Training Materials for use with Kinesis® Contoured™ Keyboards

Kinesis has included this training guide to help you adapt to the different geometry and to the relocation of some of keys. These exercises were developed by Kinesis specifically for users transitioning from the traditional keyboard to the Kinesis keyboard. Whether or not you are a touch typist, typing exercises such as these can help you to rapidly adjust to your keyboard's new reaches and motions.

Getting started
Just print the first few pages of this document and put the pages on a document holder, then open a word processing screen where you can practice by typing what you see on the page. As you progress to later lessons, you can print additional pages as needed.

Just don't overdo it with these exercises! Most new user's find that they can be productive (perhaps back to 80% of their previous speed and accuracy) with ~2 hours of practice, and they then begin to do their regular work. Try to avoid going back and forth between your previous keyboard and your Contoured keyboard during the first few weeks, since this will make your adaptation more difficult.

First exercise: "Letters"
The first exercise ("Letters") provides simple groups of keys to practice in sequence. This practice will adapt your fingers to the different (often simpler) reaches which are used with the Contoured keyboard.

The "Numbers" exercise
If you work with numbers, you should try your hand at the "Numbers" page. You can choose whether to use the embedded numeric keypad (activated with a foot pedal or with the "Keypad" function key), or the number row.

Primers
These articles have useful information about computer ergonomics, and are intended to give you something to type other than your normal work. The idea is that you will type these primers without feeling compelled to meet a deadline or be perfect.

Typing programs
If you wish to practice with your new keyboard while using the computer or just want to improve your typing skills, you may use any commercially available software typing training software that is compatible with your system.

FIRST EXERCISE--LEARNING TO REACH FOR ASSOCIATED LETTERS
(Don't overdo it!)

Print these pages and open a word processing program so you can type the letter sequences. Relax and don't worry if you make mistakes. No one is keeping score!

Section 1
afrf aded afrf aded afrf aded afrf aded afvf adcd afvf adcd afvf adcd

afvf adcd juj; afad juj; afad juj; afad juj; afad kik; fsff kik; fsff

kik; fsff kik; fsff graf olok graf olok graf olok graf olok bavf luj;

bavf luj; bavf luj; bavf luj; swsf ljuj swsf ljuj swsf ljuj swsf ljuj

deda lolj deda lolj deda lolj deda lolj afrf aded afrf aded afrf aded

Section 2
afrf aded afvf adcd afvf adcd afvf adcd afvf adcd juj; afad juj; afad

kik; fsff kik; fsff graf olok graf olok bavf luj; bavf luj; swsf ljuj

swsf ljuj deda lolj deda lolj talked staff rolled sale trees goals

fluke cackle talked staff rolled sale trees goals fluke cackle glowed

bigger before scared guild slow liked just glowed bigger before scared

Section 3
guild slow liked just sort fool talked staff rolled relaxed tasted wool

sort fool talked staff rolled relaxed tasted wool (break) afrf aded

afrf aded afrf aded afrf aded afvf adcd afvf adcd afvf adcd afvf adcd

juj; afad juj; afad juj; afad juj; afad kik; fsff kik; fsff kik; fsff

kik; fsff graf olok graf olok graf olok graf olok bavf luj; bavf luj;

Section 4
bavf luj; bavf luj; swsf ljuj swsf ljuj swsf ljuj swsf ljuj deda lolj

deda lolj deda lolj deda lolj fbvf dacd fbvf dacd fbvf dacd fbvf dacd

fvcd dcvf fvcd dcvf fvcd dcvf fvcd dcvf over believe guild drove still

cold sale trees over believe guild drove still cold sale trees folder

older aloof afar dragged rover lead foal folder older aloof afar

Section 5
dragged rover lead foal graft lower grand called glorious fodder cooked

graft lower grand called glorious fodder cooked cave decade cavalier

vacated device facade covered cave decade cavalier vacated device

facade covered (break) tafg flol tafg flol adcd jyuj adcd jyuj tafg

flol tafg flol adcd jyuj adcd jyuj ;p;k sxs; ;p;k sxs; aqaf jefa aqaf

Section 6
jefa ;p;k sxs; ;p;k sxs; aqaf jefa aqaf jefa azak jmjs azak jmjs hooj

saef hooj saef azak jmjs azak jmjs hooj saef hooj saef jnj; swsf jnj;

swsf l.lf jaff l.lf jaff jnj; swsf jnj; swsf l.lf jaff l.lf jaff home

jump mind jeweled office sports vacation home jump mind jeweled home

jump mind jeweled office sports vacation home jump mind jeweled office

Section 7
sports vacation coming divine major going afar faded lukewarm office

sports vacation coming divine major going afar faded lukewarm coming

divine major going afar faded lukewarm forward during action coming

divine major going afar faded lukewarm forward during action jaded

minor azure hopped forward during action jaded minor azure jaded minor

Section 8
azure hopped forward during action jaded minor azure hopped quaff ajar

squall liver cold sliced jokers squall quaff ajar squall hopped quaff

ajar squall liver cold sliced jokers squall quaff ajar squall liver

cold sliced jokers squall believed quivered baked jewelry jumpy liver

cold sliced jokers squall believed quivered baked jewelry jumpy buffalo

Section 9
soon believed quivered baked jewelry jumpy buffalo soon buffalo soon

believed quivered baked jewelry jumpy buffalo soon (break) molj cadd

molj cadd molj cadd molj cadd fafa kiol fafa kiol fafa kiol fafa kiol

jauj molj cadd molj jauj molj cadd molj cadd fafa kiol fafa kiol fafa

kiol fafa kiol jauj hakk jnmj hakk jauj hakk jnmj hakk jnmj najj meff

Section 10
najj meff jnmj najj meff najj meff jauj hakk jnmj hakk jnmj jauj hakk

jnmj hakk jnmj najj meff najj meff jauj frfvf kik,k frfvf kik,k frfvf

kik,k frfvf kik,k dedcd lol.l dedcd lol.l dedcd lol.l dedcd lol.l frfvf

kik,k frfvf kik,k frfvf kik,k frfvf kik,k dedcd lol.l dedcd lol.ldedcd

lol.l dedcd lol.l swsxs jujmj swsxs jujmj swsxs jujmj swsxs jujmj aqaza

Section 11
;p;/; azaqa ;p;/; aqaza ;p;/; azaqa ;p;/; swsxs jujmj swsxs jujmj swsxs

jujmj swsxs jujmj aqaza ;p;/; azaqa ;p;/; aqaza ;p;/; azaqa ;p;/; game

inside past truly please knowledge hide examples scold fax zany jail

same axes loose through nevertheless assuming familiar ridiculous

exchange masked exiled over likes favored sacked backward cerebral

Section 12
handy joust kinship daunting rhapsody walks jokers quail skill zoo oxen

dump game inside past truly please knowledge hide examples scold fax

zany jail same axes loose through nevertheless assuming familiar

ridiculous exchange masked exiled over likes favored sacked backward

cerebral handy joust kinship daunting rhapsody walks jokers quail skill

Section 13
zoo oxen dump (break) zyx wvu tsr qpo nml kji hgf edc ba zyxw vutsr

qponm lkjih gfedcba zyxwvutsrqponmlkjihgfedcba zyx wvu tsr qpo nml kji

hgf edc ba zyxw vutsr qponm lkjih gfedcba zyxwvutsrqponmlkjihgfedcba

zyx wvu tsr qpo nml kji hgf edc ba zyxw vutsr qponm lkjih gfedcba

zyxwvutsrqponmlkjihgfedcba zyx wvu tsr qpo nml kji hgf edc ba zyxw

Section 14
vutsr qponm lkjih gfedcba zyxwvutsrqponmlkjihgfedcba (break) quizzical

