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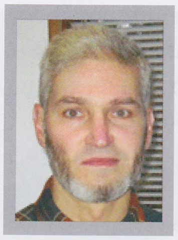


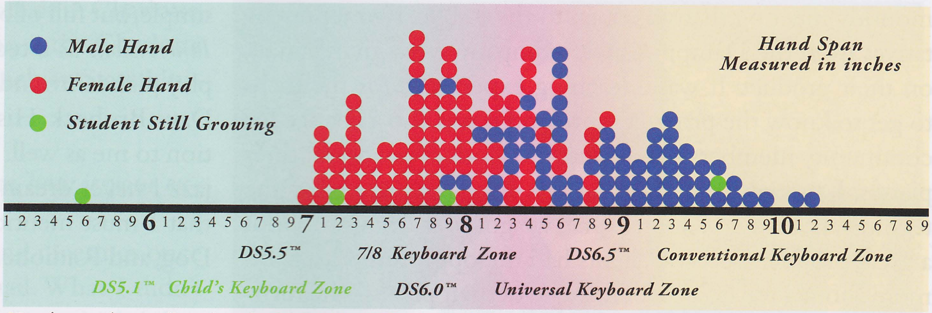
Alternate Keyboards for the World

The Donison-Steinbuhler Standard

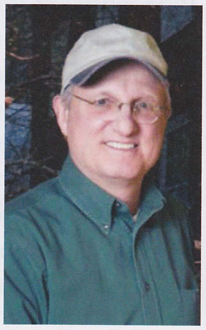
By Richard M. Brown, RPT
Tucson AZ Chapter

There is an aura of inevitability enveloping the Donison-Steinbuhler keyboard. Someone had to invent it, but why it took 300 years after Cristofori's invention of the piano defies explanation.[1]

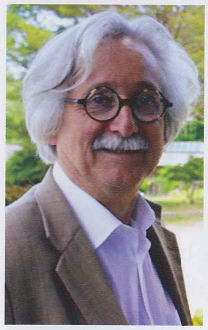
An analogy to the realm of astrophysics spans a comparable time scale. Johannes Kepler showed that a planetary orbit is elliptical, the planet sweeping out equal areas in equal times.[2] From this observation, Isaac Newton developed calculus to derive a law of gravitation: a force proportional to the product of the masses, inversely proportional to the square of the distance separating them.[3] Three hundred years after Kepler's planetary motion treatise, Albert Einstein published his General Theory of Relativity, using non-Euclidean geometry to quantitatively show how mass distorts space and time itself.[4]



Hand span data, collected at the 2004 Music Teachers National Assoication convention.



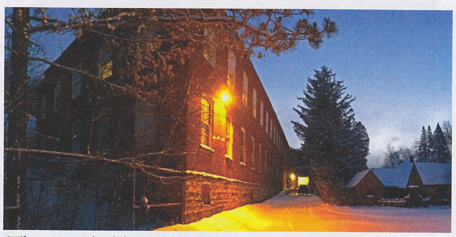
David Steinbuhler



Christopher Donison

Titusville, Pennsyvania

Two hundred and twenty years ago, Jonathan Titus settled in an area in the northwest corner of Pennsylvania that he named Edinburg.[5] By 1810, it was generally known as Titusville. The town grew slowly until 1859, when drilling tapped into a major oil reservoir. According to the 1850 census, the town's population was 250, but it grew rapidly to 9000 by 1880. As oil production declined, so did the Titusville's population, estimated now at 5400 and dropping steadily.



The Steinbuhler ribbon factory.

Steinbuhler Ribbon Factory

The Steinbuhlers came to Titusville in 1897, where William Steinbuhler established a textile factory. The business remains within the family to this day. David Steinbuhler (William's grandson) began work at the factory in 1971. A self-taught engineer and machinist, David has designed and built ribbon manufacturing machines, several of which still remain on the production line. In the days of his youth, one was expected to master all the skills required to operate the factory. David modestly considers this basic competence.

