

# **Ergonomic Workplace Evaluation**



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## **Introduction**

The workplace evaluated for this project, is the cash register workstation in the Woman's and Home Fashion departments at Sears, located in Santa Cruz, California.

This is a 4 walled, island-type workstation, located in the walkway between the Woman's and Home Fashion departments, with 4 cash registers, 2 on either side of the workstation, where customers can approach from either side. The right-handed register station (register to the right of the counter space), facing south is the focus of this evaluation (see Appendix A).

The purpose of this evaluation is to identify potential hazards and determine risk potential of the workplace environment in regards to ergonomic factors. The task will be evaluated by comparing workplace measurements and observed worker actions to recommended ergonomic guidelines, covering anthropometry, body mechanics, physiology, workplace evaluation and cumulative trauma. Recommendations based on these comparisons will be included.

## **Task**

The task evaluated at this workplace is a customer purchase.

Customers approach the workstation, from a line, one at a time and place the merchandise to purchase on the counter. Merchandise primarily consists of clothing, bath or bedding supplies, as individual items, or packaged, and occasionally boxed items.

If multiple items are presented, the worker positions the merchandise for easy access to the price tags for scanning. Using their left hand, the worker picks up or positions the first item to be scanned. Using their right hand, the worker picks up the scanner and reads the bar code on the price tag. The scanner is sometimes set down between scanning items, so the scanned item can be moved to the side, or folded, to keep separate from additional items to be scanned.

If a scanned item is not “found” in the system, the code from the tag is manually keyed into the register. If the clothing is mounted on a hangar, the hangar is removed and put in a storage box, for re-use.

The register is then accessed to “total” the sale. The customer is verbally notified of the sale total. Payment, options are cash, check or credit card.

Cash is handed to the worker. The worker may count the cash on the counter top. The payment amount is keyed into the register, and the cash drawer is opened. The money is sorted and inserted into the drawer. Any change due the customer is removed at that time, then the drawer closed. The receipt is printed, removed from the register and handed to the customer.

If a check is offered, additional identification is usually requested. The worker will place the identification and check on the counter, and write any additional information needed on the check. The register is then accessed to accept payment, the cash drawer opened and the check inserted, then the drawer is closed. The receipt is printed, removed from the register and handed to the customer.

If the customer pays with credit card, the credit card is handed to the worker. The worker swipes the card in the credit card scanner. The worker is notified on the register monitor of acceptance or rejection of the credit card. After acceptance, a credit card receipt is printed. This receipt is inserted into a signature pad, where the customer signs on the paper receipt. The customer keeps the printed receipt they just signed.

The worker takes the appropriate size bag from a shelf below the counter and items are placed inside the bag by hand.

Different aspects of this reviewed task and the workplace where it is performed can affect worker’s productivity, safety, health and quality of life.

The distance one needs to reach to scan merchandise, or if they need to lean over the counter to access the signature pad, can cause discomfort or harm to the back or shoulder if it is beyond the body’s normal capabilities. The angle one must maneuver their arms to position and scan merchandise can cause excessive stress on the joints.

The height of keyboards determines how one must position their wrists and arms. Incorrect keyboarding position can lead to serious damage to those body areas, the most common being carpal tunnel syndrome. Appropriate monitor height, relative to the height of the worker, is important to avoid strain on the eyes, neck or back.

Increased frequency, joint deviation, or force with any of these movements can put the worker at risk of cumulative trauma. Even the slightest discomfort from these or other factors can adversely affect worker comfort, productivity and their quality of life.

## **Equipment**

The equipment used for the task consists of: a cash register, consisting of a cash drawer, credit card scanner, keyboard, monitor, and a receipt dispenser; a merchandise scanner; and a customer signature pad (see Appendix B).

The cash drawer is located in the lower front of the register. It is opened by key command, and closed by pushing with the hand. The credit card scanner is located on the front of the register, above the cash drawer. The keyboard is an extended computer-style keyboard (with number keypad to the right), which sits loosely on the register, above the credit card scanner. The monitor is located on the top right of the register. The receipt dispenser is located on the top left of the register.

The merchandise scanner is a hand-held gun-type scanner, which sits to the left of the register, on the counter. The scanner is held by gripping in the palm of the hand, wrapping the fingers and thumb around the handle. The scanner is pointed at the barcode, and is actuated by squeezing a trigger on the handle with either the first or first and second finger.

The customer signature pad is located on the counter. A credit card receipt is slid flat into the device, which holds the paper receipt in position, while the customer signs it. The device captures the pressure of the signature, and displays the signature on the register monitor.