eloquently exercises bugles however banished gourmand zoological

abstract concrete yourself treatise conditional knowledge ergonomics

snail diary homer jumpy nail jolly sonar half quizzical eloquently

exercises bugles however banished gourmand zoological abstract concrete

Section 15
yourself treatise conditional knowledge ergonomics snail diary homer

jumpy nail jolly sonar half abc def ghi jkl mno pqr stu vwx yz abcdef

ghijkl mnopqr stuvwx yz abcdefghijklmnopqrstuvwxyz abc def ghi jkl mno

pqr stu vwx yz abcdef ghijkl mnopqr stuvwx yz

abcdefghijklmnopqrstuvwxyz (break) manifest juicy lopsided safeguard

Section 16
justified popular analysis kilobyte national megabyte transaction

destiny opportunity abracadabra limitation daily bagel zoom goof

pretzel prized sage honey nosed manifest juicy lopsided safeguard

justified popular analysis kilobyte national megabyte transaction

destiny opportunity abracadabra limitation daily bagel zoom goof

Section 17

pretzel prized sage honey nosed Afk; Bfj; Cdj; Djl; Edf; F;la G;dj Hjsf

Ik;a Ja;f Ksf; L;af Mj;d Nj;a Olf; Plf; Qa;k Rf;k S;fj Tf;k Uja; V;fk

Ws;k Xs;j Yj;a Za;j Afk; Bfj; Cdj; Djl; Edf; F;la G;dj Hjsf Ik;a Ja;f

Ksf; L;af Mj;d Nj;a Olf; Plf; Qa;k Rf;k S;fj Tf;k Uja; V;fk Ws;k Xs;j

Yj;a Za;j (break) Alpha Bet Card Diver Elbow Frankly Gawk Hegemony

Section 18
Important Jolted Kudos Lollipop Mashed Needle Oenological Potatoes

Quaint Roasted Spoiled Tangy Ultimately Void Wallpaper Xerox Yoghurt

Zola Alpha Bet Card Diver Elbow Frankly Gawk Hegemony Important Jolted

Kudos Lollipop Mashed Needle Oenological Potatoes Quaint Roasted

Spoiled Tangy Ultimately Void Wallpaper Xerox Yoghurt Zola (break)

Section 19
frfvf fr4rf fr4f f4f frfvf fr4rf fr4f f4f lol.l lo9ol lo9l l9l lol.l

lo9ol lo9l l9l dedcd de3ed de3d d3d dedcd de3ed de3d d3d jujmj ju7uj

ju7j j7j jujmj ju7uj ju7j j7j aqaza aq1qa aq1a a1a aqaza aq1qa aq1a a1a

frfvf fr4rf fr4f f4f frfvf fr4rf fr4f f4f lol.l lo9ol lo9l l9l lol.l

lo9ol lo9l l9l dedcd de3ed de3d d3d dedcd de3ed de3d d3d jujmj ju7uj

Section 20
ju7j j7j jujmj ju7uj ju7j j7j aqaza aq1qa aq1a a1a aqaza aq1qa aq1a a1a

kik,k ki8ik ki8k k8k kik,k ki8ik ki8k k8k swsxs sw2ws sw2s s2s swsxs

sw2ws sw2s s2s fbftf ft5tf ft5f f5f fbftf ft5tf ft5f f5f ;p;/; ;p0p;

;p0; ;0; ;p;/; ;p0p; ;p0; ;0; jnjyj jy6yj jy6j j6j jmjyj jy6yj jy6j j6j

kik,k ki8ik ki8k k8k kik,k ki8ik ki8k k8k swsxs sw2ws sw2s s2s swsxs

Section 21
sw2ws sw2s s2s fbftf ft5tf ft5f f5f fbftf ft5tf ft5f f5f ;p;/; ;p0p;

;p0; ;0; ;p;/; ;p0p; ;p0; ;0; jnjyj jy6yj jy6j j6j jmjyj jy6yj jy6j j6j

frfvf fr4rf fr4f f4f frfvf fr4rf fr4f f4f lol.l lo9ol lo9l l9l lol.l

lo9ol lo9l l9l dedcd de3ed de3d d3d dedcd de3ed de3d d3d jujmj ju7uj

ju7j j7j jujmj ju7uj ju7j j7j aqaza aq1qa aq1a a1a aqaza aq1qa aq1a a1a

Section 22
frfvf fr4rf fr4f f4f frfvf fr4rf fr4f f4f lol.l lo9ol lo9l l9l lol.l

lo9ol lo9l l9l dedcd de3ed de3d d3d dedcd de3ed de3d d3d jujmj ju7uj

ju7j j7j jujmj ju7uj ju7j j7j aqaza aq1qa aq1a a1a aqaza aq1qa aq1a a1a

kik,k ki8ik ki8k k8k kik,k ki8ik ki8k k8k swsxs sw2ws sw2s s2s swsxs

sw2ws sw2s s2s fbftf ft5tf ft5f f5f fbftf ft5tf ft5f f5f ;p;/; ;p0p;

Section 23
;p0; ;0; ;p;/; ;p0p; ;p0; ;0; jnjyj jy6yj jy6j j6j jmjyj jy6yj jy6j j6j

kik,k ki8ik ki8k k8k kik,k ki8ik ki8k k8k swsxs sw2ws sw2s s2s swsxs

sw2ws sw2s s2s fbftf ft5tf ft5f f5f fbftf ft5tf ft5f f5f ;p;/; ;p0p;

;p0; ;0; ;p;/; ;p0p; ;p0; ;0; jnjyj jy6yj jy6j j6j jmjyj jy6yj jy6j j6j

Section 24
1734 All Drive <TAB> 3907 Bored Street <TAB> 3200 Cold Place

<TAB> 5821 Daring Lane <TAB> 5487 Eagle Nest <TAB> 4509 Friendly Canyon

<TAB> 2753 Game Boulevard <TAB> 6732 House Property <TAB> 8712 Inside

Lane <TAB> 7613 James Town <TAB> 8459 Knowledge Bay <TAB> 9494 Laundry

Room <TAB> 6721 Mocha Java <TAB> 6442 Naval Station <TAB> 9874 Olive

Street <TAB> 9083 Prexy Lake Drive <TAB> 1132 Quoted Price <TAB> 4543

Razor Blade <TAB> 2272 Stage Play <TAB> 5487 Trendy Place <TAB> 6723

Underground Lane <TAB> 4438 Valor Avenue <TAB> 2243 Waxed Eloquent

<TAB> 2674 Xylophone Drive <TAB> 7612 Younts Villa <TAB> 1293

Zoological Gardens <TAB> 1734 All Drive <TAB> 3907 Bored Street <TAB>

Section 25
3200 Cold Place <TAB> 5821 Daring Lane <TAB> 5487 Eagle Nest <TAB> 4509

Friendly Canyon <TAB> 2753 Game Boulevard <TAB> 6732 House Property

<TAB> 8712 Inside Lane <TAB> 7613 James Town <TAB> 8459 Knowledge Bay

<TAB> 9494 Laundry Room <TAB> 6721 Mocha Java <TAB> 6442 Naval Station

<TAB> 9874 Olive Street <TAB> 9083 Prexy Lake Drive <TAB> 1132 Quoted

Price <TAB> 4543 Razor Blade <TAB> 2272 Stage Play <TAB> 5487 Trendy

Place <TAB> 6723 Underground Lane <TAB> 4438 Valor Avenue <TAB> 2243

Waxed Eloquent <TAB> 2674 Xylophone Drive <TAB> 7612 Younts Villa <TAB>

=1293 Zoological Gardens <TAB> (break) fvf fv<RIGHT>vf fv<RIGHT>f

Section 26
F<RIGHT>f fv<RIGHT>vf f<RIGHT>f fv<RIGHT>f f<RIGHT>fdcd dc<LEFT>cd

dc<LEFT>d d<LEFT>d dc<LEFT>cd d<LEFT>d dc<LEFT>d d<LEFT> jmj jm<UP>mj

jm<UP>j j<UP>j jm<UP>mj j<UP>j jm<UP>J j<UP>j k,k k,<DOWN>,k k,<DOWN>k

k<DOWN>k k,<DOWN>,k k<DOWN>k k,<DOWN>k k<DOWN>k fv<RIGHT>f dc<LEFT>d jm

<UP>j k,<DOWN>k fv<RIGHT>f dc<LEFT>d jmj<UP>j k,<DOWN>k f<RIGHT>f

d<LEFT>d j<UP>j k<DOWN>k f<RIGHT>f d<LEFT>d j<UP>j k<DOWN>k (break)

Section 27
44654 Adamant Canyon 14585 Bowl Lane 71425 Clone Circle 96474 Dandelion

Park Drive 36515 Edify Avenue 93654 Foolish Place 54267 Goal Lane 85494

Hooligan Boulevard 66255 Idiotic Place 82956 Jail House Road 94875 Keel

Over 52045 Lampshade Lane (break) 74068 Malamute Molt 38946 Noodles Circle 18453 Okeefenokee Creek 27465 Palate Street 32759 Quiet Place 97516 Raining Road 81953 Stoked Street 64846 Tornado Alley 75362 Urgent Matter 10839 Vellum Lane 67815 Woolens Mill Road 42617 Xanadu Dome 97264 Yearly Circle 28015 Zipped Code the this then those their these

