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## **ABSTRACT**

The purpose of this report is to identify and apply key industrial ergonomic principles to a workplace to improve the anatomical and physiological factors of operation. This approach was applied to Cyclone Manufacturing, an aerospace company that assembles and machines aeroplane parts. Analysis was conducted on the machinery used in the workplace, the tasks the workers performed and the day to day operations to improve the plant. Various alternative designs and improvements were investigated and it was determined a combination of the alternatives resulted in the optimal solution. Implementation of a continuous hinge system and pneumatic pump reduced the amount of force required to open a large furnace door by a factor of almost two. The additional implementation of a proximity suit to combat the heat of the furnace and designated workers assisted with psychosocial factors. Alongside other changes, it was determined that while these changes may cost the company a small sum, the benefit to the workers and overall operation far outweighs the cost.

## **INTRODUCTION**

Cyclone Manufacturing is an aerospace company that works on assembling and machining aeroplane parts from scratch metal bricks and metal sheets, which the company then ships out to corporations such as Bombardier to build planes. Cyclone employs over 200 workers that specialize in specific aspects of the work process. The plant contains a linear like process, varying on the parts that are ordered from customers.

The work life at Cyclone is sectioned into areas of specialty. Every employee has their own respective tasks to perform within their own groups, day in and day out. This implies that the work is on a repetitive schedule, as the metals are processed into plane parts following a guideline. Therefore, life working at Cyclone Manufacturing can radiate a dull environment. Like other factory environments, Cyclone also insists that only work be done while in the factory, thereby prohibiting the use of phones, limited talking while working, and focusing specifically on getting the job done. This exudes a strict work environment to be in. Albeit this environment, the company attempts to accommodate the stress with different events and activities to boost morale, along with generating bonuses for employees throughout the year to recognize their hard work.

## **OBJECTIVE**

The objective of this project was to find a process that is in need of human factors consideration. To do so, we began by identifying tasks and processes that may be physically and/or mentally demanding. The roles with mentally demanding tasks were identified to be the field supervisor, CNC machine supervisor, and final shipment packager. Both supervisors must ensure the employees are operating in accordance with the rules and regulations, and the final shipment packager has to ensure all parts are labeled and packaged correctly, as the parts are very expensive. As such, these tasks may lead to high stress and were hence deemed mentally demanding. The roles with physically demanding tasks were identified to be the processing line worker, painter, and masker. The processing line worker has to interact with heavy parts and machinery, the painter and masker have to move around parts and handle items at a wide range of heights, as well as interact with heavy furnace doors.

To further assess what requirements and processes are in need of improvement, opinions of the six workers from the various departments were obtained by asking them to fill out a survey found in Appendix A. The workers were selected based on how physically and/or mentally demanding their tasks were. Open ended questions were asked to promote qualitative answers, as these answers would be likely to provide more personal insight. Questions regarding social life, satisfaction at work, and sense of security were used to understand the psychological/psychosocial state of the employees, while questions regarding discomfort at work, desires, and demands were used to understand the physical aspect of the job. The work process that seemed to place the greatest physical and mental demands were then investigated further into, which in this case was the masking process. After analyzing the survey answers, it was determined that the masking process placed great physical demands that were in need of human factors consideration.

In the masking process, there are two employees: a masker and a painter. The masker begins by obtaining a 6.8 kg board from a 4 part rack at 16", 36", 56", and 76" off the ground, respectively, and then bringing the board over to the workbench. Parts are moved via a utility cart and are taped onto a board to paint. The boreings on the part are taped and then put back onto the 4 part rack. This process is repeated for the 3 remaining boards on the rack. Following this, the masker then rolls the rack to the painter, where the boards are processed and coat with tesco aircraft paint to a specified thickness at the workbench. After painting all the parts and putting it back onto the racks, the rack is rolled towards the furnace. The furnace double doors, which are 18ft x 9 ft high and weigh 300 kg per door, are opened and the cart is rolled into the furnace. After closing the door, the process is complete.

The masking process at Cyclone MFG requires individuals to engage in a lot of intensive hands-on work like carrying, lifting and carefully placing heavy objects. Because of the repetitive work, workers are more prone to experience musculoskeletal disorder. There also aren't a lot of tools at work to assist workers, often resulting in users having to manually perform tasks. Due to the restrictions pertaining to having to stand and perform certain tasks, the workers feel more fatigued and strained. The pathways between stations are also relatively long for a factory, adding to the fatigue. Furthermore, performing the same task day in and day out produces a seemingly dull environment with low worker morale. To conclude, some work products require very careful attention and negligence to the part often leads to expensive mistakes, especially evident in the painting department.

At the time of the team's visit, there were three painters and three maskers available to complete another set of surveys. The NASA Task Load Index was used to quantitatively assess the employees job performance and determine where improvements may be required. Follow up questions were asked to uncover that the job was physically demanding, and it was discovered that tasks such as lifting the boards or interacting with the furnace door were the root cause of these discomforts.

## **CURRENT SITUATION**

The two processes being investigated are moving parts on the rack and interaction with the door. These were identified based on the critical reviews by the workers and the results of the NASA Load Index. Initial analysis was conducted by simulating the postures frequented by employees while doing the task on JACK, and determining the RULA score for the 99th percentile male and 5th percentile female. All the

actions when reaching for the parts on the rack for both the 5th percentile female and 95th percentile male resulted in a RULA score of 7 except for the 99th percentile male reaching for the middle rack. In regards to the furnace door interaction, all postures for both populations yielded a RULA score of 6 or more. Per the scores, this suggests that the workplace is in dire need of an investigation and further redesign to minimize the risk of workplace injuries.

With respect to the process of retrieving boards from the rack, the current design is not suitable for a male of the 95th percentile. When reaching for the lowest rack, the force imposed on the males spine is 3965.1N for L4/L5 compression and 1267.9N for L4/L5 AP, which surpasses the recommended loading limit for both cases by more than 500N. The muscle loading of the 5th percentile female reaching for the highest rack cannot be measured accurately as she is unable to reach the highest rack with her current stature. Theoretically, if the rack was at the furthest height she could reach, her capability of abducting her shoulders would be near 5%. These numerical data extracted from Table 1 and Table 2 in the appendix B for 95th percentile male and 5th percentile female respectively. Furthermore, Figure 1 and Figure 4 from appendix B make it evident that vision of the part being grabbed is not too clear which may add to mishandeling the product.

The current furnace design imposes 683N of lateral force when initially opening or closing the door. This was determined by first finding the forces upon each of the 3 hinges of the door. The weight of the door (300kg) is divided by the number of hinges and multiplied by gravitational acceleration which provides the y component of force on each hinge. After this, the torque was calculated to be 1176 N. This torque was then divided by the distance from the edge of the door to the handle (1.752m) giving our opening/closing force of 683N. The complete calculation can be found in Appendix C.

