me to write a utility program to take a MIDI (.MID) file and print it out as a roll. Any music program can write out a MIDI file.

Printer Requirements

You need to find a dot matrix printer that does graphics (all but ancient models do) and has tractor feed for fan-fold paper, as in **Figure 3**. Dot matrix machines are obsolete for home office use today, replaced by ink-jet or laser printers that spew out individual sheets. These sheets would be a lot more work to splice into a roll. Dot-matrix printers are still available in computer stores, since businesses use them to print carbon copies (and how "obsolete" are our organs, anyway?).
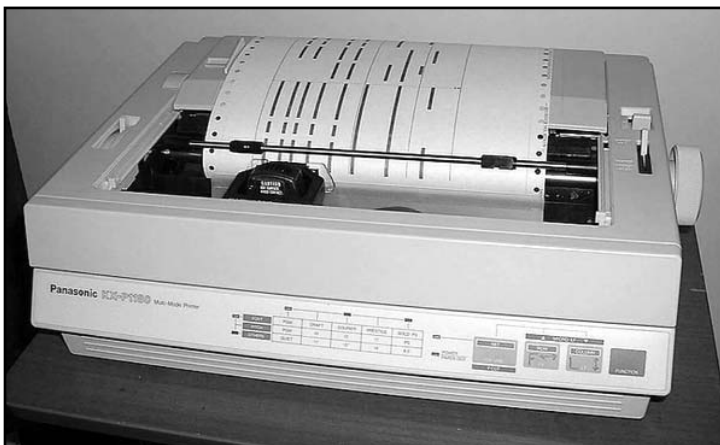

Figure 3. A dot-matrix printer needed for template production.

But before spending $300 for a new one, try to find a used dot-matrix at a garage sale or secondhand shop for a fraction of the price. Make sure its graphics mode is "Epson-" or "IBM-compatible; most are, otherwise be sure to get the manual with it, which explains the graphics codes, as we will need that to make you a MIDI-to-print program.

Arranging the Music—Get It Right First

Musical Articulation Really Matters

Articulation or phrasing refers to deliberately shortening some notes to get a better musical effect, just as phrasing in speech makes the difference between poetry and just reading weather reports.

Usually a musical "phrase" is a series of full length (legato) notes with a shortened (marcato or staccato) last note to mark the end, before the next phrase begins. Sometimes the music suggests a smooth, legato style, where each note flows into the next one, while marches sound more crisp and vigorous with marcato notes that leave some silence or "daylight" before the next note.

You should edit all this in the composition program, that you use, and listen very critically via your PC's sound card until it sounds right. Be sure to use organ or wind instrument sounds, not piano, so you can hear where notes end. When in doubt, avoid legato notes and go for the crisp, clean marcato sound. You can fool the ear and "accent" a note by ending the previous note early. It's hard to believe how much difference proper phrasing can make to the listener appeal of a musical performance.

While your sound card can play a legato note followed by another note of the same pitch, your organ cannot do this! The first note must be marcato and cut off early! So repeated notes of the same pitch must have enough paper space between them so they do not run together when sounded. You can't follow a legato note with another note of the same pitch; there must be "daylight" in between for the organ action to attack the second note, and for the ear to hear it.

Use your program's Piano-Roll View mode (as in **Figure 4**) to audit note lengths and to check for overlapping notes. Overlaps are another nasty problem with small organs, whereby a short note of an accompaniment chord, say, is lost because it lands on the same note as a long-held melody note. Such notes must be deleted or moved to another pitch in the chord.
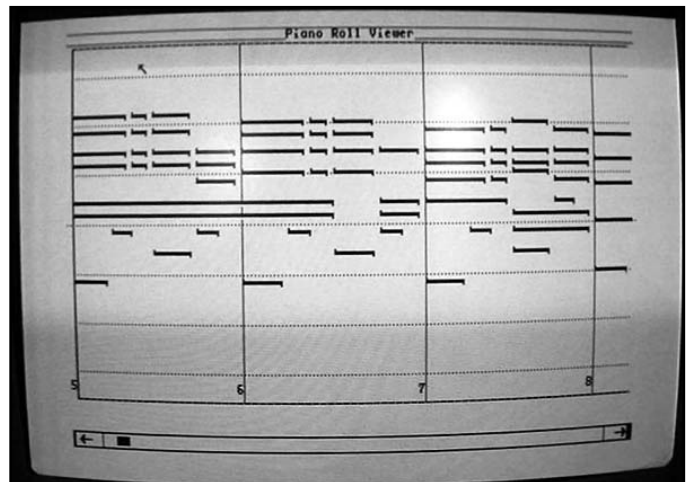

Figure 4. Piano Roll View mode as seen on the monitor.