Section 28

them there the this then those their these them there of in into on onto our off only offer odd of in into on onto our off only offer odd station nation action fusion solution motion station nation action fusion solution motion fed led sped paled soled wed soiled hiked fed led sped paled soled wed soiled hiked tried spied plied fried hide slide collide tried spied plied fried hide slide collide (break) how plow stow two throw should could would how plow stow two throw should could would rough although sought through bough fought tough rough although sought through bough fought tough move drive grove love five trove jive live hive move drive grove love five trove jive live hive

Section 29

all ball fall mall stall call hall wall shall all ball fall mall stall call hall wall shall dill still will hill sill fill mill grill dill still will hill sill fill mill grill inside outside cold hot special sale think can't inside outside cold hot special sale think can't please won't international coming slow fast yet please won't international coming slow fast yet don't with never think eats drinks before after don't with never think eats drinks before after talk find

help coming making vacation soon city talk find help coming making vacation soon city state together while during from important example state together while during from important example (break) made during

Section 30

following part know want need city made during following part know want need city every examples thing believe first last therefore every examples thing believe first last therefore children adults people national good room some children adults people national good room some look generally food times much sing ring find look generally food times much sing ring find watered go fold organization appear everything watered go fold organization appear everything backward toward forward afterward never always backward toward forward afterward never always have has news for had need must much last first have has news for had need must much last first be believe times work even better person

Section 31

excellent be believe times work even better person excellent see years jam very back forth computers people see years jam very back forth computers people when does who likes why jelly what makes where when does who likes why jelly what makes where labor vehicle flavor volume loved mobile voted labor vehicle flavor volume loved mobile voted entirely whole short tall now some women more man entirely whole short tall now some women more man want soon which stand come send think others such want soon which stand come send think others

Section 31

such back over going do great few deliver slow famous back over going do great few deliver slow famous past future during another were national which past future during another were national which said gold very past season later many room food said gold very past season later many room food This completes your first pass through the adaptation exercises. To ensure the smoothest transition from your old keyboard to your new Kinesis Ergonomic Keyboard, you should go through these exercises again, repeating them over a 5-day period.

NUMBERS LESSON (Don't overdo it!)

Section A
4545454555445454545454455554544455454554544554545444554555454545454544

5664566665454654666546565646466566565656646464646456456456654654654654 6

66544466445646544564656465454545554454656465465646654646545654

Section B
44567747447447747477474545455474554745454745464664664646767676747474744

74477447744774474747477576474657656676647567676767676756475647547657465746574

45455544544455677456745674567554567558858585885585588855858585858585858

Section C
54848484464644564564566676767678788777878787878585858545454575757545545

68567676768686858585855854848484585855855855885856786786786784455667754 5

67867868686485684658476584658465874658465874658456485686645678669999696 9

Section E
69696966898989989789789789964564567894758694758694567896969666969696869 65

64645678979456746474894749998457497548975947594647648765478659474975984 56

65846549759847594759465946587465846594744544455677456745659475947594654 86

Section F
49545794754556667788994567890007897974646077974050504040405050500505060 60

06090908080707007807050456456008908078977899065409870850855840745946450 64

09009456446574465744044004456744807540087540470654065400998877665544145 67

Section G
89011141414441141147474741471717171741441477741401471561561891891471616 15

71718181919114555414566544600011010115404047014741474144411414147474144 15

44567067067100101010010101010191919191881818166116656659454064906409101 65

Section H

4567890552221212121122121212255252552558858525252582512221455544451212582

582727272912902020209021044507878054511425147411471258525825852582582147 4

14774114774114774114777411471747174714222525252525525522252255252525552

Section I
2552858858825285828858585828858582882858288282858588582828858588582288 2

2866123456789066996633336699369363963936936393693639639369363936936396393

9933366339993369369369369369993366393996393693693399993636336933636993636

Section J
3696393693639363693693639312332122230303030300303696303696303712636549797

3245678852214719194675279846561321466794316491991518117411567993636440004

64336633663.3.3.333..33.3.36399636633.14747471.2.1.1258525852585.1.0.0.36

Section K
963.36963.6963.36963.123.321.456.654.456.789..987789.46516.16497913.16489

03020508050201470..2..43.5399936369..3.6.9.3.6.999.6.66.3.3.2.1.4.5.739.9

00.14700.36900.5282800.1234654.003164.006+666+++6++55+300+45645799+123+45

Section L
6+789+04640+0+0+0+01+1+16+6+++654+123136++-456-123-9-9-99--+-+-+-9-9-9-9-

9--99---999--789-789-789-789456-456.0-7812346**-*-6789*+-+-+-+-**-*-*-*-

9850*0*0*0*0*0789*789*3.00**+*123467899///999///99//99/99*/*/*/1230/0/0/0/

Section M
0123///==456+454.00+279=123+46546=.001234678.00*16465/16346<ENTER>4623

<ENTER>4646+46+<ENTER>468979<ENTER>464134679<ENTER

>467979<ENTER>4689746<ENTER>164979<ENTER>456464567827<ENTER>+

Overview of Ergonomic Keyboards

Personal computers have become a fixture in the office, at school and in the home. The increasing use of computers has raised concerns for safeguarding the health of the adults and children who use them. Growing evidence supports a link between the use of input devices (e.g., keyboards and mice) and discomfort or, in some cases, injury. In response to the growing incidence and awareness of keyboard-related injuries, manufacturers have added warning labels and new designs to their keyboard and pointing device product lines.

People use keyboards in many different ways. They operate them with varying degrees of intensity in many physical environments. And they use a range of software programs to accomplish a multitude of tasks. As a result of such diversity, the availability of choices among traditional and alternative keyboard designs is crucial. And because making an informed choice is equally vital, this material provides a synopsis of the potential risks related to keyboarding and guidance in evaluating alternatives.

The Role of Ergonomics

Whether you are injured by overuse of a computer in put device or not, using ergonomically designed products can increase your comfort and productivity while reducing physical stress. As a result, businesses and individuals increasingly consider ergonomics an important investment in human resources.

Preventive ergonomic programs (including training and purchases of ergonomically redesigned products) are among the most cost effective. Much like nutrition, the science of ergonomics offers guidelines for health and well being. Nutrition and ergonomics advise that personal preferences are not always healthy choices; and for either discipline to be effective, behaviors may have to change.

A poorly designed keyboard, like a poor diet, can contribute to a variety of disorders. Alternatively, sound ergonomic design, like proper nutrition, bolsters resistance to disease or injury and assists in recovery. However, just as nutritionists do not claim that a balanced diet alone prevents or cures disease, alternative keyboard manufacturers do not claim that their designs prevent or cure injuries.

Alternative Keyboard Classifications

In general, keyboard designs can be classified as traditional keyboards, split-traditional keyboards (either fixed or adjustable) or advanced ergonomic keyboards.

Traditional Keyboards

The traditional keyboard design was originally based on engineering considerations such as mechanical interferences -- not on human anatomy and physiology. It was designed to prevent mechanical key-jamming problems on 19th century typewriters by separating commonly used key combinations, arranging keys in diagonal columns, and generally slowing the typist. In contrast, computers enable users to type significantly faster and offer no break to insert paper or hit a carriage return. Yet the basic form of the traditional keyboard has remained virtually unchanged for more than a century.

Subtle additions to modern computer keyboards, however, have made keyboarding potentially more stressful. They include function keys; Return and Enter keys activated by the right little finger; Control and Alt key combinations; and numeric and cursor keypads -- all of which involve awkward, potentially stressful reaches. More than any other design, traditional keyboards encourage users to adopt physically stressful postures. They may be appropriate for casual keyboard users, two-finger typists who always look at the keys, or people who use keyboards simply as control panels to operate other input devices. However, for those people who use keyboards more intensively, the traditional design can contribute to fatigue and discomfort.

Split-traditional Keyboards

Most alternative keyboards are split-traditional designs which closely resemble traditional keyboards. They fall into one of two major categories:

(1) Split/fixed designs in which a small space, generally a wedge shape, is inserted into the center of the traditional keyboard to separate right and left halves. The main example is the Microsoft Natural keyboard, and

(2) Split/adjustable designs in which the traditional keyboard is divided into two or three sections that can be individually arranged by operators. The best known of this type of keyboard are the Kinesis Maxim, the Goldtouch keyboard, the Kinesis Evolution, and the Health Care Comfort keyboards.