According to WATBAK Analysis found in Appendix C, the spine compression force limit and shear force limit are exceeded for both 95th percentile females and 5th percentile male when opening the door. When the door is being closed the spinal loading limits are breached for the 95th percentile male while the 5th percentile female is just below the limit. Therefore, certain changes must take place to make the furnace doors accessible for a larger population.

During the summer, heat is a major factor that can affect us in many negative ways that enable the mind to hallucinate and cause stress the longer the duration that you are in the sun. This is due to the fact that heat can enable stress in the human mind and body [1]. As seen in cyclone manufacture there consists of a large furnace heater that workers must enter to place painted parts to dry. The duration the workers are contained in the furnace vary from 1-5 minutes per entry due to there being multiple other carts inside the furnace. This duration can affect the worker mentally and physically, as this adds onto the stress that the workers currently face due to the high load of incoming parts needed to be painted. With all this stress comes negative outcomes. The negative outcomes of heat stress can be categorized into physical health impacts and mental health impacts. The physical health impacts could result in low energy levels and reduced daily traveling and housework. The mental health impacts follow emotional pressure and thoughts of negativity in the users life followed by inconsistent sleep. These effects can lead to an increase in acts of violence, increased irritability, and angry mood swings. Workers going through an 8 hour shift of consistent labour can assist in enabling these human factors, making them more prone to cause problems for the company which may eventually lead to complaints that taint the company.

## **REDESIGN**

A new rack design was proposed to be implemented for holding boards. Understanding that spinal loading limits were breached because of the low height and shoulder loading limits were breached because of high heights, the new rack was designed so that the shortest can reach and the tallest can fit. The original idea was to have the boards at a standard height that is accessible for all the populations in question. However, this would require a large surface for the rack being towed around which can prove to be an hindrance in the current facility. Limiting the width of the rack to 36", as it is currently extending the overall cart so each rack can hold two boards, would allow for less of a difference from the highest rack to lowest. The proposed cart would have two racks at heights 30" and 40", as these heights are the approximate hand height from the ground of the 5th percentile female and 95th percentile male. The length and width of the cart would be 72"x36", respectively. Transportation around the facility is not affected as the width of the rack does not exceed the traffic lanes at the facility. Additionally, the bottom rack slides out such that the part can be retrieved with full vision instead of impairment by the upper rack, as shown in Figure 9 from appendix B. The redesign decreases the possible forces that can be imposed by forcing a posture due to the way the racks are designed. The 95th percentile male no longer breaches the limit for spinal loading nor does the 5th percentile female for shoulder loading as seen in figure 10.

### *Alternative 1*

The LCN 4822 Pneumatic Door Closer / Opener [3] shown in figure 7.3 can be used to assist the operators with opening and closing the doors taking into account the current hinge force distribution. This design is capable of handling heavy duty doors up to 250kg, and will lessen the degree of force on the used grip of the operator (hook grip). This option is seen to be the best option for force reduction if the door in question had been less than or equal to 250kg, but since the current door weighs 300kg is not sufficient on its own. The opening force required to open the door with this method is 245 N, obtained from calculating the moment (Calculations shown in Appendix B).

### *Alternative 2*

The image in Figure 7.4 from appendix B shows a continuous hinge system [4] where the forces that would normally strain the 3 hinges on the side of the door are displayed. This system utilizes a continuous design where the force is distributed along the side hinges where the hinge size is proportional to the door. This will significantly reduce the amount of force required to open the door as the forces are distributed along the hinges. This design along with an adjusted grip attachment are seen to be an effective method for a normal door, although the implications of using this design for a heavy duty door over a long duration of time is not optimal as the kickback force is capable of deteriorating the individual hinges integrity. This design is capable of supporting a 181kg door weight, and alone is not insufficient for the case in question. This design would have operators exerting a force of 583.1 N to open/close the door.

With this design having 16 hinges, the force/hinge is projected to be roughly 183.75N/hinge on average for a weight of 300kg, following the same principle for the original hinge calculation. The hinges are only capable of supporting 110.86N/hinge, and cannot account for the additional 72.89 N of force on each individual hinge. Keeping in mind that this calculated force/hinge is on average, the actual forces would vary depending on hinge distance from the vertical end of the door as shown in the figure.

Based on alternative 1 and 2, the optimal solution is found to be a combination of both. The continuous hinge design is effective, but alone is not sufficient and the pneumatic design is an effective long term solution but couldn't support the weight of the door. With both of these designs together, the opening force required to open the door would be significantly lower and can be left unvisited for a long duration of time. A table showing the cost of implementation is shown below in Table 5.

Table 5: Cost of Design Implementations

Design	Price
LCN 4822 Pneumatic Door Closer / Opener	\$1627.50 x 2 (for 2 doors) = \$3255
Ives 224HD Heavy Duty Full Mortise Continuous Gear Hinge	\$115/hinge x 32 hinges (16/door) = \$3680
Total	\$6935

Psycho-social factors are defined as any exposure in a workplace that may initiate physical/mental health issues such as stress, depression, or anger. As mentioned previously, heat was a major issue in the workplace that caused this stress both physically and mentally. A proposed solution to the mental and physical stress the workers endure when entering the furnace and spending time inside can be to designate one worker to enter the furnace while wearing a proximity suit for heat and fire protection. This ensures that multiple workers will not be required to go inside the furnace, as one person will have the role of organizing the parts inside in an efficient manner. The benefits of this proximity suit would be the protection offered in high heat areas while also preventing the rapid buildup of body heat. The fabrics used in proximity suits with the aluminum finish can reflect the radiating heat that is exerted in the furnace [2]. The addition of this new worker will cost the company the workers labour and the cost for a proximity suit. Although there is extra cost in implementing this solution, workers will be happy with the fact that they will never have to worry about entering a high heat environment and will ultimately reduce the mental and physical stress that workers endure on a daily basis.