Twenty years' experience on the factory floor conferred mastery of woodworking, metalworking, and machine tools. He studied piano in his youth and maintains a modest repertoire of classical music. These skills coalesced by chance in 1991 when he met Christopher Donison, a performing Canadian pianist who had designed a custom keyboard for a Steinway D.[6]

The standard piano octave spans 6.5" (165 mm) on the keyboard. Donison's custom keyboard had a 5.5" (140 mm) octave, 7/8 the octave span of a standard keyboard. David was fascinated with the engineering ingenuity, and the two discussed the possibility of commercial production. Thousands of promising pianists struggle with repertoire too difficult for them because their hands are too small. If it were possible to offer them an alternate keyboard uniquely suited to their hand size, this could be the most important innovation in piano technology since the invention of the instrument.

The Donison-Steinbuhler Standard

A summary of the Donison-Steinbuhler cooperative effort was submitted to the Piano Technicians Journal and

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[1] <https://en.wikipedia.org/wiki/Bartolomeo_Cristofori>. Bartholomeo Cristofori di Francesco (1655–1731). The piano is thus an unusual case in which an important invention can be ascribed unambiguously to a single individual, who brought it to an unusual degree of perfection all on his own.

[2] Johannes Kepler, *Epitome Astronomiæ Copernicanæ* (1618-1621).

[3] Isaac Newton, *Philosophiæ Naturalis Principia Mathematic* (1687).

[4] Albert Einstein, *Die Feldgleichungen der Gravitation, Sitzungsberichte der Preussischen Akademie der Wissenschaften zu Berlin*: 844-847 (25 November 1915).

[5] <https://en.wikipedia.org/wiki/Titusville,_Pennsylvania>.

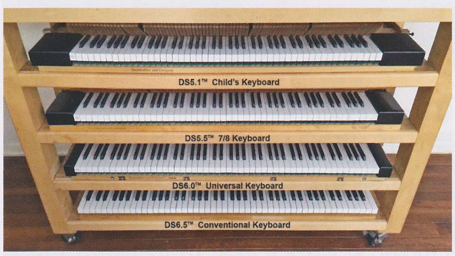
[6] <www.chrisdonison.com/bio.html>.

published in the July 1998 issue.[7] I was very impressed by that article, but concerned about the omission of the finger width parameter. The Journal published my letter to the editor that raised this issue, along with David's response.[8,9]

Research has confirmed what we all know: It takes a large hand to competently play a conventional piano keyboard. Relatively few of us are so endowed.[10]

Commercial Production

There were many technical and design issues to be solved before commercial production. David worked patiently on these for five years. By 1996 he was ready to launch his business, D.S. Keyboard. His shop is on the second floor of the ribbon factory.

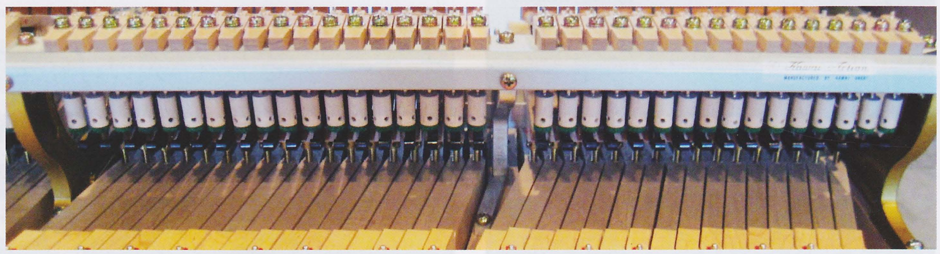


These alternate DS™ keyboards, stacked in a mobile cart, fit a Steinway B in David's home. A prospective client can test each of them before purchasing, a process important to making an informed decision.

Hand span is not the only factor to consider when selecting an alternate keyboard. The sharp keytops adjacent to G and A must provide sufficient clearance for the third (middle) finger.[11] This is less critical for the black keytops adjacent to D, because that clearance is greater.[12] There are two ways to improve middle-finger clearance: narrow the sharps or taper them. Too narrow, and the fifth finger tends to slide off the black keytop.