Split-traditional keyboards have been described as traditional keyboards with value-added ergonomics, although the degree of added value can vary significantly from one product to another. Such designs are generally most suitable for relatively healthy computer users who wish to implement ergonomic improvements while retaining what is essentially a traditional keyboard, and for computer users who don't want any adaptation period as they start using a new keyboard.

Advanced Ergonomic Keyboards

Advanced ergonomic keyboards, as Kinesis defines them, maintain the one-keystroke-per-character design of the traditional keyboard, but involve a more comprehensive implementation of ergonomic principles than do split-traditional keyboards. As a result, they usually require at least several days of adaptation and practice before full productivity is achieved. They can differ significantly one from another, and include products developed by Industrial Innovations (the DataHand), PCD Maltron Ltd. (the Maltron), and Kinesis Corporation (the Contoured keyboard family).

Most of these keyboards maintain the familiar (Qwerty) alphanumeric key layout, but may include minor changes to the positions of other keys. For example, the Contoured keyboard allocates some non-alpha keys to thumb keypads but otherwise maintains the QWERTY letter layout (and an optional Dvorak layout). Many Contoured keyboards are also programmable (user modifiable). The Maltron has an optional, proprietary letter layout and the DataHand uses multiple-action switches that activate different keystrokes when pressed in different directions.

Advanced ergonomic keyboards are often the better choices for computer users who already experience discomfort when they use traditional keyboards, as well as for those at risk of injury due

to the long periods of time they spend keyboarding. These keyboards are also good choices for healthy users who simply want a more comfortable, productive alternative.

The Ergonomics of Keyboard Design

Discomfort can lead to injury

Keyboard-related discomfort can range from fatigue and transitory aches and pains to more serious cumulative trauma disorders (CTD). CTDs are also sometimes known as repetitive strain injuries (RSI). CTD refers to a family of injuries which include nerve disorders (e.g., carpal tunnel syndrome) and tendon injuries (tendinitis, tenosynovitis), among other conditions. The common denominator is that these conditions develop gradually as a result of repeated physical trauma.

Causes of keyboard-related CTD

In general, keyboard-related discomfort and injury can result from a combination of predispositions, psychosocial stresses and physical stresses. As with many other disorders, the exact mix of risk factors that will cause illness in any one individual is uncertain. Therefore, reducing the risk of actually developing a disorder involves a healthy lifestyle and a comprehensive program to minimize known risks.

Physical Predispositions

Physical predispositions are possible links between your personal anatomy and physiology and your risk for injury. They may include wrist size and structure, age, pregnancy, diabetes and gout. For some time, researchers have attempted to identify personal characteristics and conditions that can be linked to CTD. To date, this research has not resulted in a proven method to predict the likelihood of injury based upon predispositions.

Psychosocial stresses

Psychosocial stresses stem from interactions with your social environment. Research conducted by the National Institute of Occupational Safety and Health (NIOSH) found a link between CTD and psychosocial stresses such as worry over job security or surges in workload. However, these factors explained only a small percentage of the injuries reported by the workers in the study. And according to NIOSH's Dr. Lawrence Fine, psychosocial pressures were found to be less important in explaining hand and wrist injuries than they were in explaining neck and shoulder injuries. Physical stresses were more important in explaining hand and wrist injuries.

Physical stresses

Physical stresses arise from interactions with your physical environment. These stresses apply to many repetitive activities, not just to keyboarding. However, when you engage in an activity such as keyboarding that involves more than one of these physical risk factors, the combination significantly increases your potential for injury. In fact, the combined risk is much more than the sum of the individual risk factors.

Analysis of Physical Stresses Related to Keyboard Design

The primary risk factors cited in CTD research are repetition, force and awkward postures. Prolonged constrained postures and direct mechanical pressure may also be relevant. To illustrate the effects of these risk factors, imagine loading cartons onto a conveyor. The more cartons you lift in a given period, with fewer pauses to rest, the more likely you are to develop discomfort or injury. The heavier the cartons -- and therefore the more force required to lift them -- the more likely you are to be injured.

If you lift the cartons in an inappropriate posture -- with your back rather than your legs, for example -- you are also more likely to be injured. And if you continue to lift heavy cartons, one after another, using a physically stressful motion or posture and without significant breaks, your risk of injury increases dramatically from the combination.

While perhaps it is not as obvious, the same general principles are true of other repetitive activities such as keyboarding.

Repetition
Keyboarding is a highly repetitive task. If you are an average typist, you can easily perform 100,000 keystrokes or more each day. Tasks that involve repetitively performing the same actions again and again require that your muscles contract more frequently and more rapidly -- and as a result the muscles develop less tension. You must, therefore, use more effort to perform a task repetitively, and your body needs more time to rest and recover.

Importantly, repetition represents a greater risk when the repeated action involves inherently awkward or stressful positions or motions, as is often the case with keyboarding.

Relevant keyboard features
- macro capability and other programmability;
- key layout;
- supplementary input devices such as foot switches or voice input.

Discussion
Virtually all keyboards retain the typewriter's one-keystroke-per-character principle and the Qwerty key layout to minimize retraining. Programmable keyboards, however, can reduce the more stressful aspects of repetition. Programmability allows you to develop macros that execute a series of keystrokes with a single key press. It also enables you to move the location of often-used keys to locations that require less movement or less awkward motions.

This is particularly significant because, as noted above, repetition is most stressful when the action to be repeated involves awkward postures and/or force. Optional accessories such as foot switches or integrated voice capabilities can also reduce finger repetition.

Force
Muscle force is required to maintain a typing posture and to press keys on a keyboard. When more force is required by a task, there is less circulation to the controlling muscles -- resulting in more rapid fatigue. Conversely, when the effort is reduced, the onset of fatigue is delayed.

Research indicates that decreasing effort by as little as 10% may allow you to work at the same task without fatigue for dramatically longer periods.

Relevant keyboard features
keyswitch type (e.g., mechanical, membrane); key force and travel; audible or tactile feedback; hand and wrist supports; shape of the keying surface.

Discussion
Evaluating force involves three distinct considerations: the dynamic force used to reach for and press a key, the static force used to maintain a keying posture over the keyboard, and the allocation of workload dictated by the keyboard's key layout and overall design. Research demonstrates that a keyswitch's characteristics can greatly affect the fingertip forces applied while keying.

For example, a recent study found that fingertip pressing force can be cut by almost 20% simply by reducing the force of the keyswitch. Also, as noted in American National Standards Institute ANSI/HFS Standard 100-1988, if a keyboard's keyswitch does not provide the proper tactile feedback and force profile, it "may result in slower keying activity, higher error rates, and increased operator fatigue." A keyboard's allocation of the keying workload -- based on its key layout and overall geometry -- is significant because not all fingers are equally strong.

However, many keyboards allocate the greatest proportion of the keying workload -- along with the longest reaches -- to the weakest fingers. In general, strength decreases as you move across the hand from thumb to little finger. According to one study, the maximum finger-pushing force of each finger, along with the number of keys allocated to it on a traditional keyboard, are as follows: Thumb, 37 pounds, 1 key; Index Finger, 24 pounds, 16 keys; Middle Finger, 22 pounds, 8 keys; Ring Finger, 18 pounds, 8 keys; Little Finger, 12 pounds, 25 keys. In traditional keyboarding, the weakest fingers are often assigned the longest, most awkward reaches.

Awkward Postures
The design of a keyboard can encourage you to assume a number of physically taxing postures and to maintain them for long periods of time. Research indicates that certain of these postures, discussed below, are potentially harmful because of the stresses they place on your body. While training in proper technique -- when reinforced on a regular basis -- can help to reduce these stresses, training alone cannot counteract all of the negative effects of a poorly designed product.

When evaluating a keyboard in terms of each the following stressful postures, it is important to consider them both when your body is still (static) and in motion (dynamic). Maintaining a typing posture, poised over the home row of your keyboard, is a static effort. However, when actually keying, your hands are not stationary on the home row.

Analysis based solely on your body's posture at the home row position is important, but ignores significant parts of the keyboarding puzzle -- your active typing postures and reaches. "Ulnar Deviation." In ulnar deviation, your wrist is bent outward in the direction of your little finger; while in radial deviation your wrist is bent inward toward your thumb. The neutral position keeps the wrist straight rather than bent to either side.

Relevant keyboard features
- separation of left and right alphanumeric keys;
- number of frequently used keys located along the outside of the key layout;
- position of function keys and related command and control keys;
- arrangement of keys in columns (diagonal, straight).