Other items or areas accessed during the task are the merchandise bags and hangar disposal box, both located under the counter.

## Workers

This workstation is primarily used by female workers, occasionally used by male workers. The worker observed for this evaluation is a right handed female, with the following applicable dimensions:

	inches	cm	U.S. Female Population Mean	Percentile
Height	59½	151	162.94	3%
Eye Height	54	139	151.6	2.2%
Elbow Height	36	91.5	99.8	3.2%
Wrist Height	28½	72	79	3%

If not obvious, it should be noted this worker is short in stature, and falls below the 5<sup>th</sup> percentile for all reported measurements.

Work is performed at this workstation for 4 to 8 hour shifts. An 8-hour shift is split with a lunch break, resulting in 2, 4-hour shifts. The 4-hour shifts allows a 15 min break. The number of transaction or customers per hour varies greatly, with a slow period of approximately 6 customers per hour and a busy period of approximately 25 per hour.

## Observations / Evaluation

### ***Counter Height***

The counter measures 84 cm (33 inches) high. The recommended height for hand work is approximately 5 cm (2 inches) below the elbows<sup>1</sup>. For the average female that would calculate to approximately 94.8 cm (37.25 inches)<sup>2</sup>. A recommended work height for the observed worker would be 86.5 cm (34 inches),

A recommended height for *detailed* hand work is approximately 10 cm (4 inches) above elbow height<sup>3</sup>. For the average female, that would calculate to approximately 109.8 cm (43¼ inches)<sup>2</sup>. A recommended detailed work height for the observed worker would be 101.5 cm (40 inches).

The counter is approximately 10.4 cm (4 inches) lower than the recommended work height for the average female, but about right for the observed worker. It is approximately 25.8 cm (10¼ inches) lower than the recommended detailed work height

for the average female, and approximately 17 cm (7 inches) lower than the recommended detailed work height for the observed worker.

#### Normal Working Height

	Measured	Recommended* for Ave. Female	Difference	Recommended* for Observed Worker	Difference
cm	84	94.8	-10.8	86.5	-2.5
inches	33	37¼	-4¼	34	-1

\* Recommended working height is approximately 5 cm below elbow.

#### Detailed Working Height

	Measured	Recommended** for Ave. Female	Difference	Recommended** for Observed Worker	Difference
cm	84	109.8	-25.8	101	-17
inches	33	43¼	-10¼	40	-7

\*\* Recommended detailed working height is approximately 10 cm above elbow.

When evaluating, one must consider what the counter space is used for: the customer will be walking through the store carrying merchandise, when ready to checkout, they will place the merchandise on the counter. A higher counter would require the customer to lift their merchandise that much higher, when checking out. The worker will then position the merchandise on the counter, to scan the items. So the actual workspace is above the counter, the height of the merchandise, which can vary.

The counter top is also used as a detail workspace for the worker to count cash received, and to write additional identification information on customer checks. The customer also uses the counter top as a workspace to write checks and sign credit card receipts. Both customers and the worker were observed having to lean over to complete the described detail work.

The counter height seems appropriate for the placement, positioning and scanning of merchandise, but not for the more detailed work, such as writing by both the customer and worker.

#### *Recommendation*

A higher workplace for these detailed tasks is recommended. A solution may be a separate elevated workspace above the existing counter, for both the customer and the

worker, to utilize for these detailed tasks, yet leaving enough existing counter space for merchandise.

### **Counter Depth**

The counter measures 66 cm (26 inches) deep. The approximate reach while standing for U.S. workers, at a height of 84 cm (33 inches), is 30.5 cm (12 inches)<sup>4</sup>. That's about one half the distance of the counter. Customers were observed placing merchandise at all positions on the counter, and the forward reach required of the observed worker, varied from 15 cm (6 inches) to 50 cm (20 inches).

	Measured Difference	Ave Reach*	Difference	Observed Reach Ranges		Recommended Max**	Max
				Min	Max		
cm	66	30.5	-35.5	15	50	50	0
inches	26	12	-24	6	20	20	0

\* Approximate reach distance for average U.S. workers at a working height of 84 cm.

\*\* Ref: Notes pg 75.

The forward lean required of the worker for these observed reaches varied from 0 to 30 degrees. Considering the upper body is approximately 68% of one's body weight, the lean of 30 degrees on the worker results in a forward-bending moment of approximately 616 in-lbs., which equates to an erector spinae muscle force of 308. Although this is well below the force of 770 lbs., where lower back pain risk occurs<sup>5</sup>, repetition and frequency can increase the risk.