Tapered sharps.

Bob and April Larson. Two computerized machines make most of the parts. The milling machine (left) makes all the metal parts for the actions. Bob built the router shown behind April's left shoulder. Note the cutout of the foam shipping insert on the work table.



Machined aluminum action bracket.

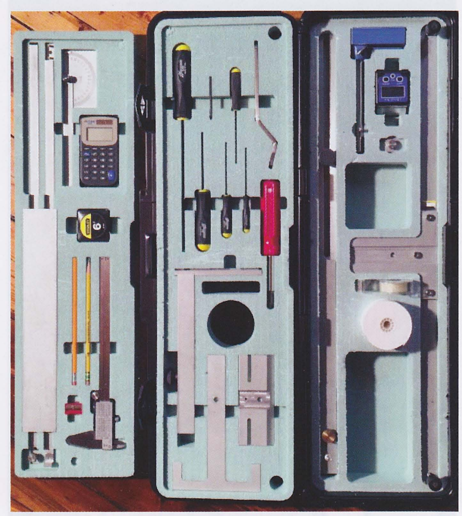
Measurement Jigs

Once a client has selected the appropriate alternate keyboard, he/she must decide whether this is to be a permanent retrofit or a replaceable keyboard. The original keyframe and action suffice for a permanent retrofit. A replaceable keyboard requires a new keyframe, reproduction of the original action stack, and replacement hammers. Most clients purchase a replaceable keyboard for a performance-quality instrument used by more than one musician. It takes only a couple of minutes to swap keyboards.

The heel of the custom key must precisely engage the damper lever, and the capstan must precisely suspend the heel of the wippen. The mid-treble action bracket must be modified due to the more acutely angled key dogleg.

Exact reproduction of the keyframe is one of the more time-consuming aspects of creating an alternate-size keyboard. It is rarely practical to ship or transport the original keyframe to David's shop—most musicians would be seriously inconvenienced without a serviceable instrument. The workaround is a data sheet containing precise measurements of the keybed, dampers, glides, capstans, string heights of all five sections, cheek block pin locations, keyslip position, and a number of other critically important parameters.

To facilitate accurate measurements, David has assembled several aluminum jigs in a compact case, with detailed instructions for the piano technician.



Technician's case containing measurement jigs.

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[7] David Steinbuhler, "An Alternative Size Keyboard for the World." *Piano Technicians Journal*, July 1998, pp. 19-20, 25.

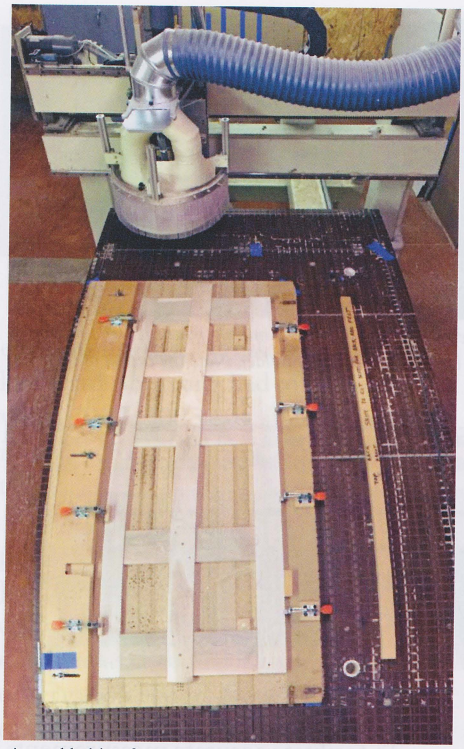
[8] Richard M. Brown, RPT, Letter to the Editor. *Piano Technicians Journal*, October 1998, p.10.

[9] David Steinbuhler, Letter to the Editor. *Piano Technicians Journal*, October 1998, pp. 10,12.