## **DISCUSSION**

Upon reviewing discussed changes and recommendations, the company, Cyclone Manufacturing, can expect a higher production rate and overall worker wellbeing, signalling that the main goal of our ergonomic analysis has been successful. With the work being designed to have a lower physical and mental strain on the worker, and the work design being changed in such a way that the worker has more options, there is a lower overall demand imposed on the worker. The addition of another worker that is responsible for interacting with the furnace may add an additional cost to the company, however, this would reduce the process time and lower overall stress for all the workers. In the next few months, Cyclone can expect to see a higher rate of job satisfaction and an improved quality and quantity of productions

Innovations to a process or design are always implemented to cause positive feedback and reactions as these new factors should only affect the workplace and workers in a beneficial manner. That being said,

with the innovations discussed in this report, we believe that workers will appreciate the new changes to the process of masking and drying parts. With the new two story, rack workers that have a short human build will have the satisfaction that they will be able to use these racks with optimal comfort, as there would be no need to go on their toes or ask other workers for assistance. This would increase the workers morale as they would feel a sense of belonging in the working environment because the utensils utilized in the process would be engineered to be used by any worker, regardless of their height. With the implementation of the new furnace doors, we believe workers will be happy to have more energy during the workday, as the load that came from opening the initial furnace door exhausted them. Now that the doors will be much smoother to open, workers will now be able to work at maximum efficiency throughout the entire day without having to worry about losing energy when heading to the furnace. Lastly the implementation of the new worker having the responsibility to work inside the furnace when in need will ensure that workers are less stressed throughout the working day. As discussed, there will be no more instances where heat will affect their mental and physical state, which ultimately concludes that the new process changes will guarantee satisfaction for each and every worker in this process.

## **CONCLUSION**

All in all, the purpose of this report was to select a manufacturing plant and apply industrial ergonomic principles to improve the anatomical and physiological factors therein. Biomechanical aspects, work physiology and postural analysis of the workload, cumulative trauma and fatigue incurred were analyzed and pertinent changes were proposed to the company.

In the new designs suggested, the racks redesigns used the golden rule of ergonomics, “shortest reach and tallest fit” to accommodate users of different percentiles, a proximity suit was introduced to reduce the psychosocial impact incurred by the workers and a hinge door system with a pneumatic closing was implemented to reduce the force workers would be required to exert. Furthermore, to address the vision issue, the bottom rack’s were revamped to slide out so the workers may have full vision before interacting with the board.

In conclusion, a combination of the two alternative concepts posed was deemed to produce the most optimal solution for the manufacturing facility. With the implementation of ergonomic and human factor based changes to the workstation, it was found that applying changes discussed throughout this report, while they may cost the company a small sum of \$6935, the benefit to the workers and overall operation far outweighs the cost and would help the workplace thrive

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## APPENDIX A

### Surveys

Table 1.1: Qualitative survey - Masker

<b>Name:</b>	Sandy
<b>Age:</b>	40
<b>Height:</b>	5'0
<b>Weight:</b>	128 lbs
<b>Experience</b>	6 years
<b>Role:</b>	Tape Masker for Parts
<b>Discomfort at work:</b>	Opening furnace door and reaching for tall carts
<b>Social life at work:</b>	She seems social with many of her colleagues, so she has a good time when having conversations with others
<b>Job Satisfaction:</b>	She has leniency at work due to her popularity at work and how everyone respects her, her colleagues help her often
<b>Desires:</b>	A more comfortable workplace that can adjust to her physique
<b>Job Control:</b>	She feels like she has control as she has had good experience in the workplace
<b>Job Demands:</b>	She is in requires low demand as she goes in pace with customer orders
<b>Job Security:</b>	She feels well respected in the plant

Table 1.2: Qualitative survey - Field Supervisor

<b>Name:</b>	Unni
<b>Age:</b>	55
<b>Height:</b>	5'8
<b>Weight:</b>	180 lbs
<b>Experience:</b>	9 Year
<b>Role:</b>	Field Supervisor

<b>Discomfort at work:</b>	Making sure the whole plants tasks are completed is stressful as there is always a time crunch in his role
<b>Social life at work:</b>	Less social with field workers, tries to set professional expectations
<b>Job Satisfaction:</b>	Most of the workers respond well to comments
<b>Desires:</b>	Assistance during peak seasons
<b>Job Control:</b>	Most of the time
<b>Job Demands:</b>	Relatively laid back, employees are trained well to be competent
<b>Job Security:</b>	Yeah, but that's probably because he is the manager

Table 1.3: Qualitative survey - Painter

<b>Name:</b>	Garry
<b>Age:</b>	55
<b>Height:</b>	5'5
<b>Weight:</b>	178 lbs
<b>Experience:</b>	8 years
<b>Role:</b>	Painter
<b>Discomfort at work:</b>	Opening furnace doors, wearing personal protective equipment
<b>Social life at work:</b>	Friends with field workers, seemed introverted
<b>Job Satisfaction:</b>	Sausage thursday (weekly events during the summer)
<b>Desires:</b>	Everything is okay
<b>Job Control:</b>	It's easy
<b>Job Demands:</b>	Sometimes has back pain
<b>Job Security:</b>	Good workplace

Table 1.4: Qualitative survey - Packager

<b>Name:</b>	Queen
<b>Age:</b>	42
<b>Height:</b>	5'3

<b>Weight:</b>	150 lbs
<b>Experience:</b>	8 years
<b>Role:</b>	Final Process Line Packager
<b>Discomfort at work:</b>	Make sure parts are not damage, the parts go to right place and making sure to be compliant with all her work
<b>Social life at work:</b>	There to get work done and go home (seemed introverted)
<b>Job Satisfaction:</b>	Easy work
<b>Desires:</b>	A raise
<b>Job Control:</b>	She just packages parts as instructed
<b>Job Demands:</b>	Not a lot, as she is just finalizing checking parts for issues and then packaging them.
<b>Job Security:</b>	Yes. Although the environment is mainly male populated, the workers are nice and friendly.

Table 1.5: Qualitative survey - Supervisor of CNC

<b>Name:</b>	Pawel
<b>Age:</b>	45
<b>Height:</b>	6'0
<b>Weight:</b>	192 lb
<b>Experience:</b>	12 years
<b>Role:</b>	Supervisor of CNC
<b>Discomfort at work:</b>	Work stress with supervising machines that have the ability to breakdown
<b>Social life at work:</b>	yes
<b>Job Satisfaction:</b>	Yes, enjoys his breaks as he gets to eat with his friends and socialize about the work
<b>Desires:</b>	Is reasonably content with his job, but in the foreseeable future might seek a raise or promotion.
<b>Job Control:</b>	Yes
<b>Job Demands:</b>	Is okay with the work, but does not like the scheduling demand as it may require odd hours and quotas varying from day to day

<b>Job Security:</b>	yes
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Table 1.6: Qualitative survey - Process Line Worker

<b>Name:</b>	Roman
<b>Age:</b>	58
<b>Height:</b>	6'2
<b>Weight:</b>	222 lb
<b>Experience:</b>	11 years
<b>Role:</b>	Processing Line Worker
<b>Discomfort at work:</b>	The difficult of heavy parts and loading parts onto the processing line and persistence in his work
<b>Social life at work:</b>	Yes
<b>Job Satisfaction:</b>	<i>Did not answer</i>
<b>Desires:</b>	<i>Did not answer</i>
<b>Job Control:</b>	Low-Moderate control, as a processing line worker has to keep up a fast pace of work (depending on daily targets)
<b>Job Demands:</b>	High demand and must be flexible for companies targets.
<b>Job Security:</b>	Not always, but yes for the most part.