Horizontal Tempo Scaling

The vertical scale is determined by the holes in your tracker bar, but how fast should the flow of time spread across the paper? How long, on paper, is a quarter note? This conversion factor is built into my software, but where did I get it? One guide is an existing roll with a musical selection whose tempo sounds right at a comfortable cranking speed. The distance between the first notes of two adjacent measures is the right spacing for that time signature and tempo. That's how I arrived at my time-per-inch scaling.

However, you may want to turn the crank faster than normal if your arrangement has heavy chords that would deflate the bellows if cranked slower. If so, then "lie" to your music pro-
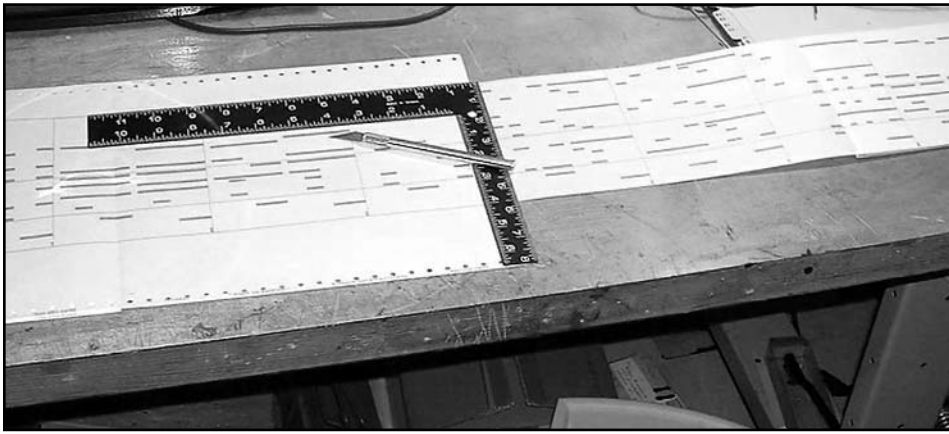
Figure 5. Triming the roll, using a carpenter's square and an Xacto knife.

roll's width, and carefully lay it along the crease, centered on the crease. You must have excess tape on each end, to guarantee that the crease is reinforced at the edges. The excess tape will tape the paper to your cutting board. Just cut the paper loose at each side, scalloping the cut inwards a little towards the roll's middle. You can then peel the little tabs of tape off the cutting board when finished. **Figure 6** shows the essentials—tape, the knife, a good light source, an organ spool to hold your work, and a radio to keep you awake during the process!

gram and give it a slower tempo. This will spread the notes out longer on the roll and use more paper. You'll naturally crank it faster to bring it up to correct tempo.

For a light piece that doesn't use much wind, you can do the reverse—program a faster tempo, so you can crank slower and save your arm!

From Printout to Playing the Roll

Several steps are needed to convert the printout (Figure 1) into a playable organ roll:

1. Trimming—the excess width is cut off both sides, using the printed edge lines as guides. A large work table is a big help, with some kind of posterboard laid over it to absorb the knife cuts and protect the tabletop and knife blade. By unfolding the printout stack in just the right pattern, you can arrange to cut two or three sheets at a time, but don't try more than three. **Figure 5** shows how it's done.

Use a steel carpenter's square and a fresh, sharp Xacto knife or equivalent. Be very careful to cut inside the edge line— it's far better to cut the roll a little too narrow than too wide. Organ scales are very forgiving of a little roll wandering (unlike those pesky 88-note piano rolls), but if the roll is too wide at any point, just a tiny bit, it will snag on the roll flanges and in the organ and stress the paper.