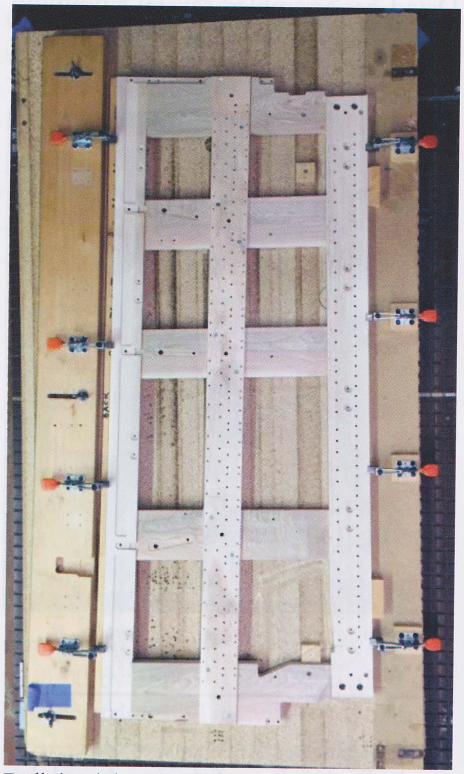
[10] Music Teachers National Association <www.mtna.org>.

[11] Richard M. Brown, RPT, Letter to the Editor. *Piano Technicians Journal*, October 1998, p. 10.

[12] The D key clearance is greater than that of the G and A keys. Check it out.



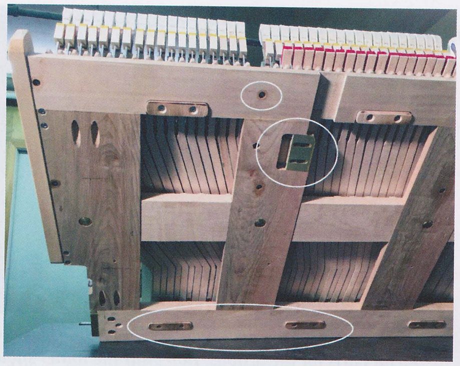
Assembled keyframe.



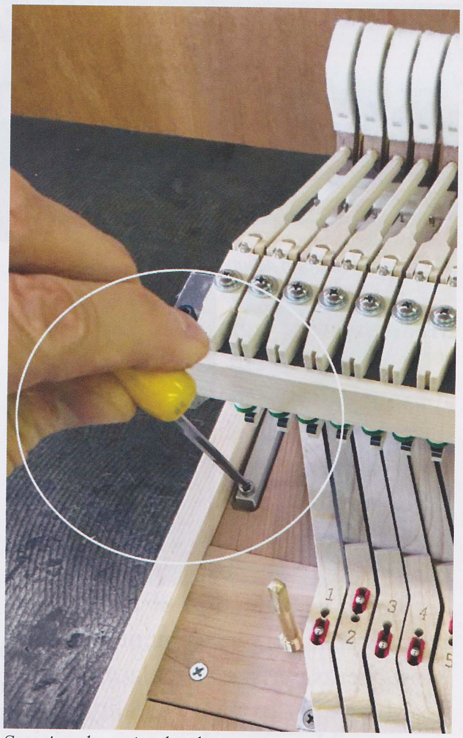
Drilled and shaped keyframe.

The Keyframe

Note the holes to mount the leveling plates, a cutaway for the braces in the bass, holes and cutaways for the action stack brackets, side plates, glide pins, filler blocks and bedding blocks. Also note the una corda pedal plate and stop rail and cutaways for the back rail felt, which is at a 2° angle.



Keyframe guide plates.



Securing the action bracket.

Accessory cheek blocks are precisely doweled to the keyframe, secured by a single flat-head wood screw from the underside of the frame.

This instrument is satin walnut, so David makes the cheek block from a solid piece of dark walnut.