Table 2.1: Quantitative Survey - Masker 1

**NASA Task Load Index**

Hart and Staveland's NASA Task Load Index (TLX) method assesses work load on five 7-point scales. Increments of high, medium and low estimates for each point result in 21 gradations on the scales.

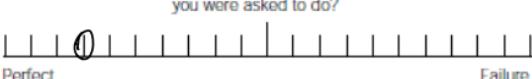
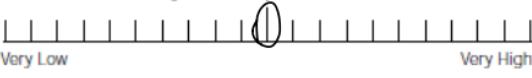
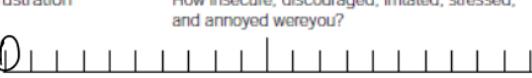
Name	Sandy	Task	Masker	Date	02/03/21
Mental Demand	How mentally demanding was the task?				
					
Physical Demand	How physically demanding was the task?				
					
Temporal Demand	How hurried or rushed was the pace of the task?				
					
Performance	How successful were you in accomplishing what you were asked to do?				
					
Effort	How hard did you have to work to accomplish your level of performance?				
					
Frustration	How insecure, discouraged, irritated, stressed, and annoyed were you?				
					

Table 2.2: Quantitative Survey - Masker 2

**NASA Task Load Index**

Hart and Staveland's NASA Task Load Index (TLX) method assesses work load on five 7-point scales. Increments of high, medium and low estimates for each point result in 21 gradations on the scales.

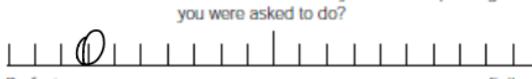
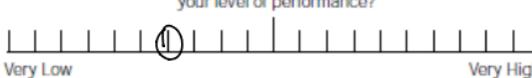
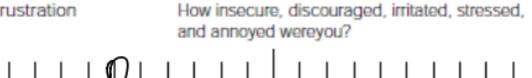
Name	Aurek	Task	Masker	Date	02/03/21
Mental Demand	How mentally demanding was the task?				
					
Physical Demand	How physically demanding was the task?				
					
Temporal Demand	How hurried or rushed was the pace of the task?				
					
Performance	How successful were you in accomplishing what you were asked to do?				
					
Effort	How hard did you have to work to accomplish your level of performance?				
					
Frustration	How insecure, discouraged, irritated, stressed, and annoyed were you?				
					

Table 2.3: Quantitative Survey - Masker 3

## *NASA Task Load Index*

*Hart and Staveland's NASA Task Load Index (TLX) method assesses work load on five 7-point scales. Increments of high, medium and low estimates for each point result in 21 gradations on the scales.*

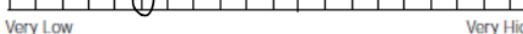
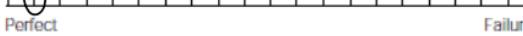
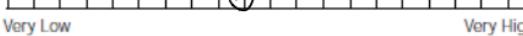
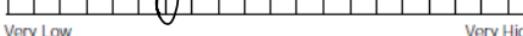
Name <b>Johny</b>	Task <b>Masker</b>	Date <b>02/03/21</b>
Mental Demand	How mentally demanding was the task?	
	Very Low	Very High
Physical Demand	How physically demanding was the task?	
	Very Low	Very High
Temporal Demand	How hurried or rushed was the pace of the task?	
	Very Low	Very High
Performance	How successful were you in accomplishing what you were asked to do?	
	Perfect	Failure
Effort	How hard did you have to work to accomplish your level of performance?	
	Very Low	Very High
Frustration	How insecure, discouraged, irritated, stressed, and annoyed were you?	
	Very Low	Very High

Table 2.4: Quantitative Survey - Painter 1

## *NASA Task Load Index*

Hart and Staveland's NASA Task Load Index (TLX) method assesses work load on five 7-point scales. Increments of high, medium and low estimates for each point result in 21 gradations on the scales.

Name <b>Garry</b>	Task <b>Painter</b>	Date <b>02/03/21</b>
Mental Demand		How mentally demanding was the task?
Very Low		Very High
Physical Demand		How physically demanding was the task?
Very Low		Very High
Temporal Demand		How hurried or rushed was the pace of the task?
Very Low		Very High
Performance		How successful were you in accomplishing what you were asked to do?
Perfect		Failure
Effort		How hard did you have to work to accomplish your level of performance?
Very Low		Very High
Frustration		How insecure, discouraged, irritated, stressed, and annoyed were you?
Very Low		Very High

Table 2.5: Quantitative Survey - Painter 2

**NASA Task Load Index**

Hart and Staveland's NASA Task Load Index (TLX) method assesses work load on five 7-point scales. Increments of high, medium and low estimates for each point result in 21 gradations on the scales.

Name	<b>Teisa</b>	Task	<b>Painter</b>	Date	<b>02/03/21</b>
Mental Demand			How mentally demanding was the task?		
Very Low					Very High
Physical Demand			How physically demanding was the task?		
Very Low					Very High
Temporal Demand			How hurried or rushed was the pace of the task?		
Very Low					Very High
Performance			How successful were you in accomplishing what you were asked to do?		
Perfect					Failure
Effort			How hard did you have to work to accomplish your level of performance?		
Very Low					Very High
Frustration			How insecure, discouraged, irritated, stressed, and annoyed were you?		
Very Low					Very High

---

Table 2.6: Quantitative Survey - Painter 3

**NASA Task Load Index**

Hart and Staveland's NASA Task Load Index (TLX) method assesses work load on five 7-point scales. Increments of high, medium and low estimates for each point result in 21 gradations on the scales.

Name	<b>Jarek</b>	Task	<b>Painter</b>	Date	<b>02/03/21</b>
Mental Demand			How mentally demanding was the task?		
Very Low					Very High
Physical Demand			How physically demanding was the task?		
Very Low					Very High
Temporal Demand			How hurried or rushed was the pace of the task?		
Very Low					Very High
Performance			How successful were you in accomplishing what you were asked to do?		
Perfect					Failure
Effort			How hard did you have to work to accomplish your level of performance?		
Very Low					Very High
Frustration			How insecure, discouraged, irritated, stressed, and annoyed were you?		
Very Low					Very High

---

*Posture replication* - the following figures represent the most intensive posture in this task