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Weight 130 x .68 = 88.4 lbs.

88.4 x 7 in\* = 616 in-lbs.

616 / 2 = 308 (Force generated by erector spinae muscles\*\*)

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\*distance of center of body mass

\*\* Ref: Cornell University: [ergo.human.cornell.edu/DEA325notes/lifting.html](http://ergo.human.cornell.edu/DEA325notes/lifting.html)

Again, considering the purpose of the counter, decreasing the depth, to decrease the reach required, may not allow enough space for the customer to place merchandise, nor enough space for the worker to scan merchandise. The observed maximum reach distance (51 cm or 20 inches) is a recommended maximum, where anything beyond should be avoided, so the counter depth should not be increased at all.



*Recommendation*

A suggestion would be to somehow, encourage customers to place the merchandise closer to the worker side of the counter.

**Toe Space**

The toe space measures 6.5 cm (2.5 inches) high, and 5 cm (2 inches) deep. The recommended toe space is 15 cm (6 inches) high and deep<sup>6</sup>.

*Recommendation*

Increasing the toe space to the recommended values should move the worker's center of gravity closer to the counter, possibly increasing their reach distance across the counter, and may help avoid leaning required for reaches.

**Merchandise Bag Access**

The merchandise bags are located on two shelves below the counter. The small and medium size bags are on a shelf 61 cm (24 inches) high, large bags are on a shelf 51 cm (20 inches) high. The wrist height for the 5<sup>th</sup> percentile average female is 72.8 cm (28½ inches), and the wrist height for the 95<sup>th</sup> percentile average female is 85.5 cm (33½ inches)<sup>2</sup>.

	Lower Measurement Difference	5 <sup>th</sup> Percentile*	Difference	95 <sup>th</sup> Percentile*	Difference	Observed Worker*	
cm	51	72.8	21.8	85.5	34.5	72	21
inches	20	28½	8½	33½	13½	28½	8½

\*wrist height of female.

These shelves are at a lower height than is easily accessible for even the 5<sup>th</sup> percentile worker, by 8½ inches. It requires bending over (for all workers) to remove a bag, which would be required for most transactions.

*Recommendations*

Locate all the bags on one shelf, at a height of 85.5 cm (33½ inches), so the taller workers can reach without having to lean over. This height will accommodate the reach of the shorter workers also.

### ***Disposal of Hangars***

Most clothing is displayed on hangars, which are carried to the checkout stand with the clothing still attached. The worker needs to remove the clothing from the hangars, and then the hangars are put into a cardboard box under the counter.

The hangar box is located under the counter, the opening at a height of 54.5 cm (21½ inches) with a 6 cm (2½ inches) gap between the top of the box and the shelf above. Due to the narrow gap at such a low height (18.3 cm below 5<sup>th</sup> percentile wrist height of female<sup>2</sup>), the worker was observed having to bend over and struggle to get hangars into the box.

### ***Recommendation***

Locate the box so hangars can simply be dropped into the box, eliminating any bending to access, and eliminate the narrow gap to fit hangars through.

### ***Merchandise Scanner***

The merchandise scanner is located on the counter, next to the cash register. Its position on the counter may vary, depending on the position one places it. Observed placement distances varied from 5 cm (2 inches), to 14 cm (5 ½ inches), all within the approximate reach while standing for U.S. workers<sup>4</sup>.

The circumference of the handle is 12.5 cm (5 inches), the grasp span for the handle is approximately 5 cm (2 inches), and the force required to activate the scanner is less than 8 lbs. The average time required to activate the scanner is approximately 1 second. These recorded values are well below the average grip strength of 100 lbs., at a span of 5 cm<sup>7</sup>.

The weight of the scanner is approximately 4 oz., which is incidental compared to the weight of the arm holding the scanner.

A variety of repetitive movements were observed when using the scanner, depending on the shape of the merchandise. These include a shoulder flexion from 0 degrees to 70 degrees, and wrist extension and flexion of approximately 20 degrees.

Another repetitive task observed, was the squeezing motion to activate the scanner. Several repetitions can occur within 30 seconds, several times throughout the day.

Even though the force is minimal, excessive repetitions of these movements can put the worker at risk of cumulative trauma (see Potential for Cumulative Trauma).