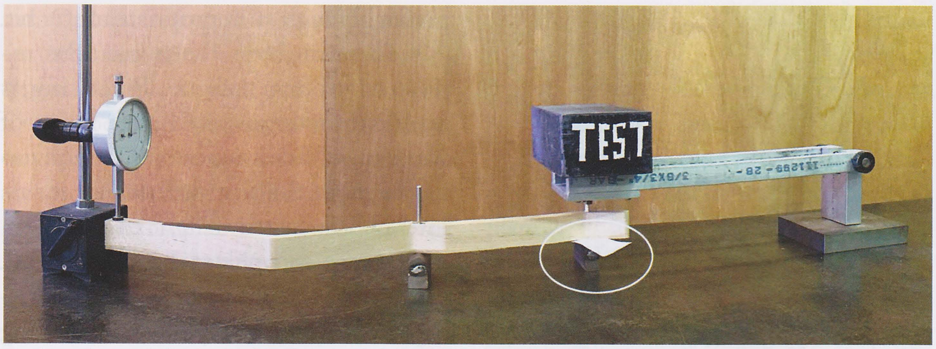
The Keys

There were many technical and engineering problems to consider. To condense the keyboard width, one must cut the key doglegs at more acute angles approaching the bass and treble limits of the keyboard. Tests on standard spruce key stock demonstrated a tendency to warp under sustained use. Key strength is tested with the key deflection tester.

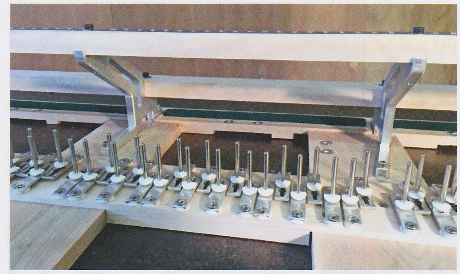
Tweaking the design of the keys in various ways and using braces achieves adequate strength in the highly angled keys.

A material more robust than spruce is needed. David fabricates keys made with maple, kiln dried and aged for years in a climate-controlled cubicle. Locally obtained maple resists warping, ensuring reliable stability throughout the life of the instrument.

Leveling keys to a uniform height is perhaps the most tedious aspect of action regulation. David Steinbuhler has invented an adjustable aluminum fulcrum for the balance rail. A small hole is drilled through the key sufficient for a slender screwdriver to engage the balance rail regulating screw. Key height can thus be precisely set without cardboard or paper punchings, and without removing the key.



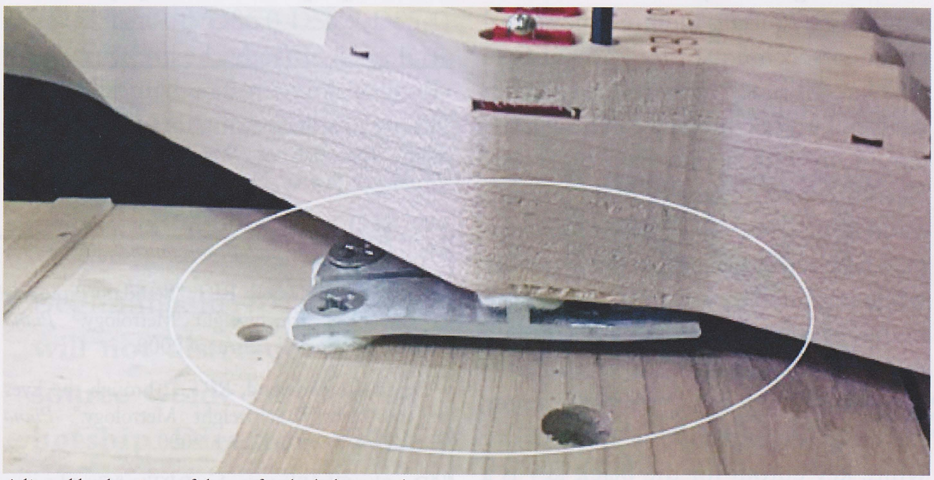
Pushing down on the front of the key until the test weight just lifts will free the paper shown in the white oval, producing the key deflection number on the dial indicator.