Table 3: Interacting with the rack

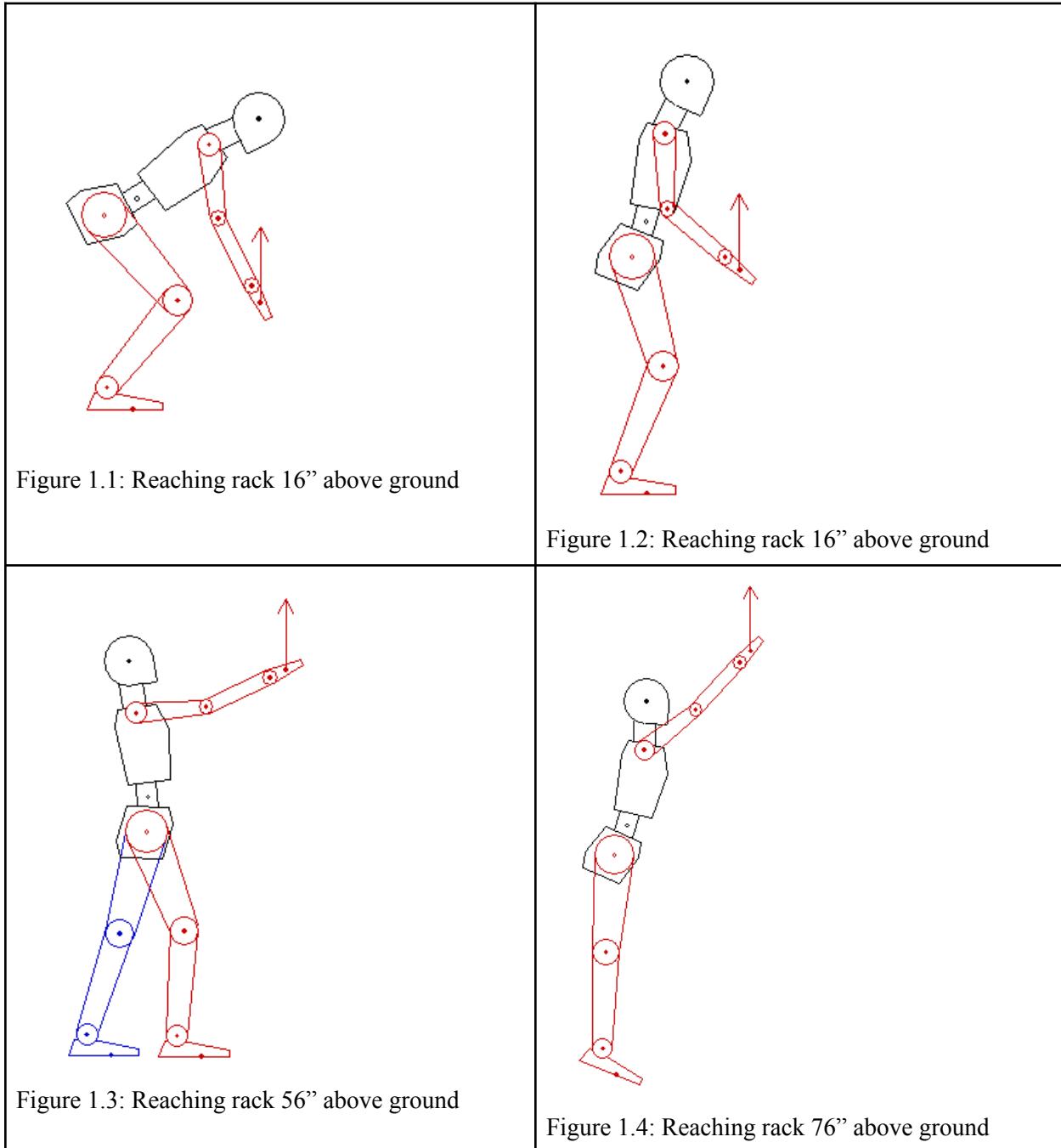


Table 4: Interacting with utility cart

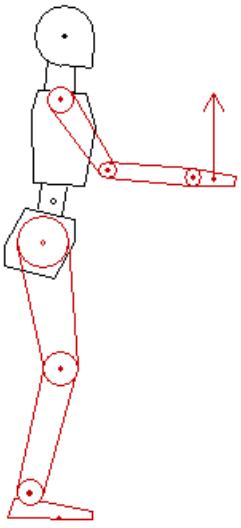


Figure 2.1: Picking up part from utility cart

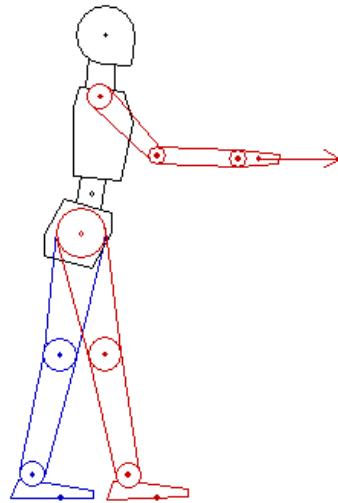


Figure 2.1: Pushing utility cart

Table 5: Interacting with furnace doors

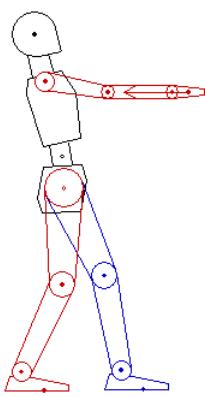


Figure 3.1: Opening furnace doors

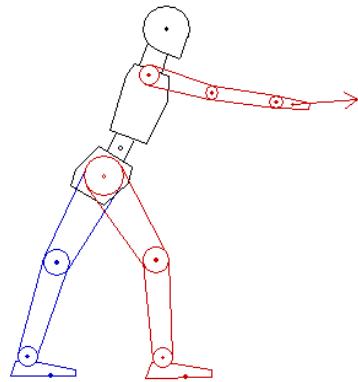


Figure 3.2: Closing furnace door

## **APPENDIX B**

Jack analysis

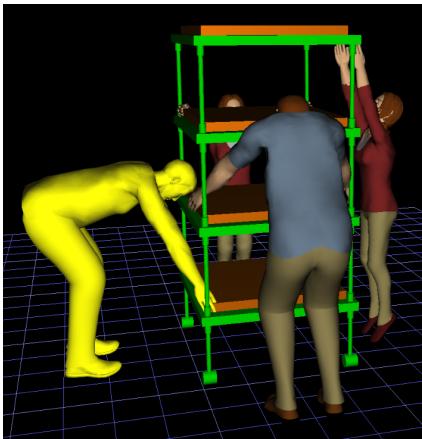


Figure 1.1: 95th percentile Male reaching for low rack



Figure 1.2: Reach Zone

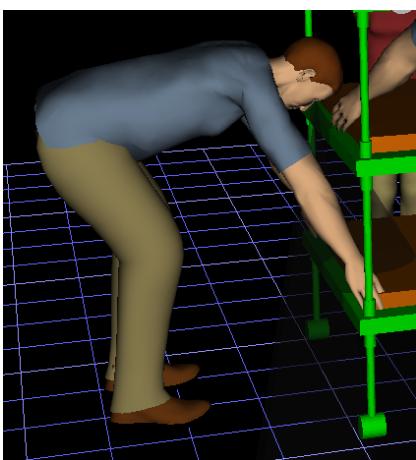


Figure 1.3: Eye Cone

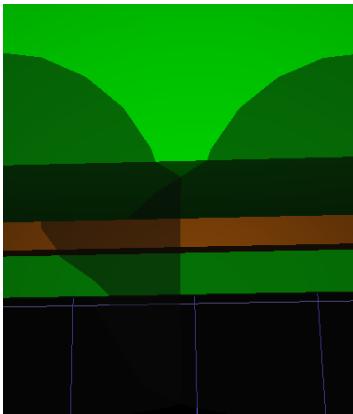


Figure 1.4: Eye View

ForceSolver						
Joint/Axis (sorted by name)	% Capable	Moment (Nm)	Muscle Effect	Jack Angle (deg)	Strength Mean (Nm)	Strength Std Dev (Nm)
R Sh Hmrl	100	-0.6	LAT	45.0	45.8	10.4
L Sh Hmrl	100	-0.6	LAT	45.0	41.8	9.5
Trunk Flx	94	-230.2	EXTN	0.0	445.5	140.4
Trunk Bend	100	0.1	--	0.0	--	--
Trunk Ax Rt	100	0.2	--	0.0	--	--
R Hip	87	-128.6	EXTN	104.5	236.6	95.0
L Hip	87	-128.2	EXTN	104.5	236.6	95.0
R Knee	99	-39.2	FLXN	34.9	118.2	34.8
L Knee	99	-32.7	FLXN	34.9	118.2	34.8
R Ankle	86	-96.3	EXTN	7.0	149.1	49.3