Discussion
The span of your shoulders exceeds the width of the right and left home row keys on traditional keyboards. In order to reach the home row on these keyboards, it is necessary to bring your hands together in front of your body with your wrists ulnar deviated. Significantly, this ulnar deviation is among the most common and most potentially damaging keyboard postures.

Alternative keyboards address the issue of ulnar deviation in one of two ways: by adding a large amount of space to separate right and left portions of the keyboard or rotating right and left halves of the layout to create a small wedge of empty space in the center. These options result in different hand and wrist angles and different positioning of the arms, elbows and shoulders. (break) Keyboards with a wide center separation keep the hands further apart than do other keyboards, and therefore require less inward rotation of the right and left keypads to keep the wrists straight.

Keyboards with a center wedge generally keep the hands closer together in front of the body and rely on an inward rotation of the keypads to reduce ulnar deviation. However, keyboards with a center wedge and diagonal key columns have the potential to increase deviation in the left wrist when typing: When the left hand is angled toward the center of the keyboard, movement from one key row to the next (e.g., from the "d" key to the "e" key) requires a motion angled in the opposite direction -- away from the center of the keyboard. This is particularly relevant to the familiar Qwerty key layout, which is biased toward use of the left hand.

A keyboard's key layout can also affect ulnar deviation. The vast majority of keyboards use the Qwerty layout. Over the years, as typewriters evolved into computer keyboards, the Qwerty layout also evolved to include more than simply letters and numbers. For example, keyboarders now make extensive use of function keys; Escape, Backspace and Delete; and the keys in the cursor, document-navigation and numeric keypads.

To maintain the integrity of the Qwerty layout, these new keys were placed around the outsides of the alphanumeric keys. As a result of adding keys along the outside edges of the keyboard, this extended Qwerty layout is now worse from an ergonomic standpoint: It adds to the workload for little fingers and encourages ulnar deviation by the placement of these keys.

Wrist Extension
With wrist extension, your wrist is bent up and back, such that the fingers are higher than the wrist joint. With wrist flexion your wrist is bent down, such that the fingers are lower than the wrist joint. The neutral position keeps the wrist at virtually the same elevation as the forearm and top of the hand, rather then bent up or down.

Relevant keyboard features
- integral palm supports or wrist rests;
- shape of keying surface;
- adjustable feet;
- frontal slope.

Discussion
Extension is among the most common of the potentially damaging stressful postures. Unfortunately, most traditional keyboard users do not demonstrate perfect keying technique, but rather drop their wrists into a dangerously extended posture by resting over the front edge of the keyboard and onto the work surface. If the keyboard's front edge does not extend more than an inch or two in front of the Space key, there is nothing to prevent extension or to provide a rest for the muscles in the hands and forearms when not actively keying.

Alternatively the design of the front edge of an ergonomic keyboard can encourage proper wrist posture. These keyboards often include some form of wrist rest or palm support. Palm supports are designed to support the fleshy heels of the hands while wrist rests generally support the hands further back, under the wrists. Some research indicates that use of wrist rests with traditional keyboards can actually increase pressure in the carpal tunnel due to the external pressure they apply at the wrists. As a result, many researchers recommend intermittent, not continuous, use of wrist rests.

A keyboard's frontal inclination -- the increase in height from front edge to back edge of the keyboard -- can also encourage wrist extension. If the keyboard is significantly higher in the back than in the front -- or offers feet to elevate the back of the keyboard -- the user will generally operate the keyboard with greater wrist extension.

Pronation
Pronation is a forearm and hand posture in which the palm of the hand is open, level and faces down. Research demonstrates that a moderate elevation of the thumb side of the hand can dramatically reduce this type of stress.

Relevant keyboard features
- lateral tilt of keypads (as measured from the key position of the thumb to the key position of the little finger);
- palm support or wrist rest design.

Discussion
Unlike traditional keyboards, many alternative keyboards are designed to elevate the thumb sides of the hands to reduce pronation -- i.e., tilt laterally to varying degrees. Research indicates that the benefits of reducing pronation are not constant -- the additional benefit decreases with increased tilt. For example, one study found that the first 10 degree reduction in pronation reduced muscle activity in the affected muscle by over 50%.

By comparison, the last 10 degree reduction in pronation provided no significantly measurable benefit. Further, keyboards that provide a dramatic tilt may sacrifice visibility and the support of the home row, increase the load on upper arm and shoulder muscles, or require the user to key against gravity.

Finally, because lateral tilt affects the overall height of a keyboard, it may be necessary to reduce the height of your work surface (or raise your chair and add a foot rest) to maintain a correct keying

posture with some dramatically tilted designs. This can be a problem because your thighs limit the degree to which you can lower your work surface or raise your chair.

Hand and Finger Extension
With hand and finger extension, the joints in your hands and fingers curl up and extend forward from your hands rather than relaxing down slightly in the direction of the palms.

Relevant keyboard features
- shape of keying surface (flat, concave or convex);
- arm and wrist supports;
- frontal inclination.

Discussion
Your fingers are not all the same length. Because a keyboard's keying surface is the principal interface between your fingers and the keyboard, the shape or contour of the keying surface affects finger and hand posture. A keyboard's keys can be arranged to form a flat, concave or convex interface for the hands.

However, if the design does not accommodate the relative lengths of your fingers (e.g., a flat surface assumes all of your fingers are the same length), your longer fingers must arch up over the keys. The result is extension of the muscles and tendons in your fingers and hands. Your muscles do not operate at maximum efficiency when contracted or extended, and the result can be more rapid muscle fatigue.

Also, finger extension tends to encourage wrist extension. To reduce the stress from aligning fingers with a flat keying surface, many keyboard users drop their wrists -- often resting them on the edge of the work surface. While this may seem more comfortable, the result of this short-term increase in comfort is a long-term increase in one of the principal risk factors for injury, wrist extension.

Shoulder Abduction
Shoulder abduction is where the upper arm is held up and away from the body laterally, elbow out, rather than remaining at the side; and adduction is where the upper arm is held closer to the center (in this case, the front) of the body.

Relevant keyboard features
- center separation (split, wedge);
- height; keyboard width (in limiting the closest position of a separate pointing device).

Discussion
Many traditional keyboard users abduct and adduct their arm and shoulder muscles in an effort to avoid the stressful hand and wrist postures resulting from the contiguous key rows on their keyboards. For example, a slight raising of the shoulders and bowing of the elbows helps to relieve tension from ulnar deviation, but ultimately leads to fatigue and pain across the back.

Alternative keyboards with a wide center separation encourage you to sit appropriately -- with shoulders back rather than hunched forward and with upper arms and elbows close to your sides. On the other hand, some center-wedge keyboards that position left and right keypads close together with a marked internal rotation can encourage you to abduct your upper arms and bow out your elbows because of the positions and angles of the two keypads.

Thumb Abduction and Hyperextension
Thumb abduction refers to a posture where the thumb is widely separated from the rest of the hand, and in hyperextension the thumb is raised higher than the back of the hand.

Relevant keyboard features
- design and placement of the keys allocated to the thumbs.

Discussion
The thumbs are the strongest, most agile digits on your hands. But traditionally they are the least used in keyboarding. Most keyboards allocate only one, shared key to your thumbs: the Space key. And most traditional keyboarders use only one thumb to strike this key. Significantly, they often hold the other thumb up and back to keep it out of the way.

Researchers have called this the alienated thumb. Their research demonstrates that simply abducting and extending the thumb in this manner can cause injury in some users. The problem is not the amount of keying work the thumb is assigned to do, but rather the posture. In general, positions at the extreme ranges of the thumb's motion require maximal contraction of the muscles involved.

Some alternative keyboards separate the Space key into two keys -- one each for right and left thumbs. Other keyboards assign even more keystrokes to the thumbs. Often, the extra thumb keys are used to shift workload away from the overused little fingers. An increased workload for the thumbs can help to limit use of the alienated thumb position. It also reduces the deviation of the right wrist that would otherwise be required in order to press peripheral keys with the little finger.

Many keyboards that increase workload for the thumbs position the thumb keys relatively close to the hands to minimize abduction and extension. They also position these keys to permit activation by other fingers with a slight movement of the arm, should the user prefer.

Prolonged, Constrained Posture
Holding a fixed posture for long periods, especially if the position is awkward, increases your risk of developing CTD. The increased risk is the result of the continuous muscle contraction required to maintain the fixed posture. Holding your hands and arms poised over a keyboard in a keying posture requires that you exert a constant, static force.