2. Taping—the fold creases are reinforced with a strip of library-quality mending tape, or Scotch "Magic" Tape. The creases are too weak to last long without the tape strip across them. Simply tear off a piece of tape a little longer than the

Once a crease has been reinforced with tape, it will no longer fold. Don't try! Start rolling up your new roll. The photo shows the taped paper being rolled up onto the organ spool. After taping the first few joints, it's time to fasten (tape) the end of the new piece to your empty spool, using a blank trailer section (see below). Roll up the sheet as you tape it, then feed it out as needed in later steps. Or without the spool, just coil it up by hand and secure with a clothespin. Note that the taped-over zigzag perforations no longer matter; you just roll up the continuous sheet.

Figure 6 also shows that you should work from the end of the tune towards the front, so the rolling up makes sense in your organ!

As you roll up each sheet as taped, be alert for the paper edges scraping on the roll flanges. This is a sign that you've trimmed the paper too wide. If so, unroll the offending section and use the steel straightedge and a very sharp knife blade to trim just a sliver of paper off the edge.

Buy some empty roll spools from any of the roll music suppliers, or your organ's maker. Or you may splice the new sheet onto the beginning of a tune already on an existing roll—see "Splicing" below.

Figure 6. The tools needed for taping together sections of the roll.

3. Editing—with a felt tip pen, mark such things as chaining of long notes, and shortening repeated notes by moving their end points closer to the beginning (never move a note's beginning). Draw a wavy line to delete entirely unwanted notes. If your computer software takes care of such things, you can omit the shortening and other
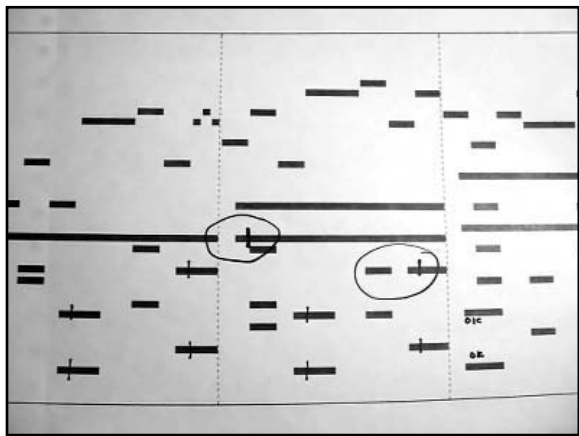
Figure l7. Articulation and repetition marks have been circled on the stencil.

articulation adjustments. Organ valve actions take longer to shut off a note than to turn one on, so notes should be arranged a bit "marcato" or even "staccato" so they end on paper earlier than they will actually stop sounding on your organ. You can do editing before trimming or taping, preferably without the radio, so you can hear the music in your mind. **Figure 7** shows some articulation and repetition marks, circled.
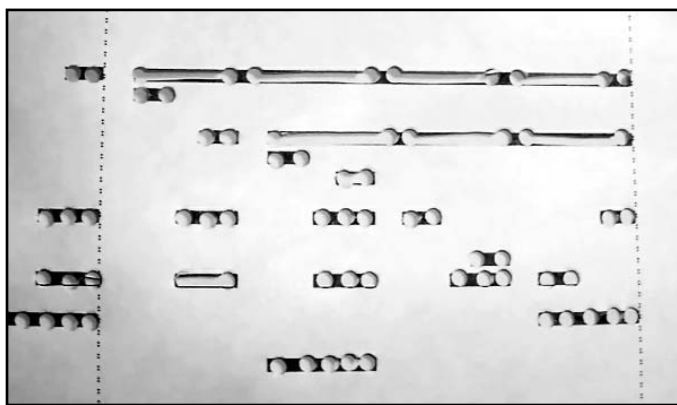
"Chaining" means breaking up a long note into several shorter perforations, leaving little "bridges" of paper between the cut-out sections. These bridges strengthen the paper and keep it from squeezing inward, tearing, and other nasty effects. The bridges should be just long enough to cover a tracker bar hole, or a little less. Organ valve actions can't shut off fast enough to break up the sound on the bridges. **Figures 8 and 9** show punched and cut examples.
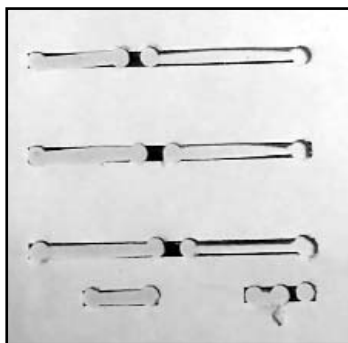

Figure 8 (top). An example of punched "chaining."