L Ankle	86	-95.8	EXTN	8.0	150.8	49.9
Force (N)						
L4/L5 Comp	3965.1					
L4/L5 AP	1267.9					
L4/L5 Lat	8.5					

Table 1: Spinal Loading of 95th percentile male.

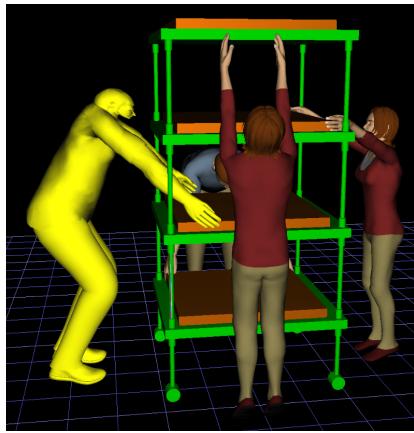


Figure 2: 95th percentile Male reaching for second lowest rack

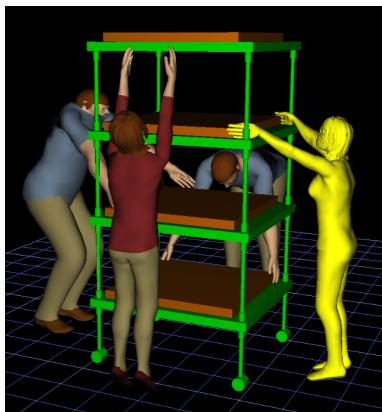


Figure 3: 5th percentile Female reaching for second highest rack



Figure 4.1: 5th percentile Female reaching for high rack

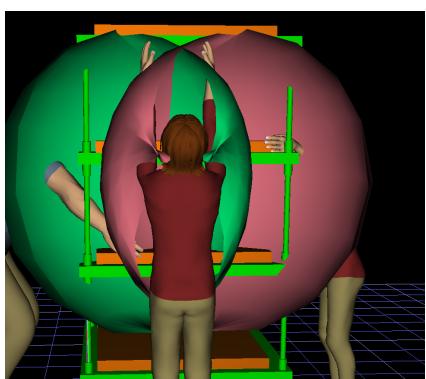


Figure 4.2: Reach Zone



Figure 4.3: Eye Cone

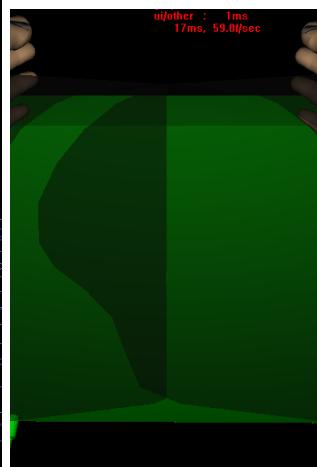


Figure 4.4: Eye View

Joint/Axis (sorted by name)	% Capable	Moment (Nm)	Muscle Effect	Jack Angle (deg)	Strength Mean (Nm)	Strength Std Dev (Nm)
R Wrist Flx	100	0.4	--	0.0	--	--
L Wrist Flx	81	4.0	EXTN	-1.1	5.5	1.8
R Wrist Dev	100	-0.5	--	-0.0	--	--
L Wrist Dev	91	-4.3	RAD	0.7	7.6	2.4
R Wr SuPr	100	0.1	--	-0.0	--	--
L Wr SuPr	99	0.9	SUP	-4.7	7.3	2.5
R Elbow	100	-2.6	FLXN	5.0	26.5	7.0
L Elbow	69	-21.5	FLXN	6.3	24.8	6.5
R Sh AbAd	100	-7.2	ABD	0.0	40.2	10.6
L Sh AbAd	4	-54.2	ABD	0.0	37.3	9.8
R Sh FwBk	100	-0.8	FWD	135.0	36.7	12.5
L Sh FwBk	99	-8.0	FWD	135.0	34.1	11.6
R Sh Hmrl	100	-0.1	--	45.0	--	--
L Sh Hmrl	100	-1.2	LAT	45.0	29.2	7.6
Trunk Flx	01	-75.2	EXTN	0.0	142.7	40.2