### *Recommendation*

Regarding the reach and arm movement (shoulder flexion) required to scan large or odd shaped merchandise, a solution may fall under the category of Counter Height, where providing a lower counter space for large merchandise to be placed, would put that merchandise at a lower working height, accessible without excessive shoulder movements. An average of the sizes of merchandise would be needed to determine this lower counter height.

Regarding the repetitive task of squeezing the scanner, a different style of trigger may help avoid the risk of cumulative trauma. For example, a second trigger on the side of the handle, which is activated by the thumb, would reduce the repetitive movements of the first and second fingers.

### ***Cash Register – Keyboard***

The recommended position for arms while using a keyboard is to keep the upper arm vertical, the forearm at a 90 degree angle to the upper arm, and keep the forearm and hand in a straight position<sup>8</sup>. An additional guideline suggests the forearm be horizontal with the hands at, or slightly above, elbow height<sup>9</sup>.

The height of the keyboard is 100 cm (40 inches). The average standing female elbow height is 99.8 cm (39¼ inches)<sup>2</sup>.

	Keyboard Height	5 <sup>th</sup> Percentile*	50 <sup>th</sup> Percentile*	95 <sup>th</sup> Percentile*	Observed Worker*
cm	100	92	99	107	91.5
inches	39¼	36¼	39	42¼	36

\*Elbow height of female.

With the measured keyboard height and the average female elbow height approximately the same, this keyboard height would fit the average female.

### *Recommendation*

Following the recommendation of keeping the wrist at, or slightly above elbow height, a slightly higher position may be more appropriate for a fixed position keyboard height.

Due to the difference in the 5<sup>th</sup> and 95<sup>th</sup> percentile female elbow height (15 cm), a better solution would be to position the keyboard at a height to accommodate the 5<sup>th</sup> percentile worker, and provide a riser under the keyboard, to elevate it 15 cm to accommodate the 95<sup>th</sup> percentile worker.

### ***Cash Register – Drawer***

The height of the cash register draw is 86.5 cm (34 inches). This should be considered or calculated as working height, which is recommended at 50 mm (2 inches) below the elbow height. For the average female that would calculate to approximately 94.7 cm (37¼ inches)<sup>2</sup>. The drawer height is 8.2 cm (3 ¾ inches) below recommended work height,

	Drawer Height	Ave Working Height*	Difference
cm	86.5	94.7	-8.2
inches	34	37½	-3½

\* Approximately 5 cm below elbow height of ave female

It is reported that output does not decrease more than a couple percent, if workspace is 12.5 cm below recommended height<sup>10</sup>. So the cash register drawer height falls within acceptable height.

### ***Cash Register – Monitor***

The cash register monitor is on a swivel mount, rotating approximately 45 degrees to the right and left of center, and tilting approximately 15 degrees up and down from center. This allows sufficient viewing from the side angles (if one were standing slightly to the side of the cash register), but little variation in height adjustment.

The recommended distance of monitors from the worker is 15 – 30 inches<sup>11</sup>. The distance of the monitor from the worker is approximately 16 inches, which is within recommended values.

The recommended monitor height is at, or slightly below worker eye height<sup>11</sup>. This resting or normal line of sight is measured at 0 to 15 degrees below horizontal line of sight<sup>12</sup>.

The top of the monitor is 137 cm (54 inches), and the bottom of the monitor is at 123 cm (48½ inches). The measured eye height of the average standing female, is 151.6 cm (60 inches)<sup>2</sup>. So the top of the monitor falls 14.6 cm (6 inches) below the average female horizontal line of sight.

	Monitor Height	5 <sup>th</sup> Percentile*	50 <sup>th</sup> Percentile*	95 <sup>th</sup> Percentile*	Difference for Ave. Worker
cm	137	141.5	151.6	162	14.6
inches	54	56	60	64	6

\*eye height, or 0 degree line of sight for females.

For the average female, the angle of view to the top of the monitor (from a distance of 16 inches) is 19 degrees below horizontal, and to the bottom of the monitor is 35 degrees below horizontal. Neither the height nor angle of view is within recommended region for the average female.

This monitor height is appropriate for the observed worker (eye height at 2<sup>nd</sup> percentile), but most other workers would need to angle their head and possibly their back to view the monitor.

### *Recommendation*

Allow the monitor to be raised and lowered on it's mount, ranging from heights of approximately 141.5 cm (5<sup>th</sup> percentile female eye height), to 162 cm (95<sup>th</sup> percentile female eye height). This should decrease the stress on the neck and back when workers are viewing the monitor.