The issue of static force may help to explain why CTD affects keyboard users whose occupations do not require a significant amount of time actively keying (e.g., telephone operators and customer service representatives). Relevant keyboard features: hand and arm supports. "Direct Pressure/Vibration." In general, direct pressure and vibration are found more in industry than in office environments. In the office, however, direct pressure can contribute to upper extremity CTD

if you rest your wrists or arms against a sharp edge or the corner of your work surface, or if you press your elbows onto the arms of your chair.

Relevant keyboard features
- front edge of the keyboard;
- hand and arm supports;
- padding for hand and arm supports;
- angle of separation between the keypads.

The Significance of Adjustability
Adjustability refers to the ability to customize the operation of a keyboard to suit the needs of an individual user. Keyboards can incorporate two types of adjustability: physical and electronic.

Physical Adjustability
Physical adjustability involves the ability to move a product's components to suit each user's anatomy or to create a specific posture for each user. This type of adjustability can involve significant tradeoffs, and it is more appropriate for some types of products than for others. With keyboards, physical adjustability is probably of most benefit to those individuals with medical conditions that require very specific accommodations. However, for the majority of keyboard users, the need for physical adjustability in keyboard design has not been established.

For example, a recent study failed to identify a significant relationship between users' anthropometry (sizes and builds) and their postures when keyboarding. Another study of adjustable and nonadjustable keyboards actually found the postures of test subjects were best with a specific nonadjustable design. (break) With a physically adjustable product, the user must make an initial choice. As a result, physical adjustability can be intimidating -- especially when the basis for making the adjustment is not intuitive. The fact that people often initially equate comfort with familiarity rather than with optimal adjustment further complicates the issue.

Finally, physical adjustability can allow latitude for misuse. In related research, data entry clerks with adjustable workstations had significantly more back pain than workers with nonadjustable workstations. The research concluded that merely providing adjustability did not prevent CTD. This and similar research underscore the need for manufacturers to train users of adjustable products: at a minimum, by providing detailed information for appropriate setup and use. And employers should provide ongoing training to ensure that products are properly adjusted.

Electronic Adjustability
Electronic adjustability (programmability) permits customization of the key layout and development of macros, both generally maintained in the keyboard itself. This type of adjustability is designed to individually optimize motions, reaches and workload allocations. However, unlike physical adjustability, electronic adjustability is generally less intimidating -- the user can simply ignore the feature altogether.

As you might imagine, most users of programmable keyboards do not change the traditional positions of the alphanumeric keys on their keyboards. Typically, they use programmability to move certain command and control keys to more accessible, less awkward positions.

For example, various software applications can make extensive use of Backspace, Return, Enter, Delete, Tab and Escape keys -- all located along the outside edges of the traditional key layout. As a result, you overuse your weaker little fingers and generally deviate your wrists to reach them in their traditional positions. In addition, macros can simplify reaches for otherwise awkwardly positioned key combinations, and can automate the entry of repetitive keystrokes.

Guidelines for Evaluating Alternative Keyboards

Ergonomic design principles suggest that products -- in this case keyboards -- should operate as a natural extension of the human body. In other words, your keyboard should work the way you are designed, not the reverse. It should function as an extension of your hand and arm. And it should reflect your body's shape and movements to reduce the potential for discomfort or injury.

While many computer products can be readily evaluated on the basis of obvious features and benefits, choosing among ergonomic products requires a new approach. These products add a variable to the selection process: the physical effect they have on the body. As a result, it is important to understand the links between ergonomic principles and specific design features when evaluating alternative keyboards. Ultimately, the most ergonomic keyboard is the one that will contribute the most to your comfort and well-being over time.

Just as the healthiest diet is based on nutritional principles and not generally on your favorite foods, the most ergonomic keyboard is based on the ergonomic principles that govern force, posture and repetition -- not on personal preferences. Alternative keyboards should be evaluated in terms of the comprehensiveness with which they address these known stresses. As with most complex issues, simple solutions -- adding a wrist rest, for example -- have not proven effective for the majority of people. A comprehensive product is more likely to be beneficial in a wide range of situations.

Overview

Evaluating alternative keyboards can be complicated because ergonomic attributes often are not readily apparent. Many keyboarding stresses are too subtle to be perceived, at least right away. Their effects accumulate over many months or years of keyboarding -- hence the name cumulative trauma disorder. At some point, these effects become so significant that you feel fatigue or discomfort. However, the subtlety of these stresses makes it difficult to compare products based on initial, subjective preference -- particularly if you are not injured (and therefore not sensitized) to them.

Ergonomic attributes may not be readily apparent for other reasons, including the following:

(1) Initially, most people have a natural tendency to equate comfortable with familiar. However, in reality, the keyboard that immediately feels the most comfortable to you may simply be the one that is most like your traditional keyboard.

(2) Because ergonomic keyboards often alter basic postures and movements they require you to change long-established habits. You probably have developed your own way of typing over many years, so any significant change will feel strange, at first. And new keyboards often involve some initial discomfort while your body adjusts to the new postures and motions required of it.

(3) If you are already injured, your tissues may be swollen and inflamed. Simply switching to an alternative keyboard design will not immediately reduce the swelling and inflammation. It may take several weeks or more for your body to begin to recover from previous injury. In some cases, the new keyboard may simply help to prevent further deterioration. As a result, the potential benefits of

alternative keyboards -- including increases in comfort and productivity, as well as a reduction in physical stresses -- are long-term propositions.

A Few Simple Guidelines
Your transition from a traditional to an ergonomic keyboard will be enhanced by following a few simple guidelines:

(1) Most importantly, schedule your first experiences with the new keyboard for a time when you are not unduly busy or under pressure to maintain your productivity. Such pressures add to frustration and can create physical tension. Be sure to follow the manufacturer's recommendations for setup and adjustment, and use the keyboard in an ergonomically correct work environment to avoid negatively affecting your evaluation.

(2) Allow yourself time for the transition. It is not usually possible to effectively evaluate an ergonomic keyboard in a matter of hours or even days. You should use a new keyboard for a minimum of two to four weeks before drawing any conclusions. In fact, there is generally some emotional stress involved with learning anything new -- and the stress can create physical tension. As a result, evaluations concluded too early may measure physical and psychological reactions to adaptation rather than to use of the product.

(3) Take frequent rest breaks. Adjusting to a new keyboard is taxing, both mentally and physically. As a result, you should take even more frequent rest breaks than when typing with a familiar keyboard.

(4) If you are injured and under the care of a health care professional, follow his/her advice. Limit your keyboarding time at first and build up gradually. If your symptoms dissipate or disappear after you begin using an ergonomic keyboard, do not dramatically increase your keyboarding time or immediately stop treatments without consulting your health care professional.

(5) Arrange your work surface and other elements of your workstation according to sound ergonomic principles. Using any ergonomic product involves an element of personal responsibility. There are actions you can take to circumvent the benefits of the best keyboard. Some involve choices you make regarding your workstation or your lifestyle. Many more involve the techniques you use when keyboarding. Nonetheless, an ergonomic product design can include safeguards to reduce the negative impact of poor technique -- much like the safety guard on an electric saw.

For example, the shape of the front edge of one alternative keyboard may act to discourage poor wrist posture while another keyboard may inadvertently encourage inappropriate posture. (break) "An Ergonomic Keying Environment." Your experience with an alternative keyboard can be affected by the chair you sit in, the desk or other work surfaces in your office, the pointing device you use, and many of the other elements of your working environment.

To evaluate the alternative keyboard and not your overall workspace, position all the elements of your workstation according to established ergonomic guidelines. If your keyboard is physically adjustable, follow the manufacturer's recommendations carefully. These recommendations may

include detailed instructions for optimal adjustment as well as warnings regarding inappropriate setup and operation.

The following is a brief introduction to workstation ergonomics as it relates to keyboarding. For more detailed information, refer to any of the many articles and books on office ergonomics.

(1) The top of your work surface should be high enough for you to rest your forearms without slouching forward onto a too-low surface or elevating your shoulders to reach a too-high surface. When you use your keyboard, your wrists should be at approximately the same height as your elbows, with your forearms parallel to the floor. If you use a mouse, make sure that the surface you use to operate it does not cause you to raise your arm or move too far to one side of the keyboard.

(2) Adjust the height of your chair up or down to allow your feet to rest flat on the floor, with your knees bent approximately 90 degrees and your thighs parallel to the floor. If the height of your work surface is not adjustable, you may need to adjust your chair to accommodate the work surface instead. You can add a foot rest, if necessary.