Table 2: % Capability of 5th percentile female



Figure 5: 5th percentile female and 95th percentile male opening the doors

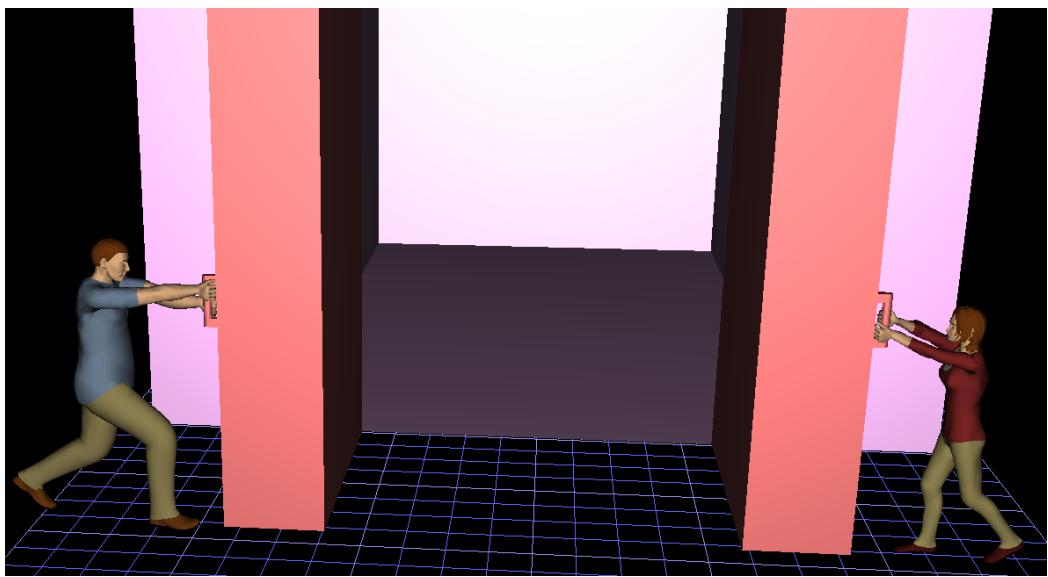
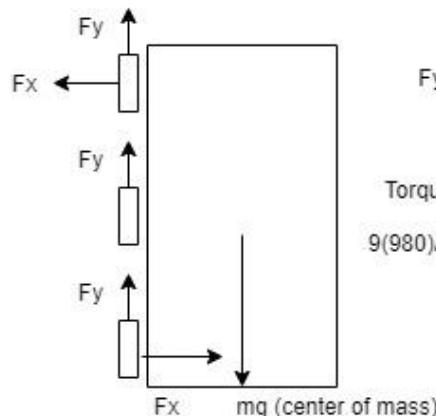


Figure 6: 5th percentile female and 95th percentile male closing the doors



$$\begin{aligned}3 F_y &= mg \\F_y &= mg/3 \\F_y &= (300 \times 9.8)/3 \\F_y &= 980 \text{ N}\end{aligned}$$

$$\begin{aligned}\text{Torque} &= 3 F_y \times 3 - 2F_x \times 3.75 = 0 \\F_h &= 9F_y/7.5 \\9(980)/7.5 &= 1176 \text{ N} \rightarrow \text{turning effect}\end{aligned}$$

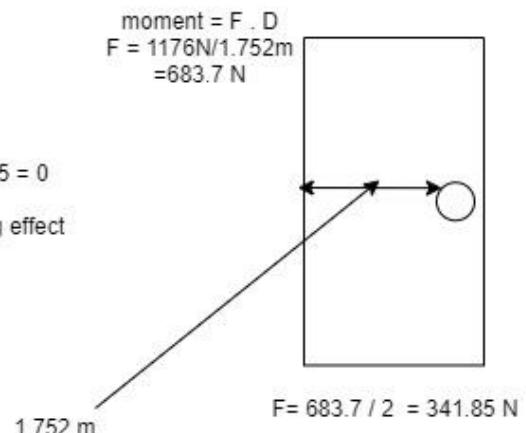


Figure 7.1: Multiple hinges

Figure 7.2: Moment

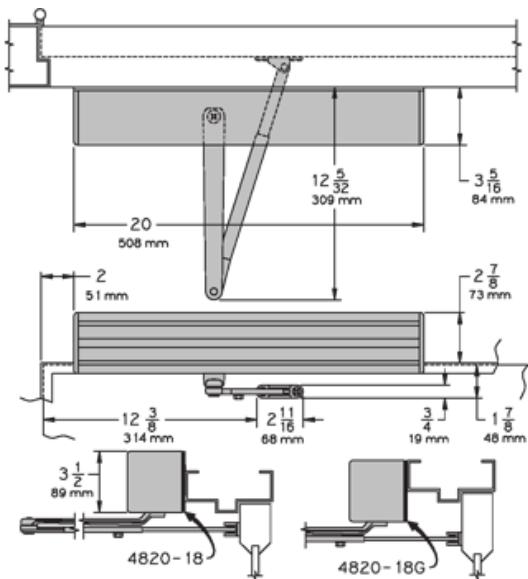


Figure 7.3: LCN 4822 Pneumatic Door Closer / Opener

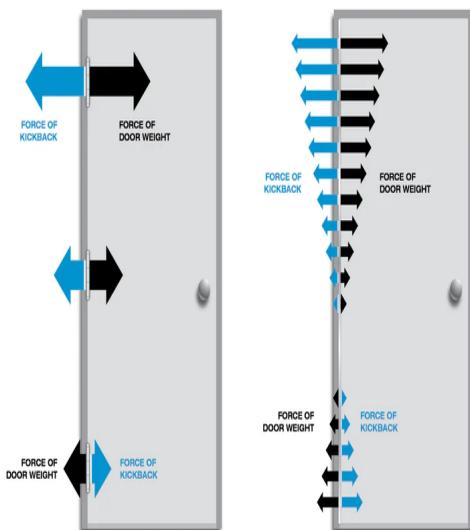


Figure 7.4: Continuous Hinge Design

Calculations for alternative 1 and 2

$$300\text{kg} - 250\text{kg} = 50\text{kg} \times 9.8 = 490/2 = 245 \text{ N} - \text{Alt 1}$$

$$300\text{kg} - 181\text{kg} = 119\text{kg} \times 9.8 = 1166.2/2 = 583.1 \text{ N} - \text{Alt 2}$$