***Cash Register – Receipt Dispenser***

The receipt dispenser is located at a height of 120 cm (47 inches), and a reach distance of 45.4 cm (18 inches). This distance is within the approximate reach while standing for U.S. workers, just under 50 cm (20 inches) inches at a height of 120 cm<sup>4</sup>.

Even though this is within approximate reach, it requires shoulder flexion of approximately 70 degrees for the observed worker. Removal of the receipt requires minimal force, enough to grasp and rip a piece of paper, but it is a potential for trauma, since it is the same motion repeated for each transaction.

***Recommendation***

Locate the receipt dispenser closer to the worker, to avoid excessive reach and shoulder movement - for example print the receipt out the front of the register.

***Cash Register – Credit Card Scanner***

The credit card scanner is located on the front of the register, above the cash drawer, at a height of 91.5 cm (36 inches). The card is grasped between the thumb and fingers, and held flat or horizontally, requiring wrist/forearm supination of about 10 to 15 degrees (rotating out from a vertical handshake position). The card is inserted into the scanner and slid to the right or left a distance of about 25.5 cm (10 inches). The reach distance is negligible, it is directly in front of where the worker would stand.

The height is approximately at the elbow height of the average female worker (99.8 cm)<sup>2</sup>, so the forearm is held at approximately 90 degrees to the upper arm. This results in a pivoting motion from the elbow, instead of the shoulder, which is a preferred movement<sup>13</sup>. The height, reach and swipe movements are all within acceptable ranges and recommendations.

***Customer Signature Pad***

The customer signature pad is located on the counter, usually on the customer side of the counter, approximately 51 cm (20 inches) from the worker side of the counter. It is connected to the cash register by a wire, with limited mobility. Due to the height of the counter (see Counter Height) the worker must lean and reach over the counter to insert

the receipt for the customer to sign, and the customer in turn must lean to sign on the signature pad.

### *Recommendation*

As per Counter Height recommendation, a higher counter height to accommodate detail workspace should reduce the reach and lean required to access the customer signature pad. A longer and more flexible cord will make the pad easier to move around the counter top and in turn, more accessible to the worker and customer.

### ***Floor and Standing***

To reduce fatigue in the back, legs and feet, hard floors should be avoided. The floor in this workstation is carpeted from edge to edge, with significantly more cushion than the carpeted area in the store. This is the recommended flooring for a work area<sup>14</sup>.

Static standing posture can result in venous pooling, blood collecting in the legs, which can cause swelling of the legs, ankles and feet. Moving and walking help reduce this venous pressure in the lower limbs<sup>15</sup>. This workstation allows space to move around. The task itself requires the worker to step side to side, or at a minimum, shift their weight from leg to leg.

### *Recommendation*

Because their work requires them to stand, provide seating for the workers to sit down and relieve the pressure from their legs and feet, when they are not busy.

## **Potential for Trauma**

Cumulative Trauma risks result from repetition or duration of movements, joint deviation and force. Following the 30 s Rule, a task is considered repetitive if it is repeated in less than 30 seconds. Although, if a movement's cumulative repetitive duration is less than 1 hour a day, there is less risk for trauma<sup>17</sup>.

A few areas were noted to be at of risk of cumulative trauma, using the merchandise scanner and reaching for the register receipt. Following the recommendations should reduce the repetition or amount of movement needed for these tasks, thus reducing the risk of cumulative trauma.

### ***Rapid Upper Limb Assessment (RULA)***

The RULA evaluates posture, muscles and force, and provides a numeric rating between one (low) and seven (high), indicated the risk of repetitive strain injuries. A low rating does not assure the workplace is free of risk, nor does a high rating indicate a severe problem exists, the goal is to identify areas of potential risks that may require attention.

The RULA evaluation score for this workplace observation is a 4<sup>18</sup>.

The areas that have significant contributions to this score are upper arm, and trunk posture. Upper arm movements up to 70 degrees and a forward trunk leaning up to 30 degrees were observed. Even though force is minimal with these movements, significant frequency contributed to their score. (RULA considers more than 4 times a minute repetitive).

Note that this observation was of a worker of shorter than average stature, which may have required more leaning or further reaches than a taller worker. I would expect a similar score for a taller worker, due to other noted factors, such as monitor height, and merchandise bag locations.

### **Worker Physiology**

Worker physiology evaluated for this study is heart rate. The worker's basal heart rate is 72 beats per minute. The predicted maximum heart rate for this worker is  $(220 - \text{age}) = 190$ <sup>16</sup>. The recorded heart rate immediately following a busy period was 88. The average recorded heart rate during workplace shift was 80.