(3) You should sit close enough to the keyboard that your upper arms rest comfortably at your sides, elbows in. You should not have to extend your elbows forward to reach the keyboard.

(4) The position of your monitor can affect the comfort of your hands and arms -- not just that of your neck and back. In general, your monitor should be just below eye level. If you sit in front of your monitor in a comfortable typing position and look straight ahead at the "horizon," your monitor screen should be just below your line of sight. Also, if the monitor is too close or too far away to view comfortably, it will add physical stress as you adjust your working posture.

Productivity Transitioning

Keyboarding is a complex, highly skilled activity, relying on motions and reflexes that have been reinforced over many months or years of traditional keyboard use. Your first experience with any alternative design will, of necessity, be a bit disorienting because you must develop a muscle memory for the new postures and reaches.

Some alternative keyboards include typing-training software or adaptation exercises specifically designed to assist in your transition. Whether or not you are a touch typist, they help by reinforcing the new motions you must make to reach keys. If you schedule your first experiences with the new keyboard for a time when you are not unduly busy or under a deadline, you will ease your transition and avoid unnecessary frustration. Importantly, experience demonstrates that most people, after they have made the transition to an alternative keyboard, feel that their adaptation was faster and easier than they anticipated during the first few hours or days of use.

When you begin using an alternative keyboard, make a special effort to reduce your typing speed for a short period. It can help you to develop a feel for the keyboard and will pay off in terms of a smoother, faster transition. After you feel comfortable with the keyboard, your speed will begin to increase naturally. Research demonstrates that, with a little practice and a supportive environment, most keyboard users readily adapt to new keyboard designs. And, while the transition to each

keyboard is different for each user, simply becoming comfortable with any Qwerty-based design should not take you more than a few days to a week.

If you are a very fast typist, your skills are highly evolved and it may take somewhat longer for you to transition from one keyboard to another. Also, moving back and forth between various keyboard designs may slow your transition. Keep in mind that productivity is more than typing speed. It is actually comprised of speed, accuracy and endurance. Gains in individual productivity depend on variables such as original typing speed and accuracy, existing injuries, type of keyboarding work, and overall typing technique.

Most alternative keyboard manufacturers do not promote speed increases as a benefit of their products. In fact, an increase in speed results in an increase in repetition for a given period of typing: Typing faster can actually increase your risk for discomfort and injury, all other factors being equal. However, you should regain your previous typing speed. If you are a slow-to-medium-speed typist, your speed may actually increase.

Physical Transitioning

The postures you assume when using your traditional keyboard and the motions you use to strike the keys can cause physical stress. An alternative keyboard that does not address these stresses in a comprehensive manner will generally not provide a significant physical benefit. In other words, if your new keyboard feels and operates much like your traditional keyboard, your body will react to it in the same way. But a more comprehensive keyboard design will feel a bit different and require a brief period to transition physically.

Begin slowly and take frequent rest breaks. Working with a new keyboard is similar to using a new piece of exercise equipment: It places new demands on muscles and other structures. You should be prepared for some fatigue or even mild soreness at first, as your body develops a new muscle memory and adjusts to the postures and motions demanded of it. And the additional repetition required to practice with your new keyboard and reinforce new motions is more physically demanding than routine keyboarding.

If you feel minor discomfort, take a short break. If your discomfort persists for more than a few days, stop using the keyboard until you can discuss the situation with your health care provider. Generally, it takes longer for your body to physically transition to new postures and motions than it does to regain confidence and productivity. You should allow a minimum of two weeks for physical transitioning.

Research Studies of he Kinesis Contoured Keyboard

Research objectives

The Kinesis Contoured Ergonomic Keyboard was designed after nearly two years of research and development, and it has been in widespread commercial use since 1992. The intended market included both those healthy, intensive computer users seeking more comfort and productivity, as well as injured computer users dealing with repetitive strain (overuse) injuries.

The research objectives for this product were to provide the maximum benefits of comfort and productivity without requiring a computer user to re-learn how to type. The objectives would be achieved by minimizing all physical stresses known to be risk factors for repetitive strain injury, while at the same time incorporating a variety of productivity-enhancing features. The target for adaptation time a few hours to begin working and a few days to be close to full speed. The target for performance was at least full speed and normal accuracy for a good touch typist, with improved speed and accuracy for new typists and not-quite-touch typists.

Testing overview

Kinesis conducted extensive usability and physiological research during product development to validate reductions in both muscle force and stressful postures when Kinesis keyboards were substituted for traditional keyboards. Since 1992, numerous independent laboratory tests have been performed, some of which are cited below. The conscensus of these studies is that Kinesis Contoured keyboards are effective at reducting in the known physical stresses and are preferred by computer users who try them.

Note: Abstracts of various keyboard studies are available online at http://www.tifaq.org/keyboards/abstracts.html

Lawrence Livermore National Laboratory Study

Ergonomic and medical professionals at Lawrence Livermore National Laboratory performed a pilot evaluation of a traditional computer keyboard and three alternative designs, including the Kinesis Contoured keyboard. The study concluded that alternative keyboards do provide quantitative improvements over the traditional keyboard in terms of wrist postures when typing, as measured by two critical wrist angles: flexion/extension and radial/ulnar deviation.

The results varied significantly among the keyboards, however. It is significant that the ability to physically adjust keyboard components did not automatically produce significant postural benefits. The product that resulted in the best typing postures under the terms of the study -- the Kinesis Contoured keyboard -- was the only nonadjustable alternative keyboard.

Global Ergonomic Technologies, Inc. (GET) Study, 1993

A major independent study of the Kinesis keyboard was conducted at the laboratories of Global Ergonomic Technologies (see also http://www.kinesis.com/lab-data.htm). Throughout the study, measurements were taken of hand angles, electrical muscle potential, and keying speed and accuracy. Comparative preference ratings of each keyboard were also collected and analyzed. The study concluded that the Kinesis keyboard demonstrated "substantial physiological advantages, good performance and more [user] preferences compared to the traditional keyboard."

Electromyographic (emg) readings were taken to measure the activity of four muscle groups: controlling hand ulnar deviation, hand extension, elbow abduction and inward twisting of the forearm (pronation). Among the study's emg findings: ". . . substantially less load on muscles controlling hand deviation, extension, and pronation on the Kinesis keyboard." Postural analysis also showed "hand deviation and extension were substantially less on the Kinesis keyboard than on the traditional keyboard." In all cases, subjects using a traditional keyboard demonstrated extension and deviation above the recommended maximums, while using a Contoured keyboard these values were below recommended maximums.

The study also evaluated performance and concluded: "Although subjects only had 7 hours of training on the Kinesis keyboard, keying performance was almost up to their performance level on a traditional keyboard. . . . There were no significant differences for number of errors between the two keyboards."

As to the more subjective measures: "Subjects indicated substantial preference for the Kinesis in areas of comfort, fatigue, and usability. They preferred the Kinesis by almost two to one as an overall choice."

Citation: Smith, W.J., & Cronin, D.T. (1993). Ergonomic test of the kinesis keyboard. Proceedings of the Human Factors Society (pp. 318-322). Santa Monica, CA: Human Factors and Ergonomics Society. See also http://www.tifaq.org/keyboards/abstracts.html.

Jahns/Litewka Adaptation Study
An adaptation study for the Kinesis keyboard was conducted by a team of researchers, including the late Dieter W. Jahns, past Executive Director of the Board of Certification in Professional Ergonomics, and Jack Litewka, President of Applied Ergonomics. The study consisted of a baseline test on a traditional keyboard and a total of eight hours of typing exercises over a three-day period using the Kinesis keyboard.

Citation: Jahns, D.W., Litewka, J., Lunde, S.A., Farrand, W.P., & Hargreaves, W.R. (1991). Learning curve and performance analysis for the Kinesis™ ergonomic keyboard--a pilot study. Presented as a poster at the HFS 35th Annual Meeting (San Francisco, CA, September 2-6, 1991).