Figure 9 (above). An example of cut "chaining."

Each chain "link" perforation (after it's punched and cut) should be no more than 2" or 5 cm long at the most, and much shorter if it's near either edge or other long notes. Chaining is best done by hand and eye, taking into account other nearby notes so you don't put the bridges all in the same place. After you've gained some experience, you can skip marking chains in the editing phase and lay them out as you punch.

4. Punching—the beginning and end of each note is punched out with the center punch (see "Making A Punch" below). Chaining of long notes must be planned and punched at this time, if not already marked during Editing. Make sure each hole is punched clear through, as "swinging chad" is very distracting during the next step, the "Cutting" step.
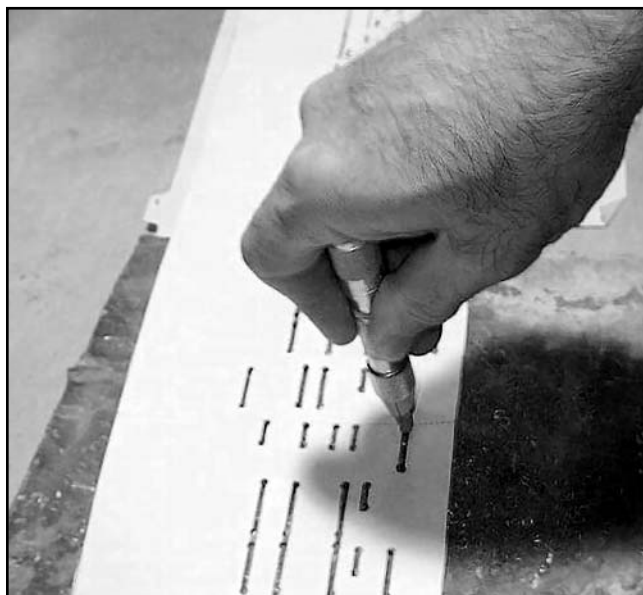

Figure 10. The punching process, done correctly, leaves no "swinging chad." Here, lead is used as the firm back surface.

The paper being punched must be backed up by an expendable, firm but pliable material, which rests on a solid surface such as a very strong workbench or a concrete floor. The best backup material is lead sheeting, such as used for chimney flashing by roofers, but shirt cardboard or a few layers of manila notebook divider sheets also work. Lead is best, but be sure to wash your hands after each punching session. **Figure 10** shows lead.

It's possible to skip punching (and making a punch tool), just by cutting the crosswise start and end edges of the printed perforation with the same knife used in cutting. However, the sharp corners this leaves may be prone to tearing when the roll is played a lot, so be careful not to overcut the ends.

5. Cutting—the punched holes are connected by cutting with the same sharp knife (*Xacto* brand). You should be able to do this freehand, certainly if you have "chained" the long notes into short enough "links." Use shirt cardboard or manilla sheets for backing. Figures 8 and 9 show freehand cuts between the punched holes. I cut my strips narrower than the holes since my punch is a little wider than it should be.

David Wasson, builder of the organ, "Trudy," made himself a double knife, with two blades spaced the width of a perforation, so he could cut it with a single stroke, but I'm content to make two cuts with a plain Xacto knife. If you've edited the chaining correctly, each knife cut will be less than 1.5" or 4 cm. Keep the blade sharp—a pack of fresh blades is cheap.

I like to punch several feet of music at a time, then roll it back and do the cutting. It depends how quickly your hands get tired of the one task or other, and how fast you get bored!

You may notice some commercial rolls are punched completely with circular holes, no straight cuts. Each note starts with two or three overlapping holes to make a solid opening, then followed by a "chain" of closely spaced holes, as in some notes of Figure 8. If you really like punching holes a lot, you can do this, but I'd rather rest my arm and connect the dots with a knife.

