

THE DUO-ART EXPRESSION BOX

There has been a lot written about the Duo-Art expression box. One of the most misleading comments that still seems to prevail from time to time is the belief that once the accordion pneumatics are perfectly gapped, this in turn invariably creates a perfect Duo-Art expression system. I think you will see that there is a bit more to it than that. Read this short article and see if you don't agree-- there's more to this pneumatic device than one can tell you by just reading about them.

The "ideal box" (although there is no such thing) will make a perfect linear chart with the step numbers going across the chart and the pressure measured with a fixed bleed leak at either output elbow, going up the vertical axis. Straight lines are not really possible in real life, but one can get it fairly linear. It's amazing actually how close to the ideal they will get. The Theme slope should be greater than the Accompaniment slope, because the rate of the theme spring measures half that of the accompaniment spring, due to its thicker wire.

Most of my measurements and charts have shown that when you begin the Theme at 5.5" and the Accompaniment at 5" of vacuum water pressure, you will usually end up at 40" and 28" respectively, in a reasonably straight line at the far top right-hand corner of the page with little or none of that lazy 'S' curve so common with typical mechanical contrivances of this sort. Not that they don't naturally tend to prefer that, but it is possible to overcome it.

For all those rebuilders who believe that by merely adjusting the accordions perfectly they will have a perfect box, I think they have a rather large surprise in store for them. The Duo-Art expression box is a complete system in itself, dependent upon many, many interacting parts, all of which (except the spill felt) move. Change one, and you have to change them all. Just simple things like spill spring tension can change what you are getting when you chart the box, so when you replace the box and add expression lever tension, that too subtracts from the accordion speed and hence the depth and effect of some quick expression codes.

The most troublesome of all the box's problems can be shaft run-out or wobble and/or tight or misaligned knife valve hook wires inside the "regulators," as the felt bushings in the box and the holes they are glued into can allow the shaft to deflect. Also there is the problem of the accordion brackets deflecting slightly as they operate, and especially the two accordion shafts are quite often too tight for a variety of reasons, making them have too much static friction and it causes a return error, preventing the accordions from returning quickly enough or at exactly the same place, given the same expression code. When a difference of just 1/32" in the step 1 accordion can make a 1.5" vacuum difference at "Zero intensity," and when a total system like this box can only be held to a 1/16" overall tolerance at best, then I think you get a more accurate picture of what you're up against, and how difficult it may be to do what you would like to do.

What most rebuilders do to improve repeatability is to increase the spill spring tension. This is exactly wrong! They exchange poor repeatability with a slow box (*another characteristic of a good box that I'm not even covering, here*). But then, they worry that if they ease the snugness of the top accordion shafts to prevent rotational friction, they will cause the shafts to deflect laterally and create more non-linearity (which is correct). That's why doing a Duo-Art box is an artistic tradeoff that may require a full day of my time just to get it absolutely right again (and I've been doing these for years). That's why it's really not possible to explain all of this in a letter. This box is a Rube Goldberg trapeze act. You either figure it all out and then take the time required to chart the box and keep doing it until it's right, or you say, "That's good 'nuf." How critical are you?

By the way, all this testing begins with some good gauges and specially built testing equipment for the purpose, plus a very accurate bench pump and regulator, and a box fixture that allows you full access. Centrifugal suction boxes will NOT work. You must have a positive displacement Duo-Art pump if you want it absolutely right and if your figures are going to mean anything. This all takes a lot of preparation and time. Then your first box or two might take 3-4 days of work and you might find yourself saying, "This is impossible." One thing for sure-- it isn't cost-effective, and few can tell the difference between mediocre and just right.

I mentioned the accordion settings earlier. The accordion settings should be set approximately right to begin with. That gives you a good base to start with. But as anybody can see, the degree of closure depends on 3 things-- a screw, a cushiony soft felt pad, and the actual pressures being generated at the time. The third item-- the pump pressure-- varies, varying the depth that the screws can bury themselves into the felt cushions, during play. Then after the box's many other parameters and adjustments and easings have been optimized, the perfectionist will return to the accordions and rescale them for a perfectly linear static adjustment of the box in both Accompaniment and Theme slopes.

The regulation requirement of the Duo-Art box is that the settings of Accompaniment and Theme at their Zero intensities are such that the Theme will always take precedence over Accompaniment. That can only be done if the difference in their preset level is great enough to raise the one way flap valve for that side. For all practical purposes, and for the characteristic of the average piano, that level is about 1/2" difference (not always, but usually). So you always begin with the box zero adjustments begun at the ideal level with an approximate fixed bleed of about 3/32" or so. Too small a fixed bleed, and you will get possibly more ideal charts, but not very good linearity in actual practice, and you will have to do it all over. But then again, the sizes of those bleeds depend in large part on the pump capacity, because the Duo-Art system is also scaled to gas out the pump and its own capacity drops at a predetermined rate as demand and pressures increase.

Craig Brougher