Gerard, Jones, Smith, Thomas, & Wang, 1994 (Muscle force measured by EMG)
EMG was used in evaluation of the Kinesis ergonomic keyboard (Gerard, Jones, Smith, Thomas, & Wang, 1994) which has its keys split apart and set in two concave "dishes" on each side of the keyboard. They determined that the resting posture of the hands on the Kinesis keyboard required significantly less activity to maintain as compared to a standard keyboard. Reduced muscular activity was also measured for typing, which may be attributable to the Kinesis' unique key arrangement

Citation: *Gerard M.J., Jones, S.K., Smith, L.A., Thomas, R.E., & Wang, T. (1994). An ergonomic evaluation of the Kinesis ergonomic computer keyboard. Ergonomics. 37, 1661-1668*

Lopez study, 1993 (quantitative and qualitative comparisons of several keyboards)

…For the normal control group, the greater wrist extension occurred with the Comfort keyboard, and less extension occurred with the Kinesis than the IBM keyboard…

…The CTS group found the Kinesis keyboard to be the most comfortable for all three area. The IBM received the most favorable ratings from the normal control group for minimizing upper arm discomfort. The normal control group rated the Kinesis most favorably for minimizing forearm and wrist discomfort…

…As a group, participants achieved 95% of their baseline typing speed in eight hours of training. More than half exceeded their baseline performances by the end of the study. Accuracy was generally the same on both Kinesis and traditional keyboards. Survey results showed that most participants preferred the Kinesis keyboard and considered it to be more comfortable…

Citation: Lopez, M.S. (1993). An ergonomic evaluation of the design and performance of four keyboard models and their relevance to carpal tunnel syndrome, Unpublished doctoral dissertation, Texas A&M University, College Station, TX

Ergonomic Features of the Kinesis Contoured Keyboard

The Kinesis Contoured Keyboard is designed to conform to the shape and movements of the human body, reducing the force and stressful postures that contribute to discomfort and reduce productivity. Important elements of the Kinesis keyboard's design include:

(1) Traditional key layout. The key layout retains the familiar Qwerty configuration, minimizing adaptation requirements. (Optionally, the keyboard supports the Dvorak layout.)

(2) Reprogrammable key layout. Programmability features allow simple, rapid changes to the positions of keys, plus the optional creation of macros -- all of which are stored in the keyboard's memory. As a result, users can easily adjust the keyboard's operation to reduce stressful reaches based on individual use patterns and to provide optimal workload allocation.

(3) Separated, concave alphanumeric keypads for each hand. This separation minimizes strain and stretching by positioning arms at approximately at shoulder width -- with wrists straight, reducing abduction and ulnar deviation. Because of the keyboard's lateral tilt (i.e., center elevation), the thumb sides of the palms are positioned higher than the little-finger sides to reduce pronation. Keys are arranged in vertical columns to reflect the natural motions of the fingers, and keypads are sculpted and concave to fit the varying lengths of fingers.

(4) Embedded 10-key layout. A traditional numeric (10-key) keypad is embedded into the right alphanumeric keypad, providing ergonomic advantages for number-intensive operations. (Optionally, the 10-key can be programmed to operate from the left keypad.)

(5) Separate thumb keypads. Thumb keypads redistribute workload from the relatively weaker and overused little fingers to the stronger thumbs. The thumb keypad includes heavily used keys such as Enter, Space, Backspace, Delete and the combination keys (Control and Alt on the PC, or Command and Option on the Macintosh). The keying workload is therefore more evenly distributed and lateral motions required to reach peripheral keys are reduced, limiting ulnar deviation.

(6) Closer placement of function keys. Soft-touch function keys are positioned closer to the alphanumeric keys to reduce awkward motions and stretches, particularly for key combinations involving thumb keys (Control and Alt, for example).

(7) Integral palm support. A palm support with optional self-adhesive pads enhances comfort and reduces stressful extension of the wrist. It provides a place to rest the hands while not actively keying and limits the effort required to remain poised over a keyboard.

(8) Low-force, tactile keyswitches. The low-force (45 grams) mechanical keyswitches are engineered to provide both tactile and audible feedback. Their long travel (4 mm), with activation at approximately 2 mm, reduces the jarring impact of "hitting bottom."

(9) Optional foot switches. Up to two foot switches can be used to perform keystrokes, redistributing a portion of the workload away from the hands. (10) Minimum footprint. At 16 5/8" by 8 1/8" by 3", the Kinesis keyboard is smaller than a traditional keyboard.

Kinesis Case Studies of Contoured keyboard users

Since 1992, tens of thousands of people have used and loved Kinesis Contoured keyboards. Excerpts from the stories of a representa few of these follow:

Business Executive:
"Although I'm not injured, I can feel the reduced muscular effort required to use the Kinesis keyboard. My fingers go naturally to the home row. And since they have much less traveling to do, they don't tire as quickly."

Microcomputer Systems Manager
"I was really attracted to the fact that the Kinesis is a Qwerty keyboard, so I wouldn't have to learn a whole new key layout. I was able to use the keyboard right away. Within the first week and a half I couldn't tell any difference in my productivity. I think I actually type faster."

Researcher
"After doing a fair amount of research on keyboards . . . I decided to try yours. After only a few days it was clear that this was the keyboard I wanted to keep. It's far and away the most comfortable keyboard I've ever used. My fingers, hands, and arms don't get tired nearly as quickly now, and my speed has increased by about 20 - 25 wpm."

Administrative Assistant
"I was wearing wrist braces 24 hours a day and facing surgery for carpal tunnel. Surgery was not appealing; I wanted an option. The Kinesis keyboard made all the difference in the world to me."

Communication Services Coordinator
"Everything's right there at my fingertips. I don't have to stretch my hands or manipulate my body to perform keystrokes. Within two weeks of using the Kinesis keyboard, my pain was gone. My doctor was amazed at my rapid progress. As long as the Kinesis keyboard follows me wherever I go, I'll be fine."

Financial Analyst
"The Kinesis saved my job."

Novelist
"The keyboard saved my hands. I work on deadline, a task which would normally be agony for me. I truly feared my hands would not hold out to finish this book. However, after a week, I realized that my hands and arms did not hurt."

Canadian Government Employee
"The keys are all where you expect them to be. I can feel the difference between typing on the Kinesis and a traditional keyboard."

Programmer
"I used the training materials for about an hour and was back to my normal typing speed of 100 words a minute in four or five days. I love this keyboard."

Engineer
"With the Kinesis, my thumb discomfort is totally gone. This past weekend I typed on a traditional keyboard and I really paid the price."

Software Developer
"It's a great keyboard. My speed and accuracy have improved remarkably."

Legal Secretary
"Being able to reprogram keys away from my little fingers has helped immensely. I also use a foot switch for Shift, and that's helped alleviate my pain."

Loan Processor
"After a total of four hours on the Kinesis, I'm able to type just about as fast as I normally do -- 120 words a minute."

Lawyer
"I typed an entire brief without needing a break. At the end of the day I had no pain. That would never happen on a traditional keyboard."

Vice President
"My hands felt relaxed when I type. I especially like the function keys and positions of the Space and Backspace keys. . . . The touch is exceptional."

Engineer
"I think the idea of separate keywells is better than other designs I've seen. Our company ergonomists have looked at the Kinesis and like what they see."

System Programmer
"I feel more comfortable. My knuckles have improved and my ulnar-side pain is reduced. I like the wider separation between keying areas -- I wonder why people would use a traditional keyboard now."

Legal Secretary
"Being able to reprogram some keys away from my little fingers has helped immensely. I also use a foot pedal for Shift, and that's helped alleviate my pain. Adaptation wasn't a problem."

College Student
"I am a blind programmer with tendinitis. And I'm a satisfied Kinesis customer. The Kinesis keyboard is a great product. It only took me one day to naturally find the home row on the Kinesis and one week to become totally happy with the keyboard."

Transcription Department Supervisor
"After trying several other keyboards we brought in the Kinesis for a trail. This is the only keyboard that seems to be doing any good. Carpal tunnel syndrome and other types of RSI

[repetitive strain injury] are a problem at our hospital, so we are trying hard to find a good keyboarding solution."

Legal Secretary
"At the end of the day I feel fine, and I notice that I feel fine. No aching shoulders, no aching back, no aching arms. No aches at all."

Police Department Records Supervisor
"I manage a department with three staff members who are literally using it around the clock -- all on different shifts. All three like the keyboard a great deal. I am pleased enough with the results of our use that I would recommend the keyboard to anyone. . . . One of the users commented that there is no pain, no strain on the Kinesis. Another says it is really comfortable. And the third user could feel the difference immediately. We're sold."

Computer Director, State University
"This keyboard is the most exciting thing since the graphical user interface. When I got the keyboard and put my hands on it, I just said 'ooooooh' it felt so good. . . . Placing my hands into the keywells is like putting on an old sweater, or the comfort of an old friend. . . . I took to it like a duck to water."