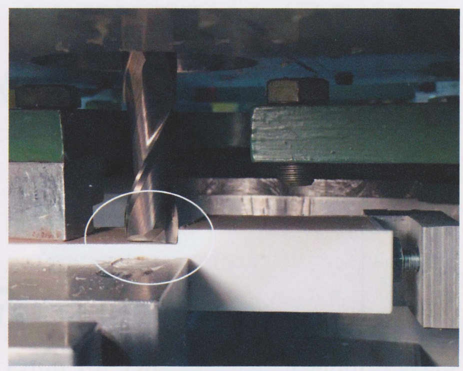
New keyframe balance rail with the Steinbuhler adjustable aluminum fulcrum.

Highly angled keys of the DS5.1 keyboard.

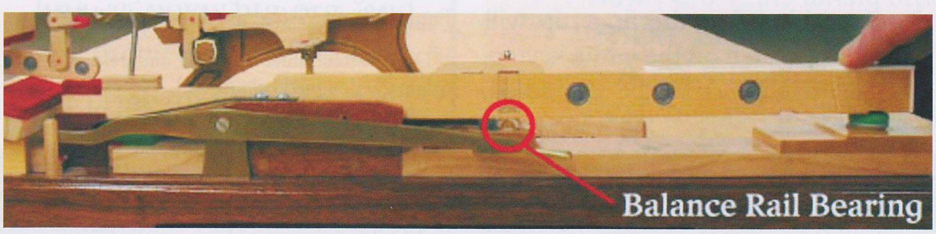
April Larson uses a precision industrial router to square the key fronts.



Adjustable aluminum fulcrum for the balance rail.



David Steinbuhler's father made this machine about 20 years ago.



Steinway Accelerated Action.

The top of the aluminum fulcrum is machined flat, with sharp edges supporting a single felt punching. As the key rocks on the fulcrum, these sharp edges will progressively indent the punching. Unattended by a piano technician, the result would be a downward bowing of the keys with the nadir at middle C.

Steinway's 1934 fulcrum innovation was a rounded balance rail bearing, the so-called Accelerated Action™.[13]

David's aluminum fulcrum accomplishes the same objective, with the advantage that key height is easily regulated using only a thin screwdriver. Replacing all the punchings and re-regulating key height requires only an hour of a technician's time, perhaps once every five years.

Increased mass signifies increased inertia. However, the total mass of the key is essentially unchanged, because the higher density of maple is offset by the reduced width of the customized key. With skillful weighting, key responsiveness is comparable to that of conventional spruce keys.

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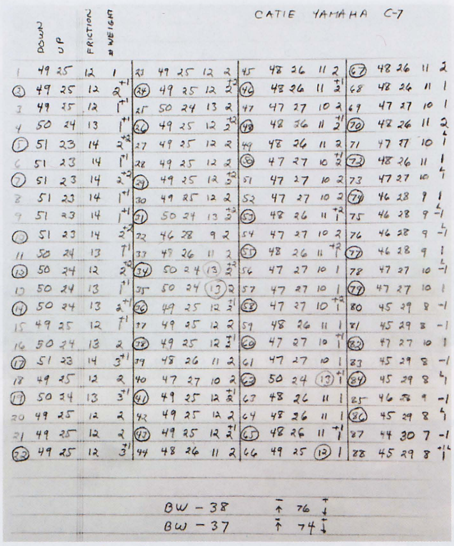
[13] <www.steinwaypianos.com/kb/how-it-works/accelerated-action>.