Finishing the Job—Assembling the Complete Roll

A completed roll, ready to play, has many sections of paper spliced and wound onto the spool:

> •A tab, to attach onto the organ's take-up spool
> •A leader, a few feet of blank paper
> •The first piece of punched music
> •A spacer, a few inches of blank paper before the
> next musical piece
> •The next piece of music
> •A trailer, blank paper that's taped to the bare spool

You'll assemble the sections in the reverse order, from the bottom of this list up. Fasten the trailer to the empty blank spool with just one snip of tape in the center; if you overdo this tape, the paper will not be free to wind up straight on the roll. Then splice the other sections together.

To make the blank sections, just "compose" a few bars of silence and print them out as music, then trim and tape the fold seams as usual. If you put several silent measures at the end of each piece, you'll get the spacers and trailers for free. I also "recycle" sections of music that I printed and trimmed but found errors before punching.
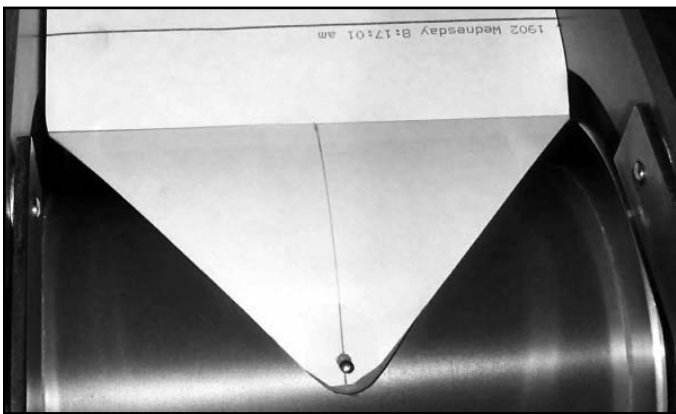

Figure 11. The finished roll tab, neatly inserted on the take-up spool of the organ.

To make the tab, I use thin, flexible cardboard, like the manila notebook dividers. Cut this into a triangle, more or less equilateral, with its base exactly equal to the roll width. Splice that to the roll leader. At the point opposite, which will attach to the organ's spool, I snip a little bit off the end to square it off, leaving a flat edge of about one cm.

I fold a couple pieces of tape over that edge to reinforce it, then punch a hole for the organ's grabber tongue to pass thru.

Figure 11 shows the finished tab in the organ. Alternately, you can buy replacement tabs for player piano rolls from QRS, to glue onto the tip of the triangle, after snipping off more than you would for the homemade hole.

Tools and Techniques

Making A Punch

Hollowed-out center punches used to be available, but you can have your own made from a carpenter's spring-loaded center-marking punch (**Figure 12**). First the bit (tip) is removed and annealed (softened) by heating it red-hot and then letting it cool slowly. It's dangerous and impossible to work the metal without first annealing.

Figure 12. A hand-made, hollowed-out center punch.

Next grind the sharp tip off, leaving a flat butt end. Using a metal lathe, turn down the diameter of the bit to the desired hole diameter, plus several thousandths for the wall thickness. Turn down only the last 1/8" or so of the punch bit, leaving the rest of the metal for strength. Then the bit is hollowed out with a drill bit mounted in the lathe's tailstock, where the drill size is several thousandths less than the punch's diameter. Drill to a depth of at least 5/8". Don't drill beyond where the bit will be surrounded by the punch. Next sharpen the tip by holding a file against the edge while the piece turns in the lathe. Finally, use a Dremel tool to grind a notch from the outside into the end of the center hole, to let the chad holes out. **Figures 13 and 14** show the finished product

Before use, the punch bit must be re-hardened, by heating and quenching. A machinist knows how to do this, like my friend Keith Taylor who made my punch. Once hardened, the tip should be sharpened again. It will punch many meters of roll paper before needing re-sharpening.

Splicing

When joining two pieces of roll paper, it's important to get the joint straight. Otherwise the paper will not roll up tight and solid on the spool, and will wander back and forth on the tracker bar while playing. Small organs will tolerate the wander, but the inability to wind up the paper tightly is sloppy and bad for the paper if it extends beyond the roll flanges.

Figure 13 (above). A finished hollowed-out center punch.

Figure 14 (below). A close-up of the punch.