The percent maximum heart rate range for this evaluation is:

$$100 \times ( (80 - 72) / (190 - 72) ) = 6.7\%$$
<sup>16</sup>

This is well below the recommended maximum percentage of 33%<sup>16</sup>.

This is not a very strenuous task, but a busy period can involve considerable movements or stress, either one potentially raising the worker's heart rate. These heart rate figures are well within recommended guidelines.



## Conclusion

Avoiding repetitive motions is one goal of ergonomic workplace design. One solution is to allow switching between right & left hand or limb usage on the tasks. Some elements in this workstation accommodate this very well: each workstation has an adjacent workstation that is a mirror image of the other, set up for opposite hand usage. Specific elements that achieve this goal are the credit card scanner, cards can be swiped right to left or left to right; and the merchandise scanner, which can be used by either hand.

Another goal of ergonomic design is to accommodate as many workers as possible: design for the variety of strengths, shapes and sizes of people one may hire. Accomplishing this goal may require designs that adjust, to accommodate the tallest or the shortest with the same comfort, as in the keyboard or monitor recommendations.

The potential for risk of trauma due to joint deviation or repetition was indicated in the RULA evaluation and identified in some of the specific areas or processes of the task. Following the recommendations should alleviate the risk of injuries in these areas.

It is important to keep the comfort and safety of the workers in mind, not only for the workers benefit and well being, but for the company also. Employee retention is important, absenteeism or frequent turnover can be costly to a company. Employee health records, complaints, and absentees can all be indicators of potential problems.

In this workplace, the worker deals directly with customers: their actions and behavior, any discomfort, stress or problems with equipment will be witnessed by the customer. Proper workplace design can help avoid these problems and can also help worker attitude and efficiency which is appreciated by customers.

For a summary of recommendations, see Appendix C.

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## Appendix A: Workstation

### *Customer Point of View*



## Appendix B: Workstation *Equipment*



## **Appendix C:**

### ***Summary of Recommendations***

#### *Counter Height*

A higher workplace for detailed tasks is recommended, at 110 cm (43 inches). A solution may be a separate elevated workspace above the existing counter, for both the customer and the worker, to utilize for detailed tasks, yet leaving enough existing counter space for merchandise.

#### *Counter Depth*

Encourage customers to place the merchandise closer to the worker side of the counter.

#### *Toe Space*

Increasing the toe space to 15 cm high and deep should move the worker's center of gravity closer to the counter, possibly increasing their reach distance across the counter, and may help avoid leaning required for reaches.

#### *Merchandise Bag Access*

Locate all the bags on one shelf, at a height of 85.5 cm (33½ inches), so the taller workers can reach without having to lean over. This height will accommodate the reach of the shorter workers also.

#### *Disposal of Hangars*

Locate the box so hangars can simply be dropped into the box, eliminating any bending to access.

#### *Merchandise Scanner*

Provide a lower counter space for large merchandise to be placed, which would put the merchandise at a lower working height, accessible without excessive shoulder movements. An average of the sizes of merchandise would be needed to determine this lower counter height.

Using a different style of trigger may help avoid the risk of cumulative trauma. For example, a second trigger on the side of the handle, which is activated by the thumb, would reduce the repetitive movements of the first and second fingers.

#### *Cash Register - Keyboard*

Position the keyboard at a height to accommodate the 5<sup>th</sup> percentile worker, 92 cm (36 inches) and provide a riser under the keyboard, to elevate it 15 cm to accommodate the 95<sup>th</sup> percentile worker.

#### *Cash Register - Monitor*

Allow the monitor to be raised and lowered on it's mount, ranging from heights of approximately 141.5 cm (5<sup>th</sup> percentile female eye height), to 162 cm (95<sup>th</sup> percentile female eye height). This should decrease the stress on the neck and back when workers are viewing the monitor.

#### *Cash Register – Receipt Dispenser*

Locate the receipt dispenser closer to the worker, to avoid excessive reach and shoulder movement - for example print the receipt out the front of the register.

#### *Customer Signature Pad*

A higher counter (for detailed work, see Counter Height) will improve access the customer signature pad. A longer and more flexible cord will make the pad easier to move around the counter top and in turn, more accessible to the worker and customer.

#### *Floor and Standing*

Because their work requires them to stand, provide seating for the workers to sit down and relieve the pressure from their legs and feet, when they are not busy.