Stanwood key weighting system.[14,15,16,17,18]



CATIE YAMAHA C-7

Key	Down	Up	Friction	# Weight	Key	Down	Up	Friction	# Weight	Key	Down	Up	Friction	# Weight	Key	Down	Up	Friction	# Weight
1	49	25	12	1	23	49	25	12	2	45	48	26	11	2	67	48	26	11	2
2	49	25	12	2 +1	24	49	25	12	2 +2	46	48	26	11	2 +1	68	48	26	11	1
3	49	25	12	1 +1	25	50	24	13	2	47	47	27	10	2	69	47	27	10	1
4	50	24	13	1 +1	26	49	25	12	2 +2	48	48	26	11	2 +1	70	48	26	11	2
5	51	23	14	2 +2	27	49	25	12	2	49	48	26	11	2	71	47	27	10	1 L
6	51	23	14	1 +1	28	49	25	12	2	50	47	27	10	2 +1	72	48	26	11	1
7	51	23	14	2 +2	29	49	25	12	2 +2	51	47	27	10	2	73	47	27	10	1 L
8	51	23	14	1 +1	30	49	25	12	2	52	47	27	10	2	74	46	28	9	1
9	51	23	14	1 +1	31	50	24	13	2 +2	53	48	26	11	1 +2	75	46	28	9	-1 L
10	51	23	14	2 +2	32	46	28	9	2	54	47	27	10	2	76	46	28	9	-1 L
11	50	24	13	1 +1	33	48	26	11	2	55	48	26	11	1 +2	77	46	28	9	1
12	50	24	12	2 +2	34	50	24	13	2 +2	56	47	27	10	1	78	47	27	10	-1 L
13	50	24	13	1 +1	35	50	24	13	2	57	47	27	10	1	79	47	27	10	1
14	50	24	13	2 +1	36	49	25	12	2 +1	58	47	27	10	1 +2	80	45	29	8	-1
15	49	25	12	1 +1	37	49	25	12	2	59	48	26	11	1	81	45	29	8	-1
16	50	24	13	2	38	49	25	12	2 +1	60	47	27	10	1 +1	82	47	27	10	1
17	51	23	14	3 +1	39	48	26	11	2	61	47	27	10	1	83	45	29	8	-1
18	49	25	12	2	40	47	27	10	2	62	50	24	13	1 +1	84	45	29	8	1 L
19	50	24	13	3 +1	41	49	25	12	2 +1	63	48	26	11	1	85	46	28	9	-1
20	49	25	12	2	42	49	25	12	2	64	48	26	11	1	86	45	29	8	1 L
21	49	25	12	2	43	49	25	12	2 +1	65	48	26	11	1 +1	87	44	30	7	-1
22	49	25	12	3 +1	44	48	26	11	2	66	49	25	12	1	88	45	29	8	1 +1L

BW - 38 ↑ 76 ↓

BW - 37 ↑ 74 ↓

Stanwood data sheet.

The picture above illustrates the weighting procedure for the highly angled extreme bass black keys of the DS5.1 keyboard. Note the lower projecting braces. Gram weights are placed at the front of the keyboard.

This method yields a very precise number for downweight (DW) and upweight (UW). The result is a balance weight of 37 grams = (DW+UW)/2 for this keyboard, as well as a friction number. Friction = (DW-UW)/2. In this instrument, friction varies from 12-14 grams in the bass and 8-10 grams in the treble.

Playing the DS Action

Mine is a slightly modified DS6.0 keyboard with the original keyframe and action stack. At my request, David tapered the black keytops to provide extra middle finger clearance for notes G and A. Original downweight and upweight were duplicated as closely as possible. The DS6.0 keyboard does not require bracing for the extreme bass black keys—the dogleg angles are not as acute as those shown in the DS5.1. The replaced balance rail utilizes conventional punchings for regulating key height.

Responsiveness feels comparable to the original keyboard of this 7'5" Kawai GS-70. Trills require no essential change in technique for fast repetition. The hand is much more relaxed playing octaves. Finger crowding can be a problem, even with appropriate black key clearance—one example that comes to mind is the Chopin C♯ minor *Impromptu*, where sequential fingers play rapidly while confined to a narrow space. Keys being narrower, accuracy requires a more precise technique. If the fifth finger strikes a black keytop off-center, the error is conspicuously audible. The white key cutout for the black key is a bit too cleanly cut—upon releasing the depressed black key, the fingertip will occasionally catch on the white keytop. This sharp edge could be smoothed, preferably with an appropriate router bit.