I know of two good splicing techniques. My own method is based on giving each end a straight cut exactly at right angles (square) to the edges, then butting the two cuts together perfectly by eye and applying tape. Since my computer program prints lines across the roll to mark measures and beginning and end, I usually have a line on which to lay my steel straightedge to guide my knife. If I have no such line, as on an existing roll that I'm adding my work on to, I use the steel square to line up with one edge of the roll and get a right-angle cut.

Then I weight down one end on the table, hold a short piece of tape in one hand, and use the other hand to align the other edge perfectly with the weighted-down piece. If the backing material under the roll (maybe just the table top) is not the same color as the paper, your eye will know when the two ends are aligned, with the gap the same width across the paper. The edges need not quite touch and should not overlap. When they appear aligned, carefully slip your tape over the cut, near the center. Then, being careful not to disturb the papers, peel off and lay down a strip of tape just a bit wider than the roll, as if reinforcing the fold creases. Trim as needed.

Another splicing method is good when you have two irregular ends to join, suggested by organ and roll dealer Hal O'Rourke. Line up the opposite pieces so the ends overlap. Weight down each piece solidly, and use a long straightedge to make sure they're exactly parallel and lined up at the edges. Lay a small steel ruler over the overlap and cut with a sharp knife, cutting both pieces in one stroke. You needn't cut at a perfect right angle, since the two ends will naturally match.

Now, with the weights still holding firmly, bend each cut end upward if necessary, so each end is up in the air off the table. Peel off a full-width and longer piece of tape, and carefully slide it upside-down (sticky side up) along the table under the two cut edges. Do this with one finger stuck to an end of the tape piece. When it's in position, with the other hand push down one edge, then the other, of paper onto the tape. Trim as needed. This method does put the tape on the bottom of the roll, toward the tracker bar. I like the tape away from the bar, so I'd turn both sections over before doing this.

Holding Box for the Loose Working End

As you're editing, punching, or cutting a trimmed and tape-reinforced musical piece, the "supply side" may already be spliced onto the spool (recommended), or kept loosely wound up and held with a clothespin or large paper clip, which you'll need to release and re-seat as you unwind more music to work on. What about the loose end that you've already done?

If "Da-Da" and "Meow" are not household words, you can just let it pile up on the floor off the right hand side of your workbench, being very careful when you wind it back up to deal with twists, snarls, and catching on the table's edge. Works for me so far.

Better to make a holding box to go on the floor. Make it at least a meter long, at least half that much high, and just a little bit wider than the roll paper. Cut up big cardboard boxes and put the halves together with duct tape. As the finished paper goes over the right edge of your table, the paper should pile up in a rounded zig-zag in the box, as in a Link orchestrion. It will pay out neatly as you wind it back onto the supply roll, turning it in your fingers. To take a break, just set the unworked paper roll on top of the paper folds and lift the box to a safe place.

Fixing Mistakes with Splices or Tape

What if, after you've punched and played the roll, you find a mistake, or change your mind about a few notes? If you have a lot of changes in one short section (a few bars), you may edit in your composition program, re-print just those measures, edit, punch, and cut them, then cut the bad section out of your roll and splice the new one in place of it. My program prints a cross line at each bar, along with the measure number, to make splicing cuts easier, and to find your place in many meters of roll.

But a few isolated errors can be patched by covering with tape. Use the same good quality library tape as for reinforcing the paper folds. The piece of tape may have to cover some correct holes too; just punch and cut them out again. Underneath the bad holes that you want covered, rub some talcum powder or oil from the shiny side of your nose on the back side of the paper, to keep the tape from sticking to the next layer when wound back up on the roll.

For future reference and sanity, remember to copy any tape patches into your computer version of the score, in case you ever re-print that music.

Obtaining the UltiMusE Program

If you run Linux on your PC, you can download UltiMusE for free from my Web site:

http://members.aol.com/knudsenmj/myhomepage/index.html

Here you can also hear some of my compositions that I've punched, or will punch, into 31er organ rolls, such as *St. George's March*, *The Homely Coed*, and *Fighters of the Flames*.

> Mike Knudsen is a retired telephone and computer engineer. He begin collecting mechanical music in 1973 and is a member of COAA and MBSI. He lives in Maine.