The real joy is the miraculous reduction of arm fatigue. Practicing is no longer arduous, even after hours of work on difficult repertoire. The piano has become the instrument that it was intended to be—a delight to play, with confidence in one's technical progress. Just imagine a gifted young child learning on the DS5.1 keyboard, advancing to the DS5.5 by age seven, then to the DS6.0 by age 12. Perhaps the conventional keyboard will suit the hand of this developing musician, perhaps not. The beauty of this scenario is the appropriate keyboard for the hand, at any age, at any stage in life.

The Future of the DS Keyboard

David Steinbuhler has crafted and shipped just over 100 custom keyboards for the past 20 years. Manufacturing is hardly an appropriate term—these are meticulously created, unique works of

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[14]David C. Stanwood, RPT, "Mastering Friction With The Balance Weight System." *Piano Technicians Journal*, November 1990.

[15]David C. Stanwood, RPT, "New Touchweight Metrology." *Piano Technicians Journal*, June 1996.

[16]David C. Stanwood, RPT, "Standard Protocols of the New Touchweight Metrology." *Piano Technicians Journal*, February 2000.

[17]David C. Stanwood, RPT, "Through the Eyes of the New Touchweight Metrology." *Piano Technicians Journal*, March 2000.

[18]David C. Stanwood, RPT, "Component Touchweight Balancing – Blueprint for the Future." *Piano Technicians Journal*, April 2000.

[19]David Steinbuhler replaced and re-drilled the originally designed balance rail.

art. Orders are typically backlogged six months, and with a production time of three months, a client may wait nearly a year before receiving a replacement keyboard. The cost is relatively modest in comparison to the value of the instrument, typically less than ten percent of the instrument's retail price.

Clearly there must be a more efficient means of custom keyboard production, and David has been giving this some serious thought. Twenty years of experience and innovation constitute a veritable arsenal of knowledge, one which David wishes to preserve. The first step will be the formation of an independent entity known as Steinbuhler & Co., a non-profit organization undergirding the Donison-Steinbuhler Standard Foundation.

David has submitted a grant application to the Crawford Heritage Community Foundation.[20] The purpose of this enterprise will be the perpetuation of a D.S. Standard (DS6.0, DS5.5, DS5.1) for alternate-size keyboards, consolidation of detailed craftsmanship technology, and dissemination of this extensive knowledge base.

Eventually, others will undertake production responsibilities. With additional sources for alternate keyboards, pianists will see shortened fabrication times, reduced delivery times, and lower costs. This could be an exciting time for piano technicians, some of whom will set up shop with the assistance of the Donison-Steinbuhler Standard Foundation. It should become a very successful business, because most aspiring pianists struggle with the conventional keyboard.

The number of performing artists could significantly increase—musical careers newly open to a host of talented individuals whose hands were never designed for the conventional keyboard. Three hundred years after Cristofori, the instrument he invented could become fully accessible to the majority of those who wish to study it.

Acknowledgments

I wish to thank David Steinbuhler for the production photos, procedural explanations, and for his consummate craftsmanship. To Jeff Hickey, RPT, of the Portland, Oregon chapter, I owe the inspiration to prepare and submit this article.[21] I am forever grateful to the late Newton Hunt, RPT, whose patient instruction helped me hone my skills as a piano technician. ■

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[20] <www.crawfordheritage.org>.

[21] Jeff Hickey, RPT, "Broken Agraffe Removal." *Piano Technicians Journal,* December 2015, pp. 26-28.

A PTG member since 1986 and an RPT since 1987, ***Richard M. Brown's*** *academic credentials include Doctor of Medicine (M.D.) from the University of Washington (1973) and Juris Doctor (J.D.) from Lewis & Clark law school (2004). He is diplomate of the American Board of Nuclear Medicine, and is admitted to the Oregon State Bar. He is currently retired, residing in southern Arizona.*

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