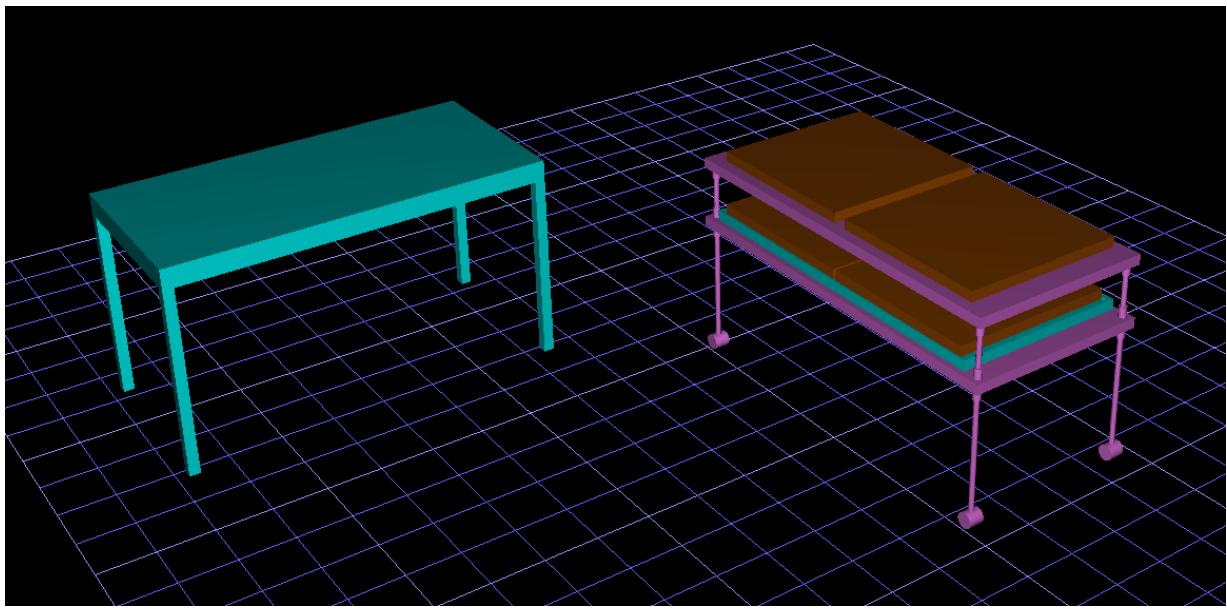


Figure 7.1: Rack Redesign

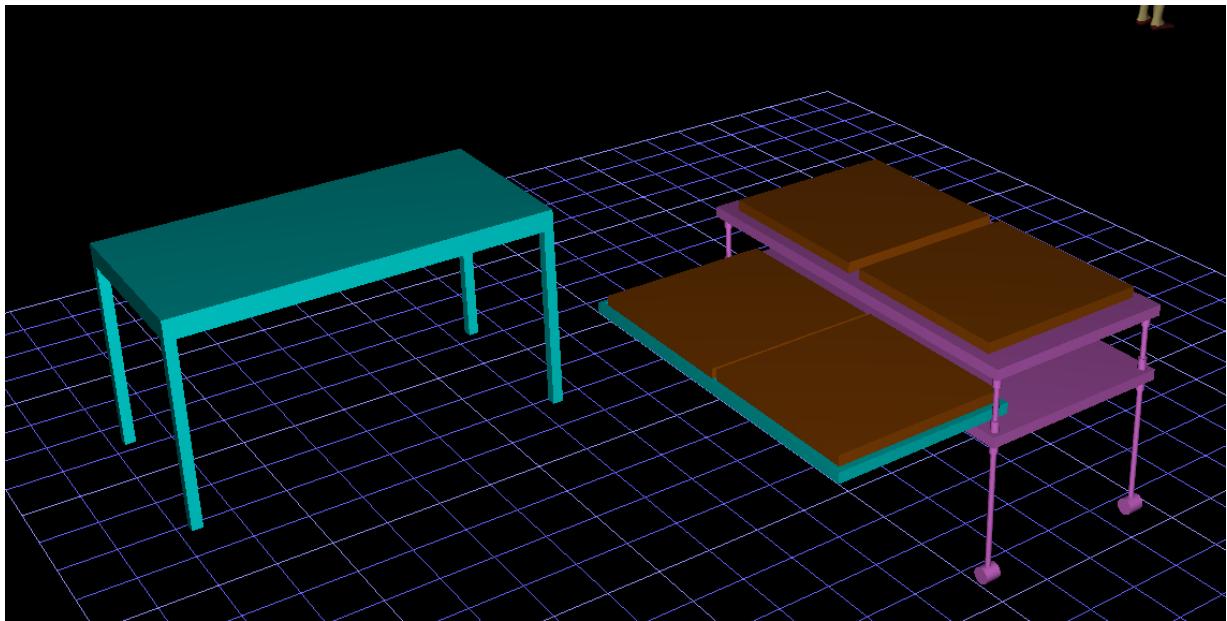


Figure 7.2: Rack Redesign with door slid out

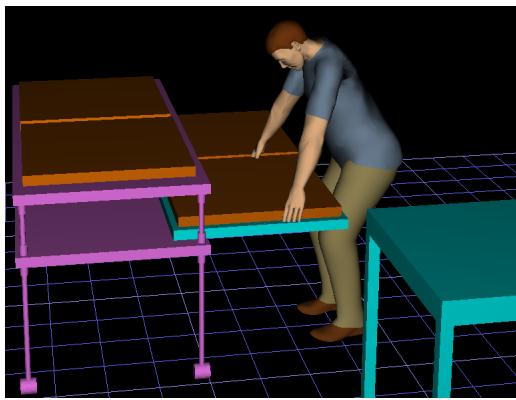


Figure 8.1: 95th percentile Male reaching for low rack

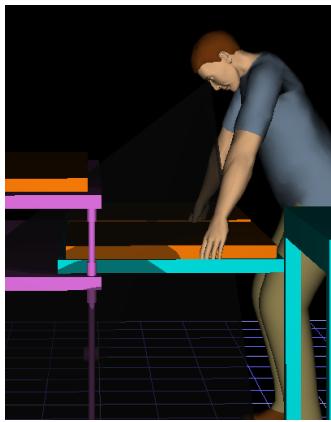


Figure 8.2: Reach Zone



Figure 8.3: Eye Cone

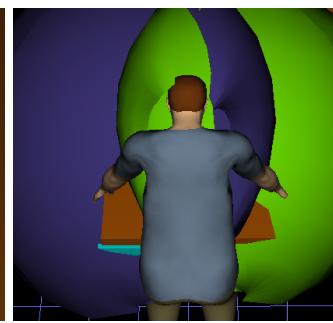


Figure 8.4: Eye View

Joint/Axis (sorted by name)	% Capable	Moment (Nm)	Muscle Effect	Jack Angle (deg)	Strength Mean (Nm)	Strength Std Dev (Nm)	
R Sh Hmrl	100	-0.5	LAT	-0.1	35.7	8.1	
L Sh Hmrl	100	-0.6	LAT	-0.1	33.2	7.5	
Trunk Flx	98	-121.5	EXTN	0.0	327.4	103.1	
Trunk Bend	100	0.2	--	0.0	--	--	
Trunk Ax Rt	100	0.1	--	0.0	--	--	
R Hip	95	-68.2	EXTN	50.0	203.2	81.6	
L Hip	95	-68.1	EXTN	50.0	203.2	81.6	
R Knee	100	8.5	EXTN	33.1	155.9	54.6	
L Knee	100	13.9	EXTN	33.1	155.9	54.6	
R Ankle	98	-45.0	EXTN	7.0	149.1	49.3	
L Ankle	98	-44.8	EXTN	8.0	150.8	49.9	
Force (N)							
L4/L5 Comp	2521.6						
L4/L5 AP	624.5						
L4/L5 Lat	-4.2						

Table 3: Spinal Loading of 95th percentile male.

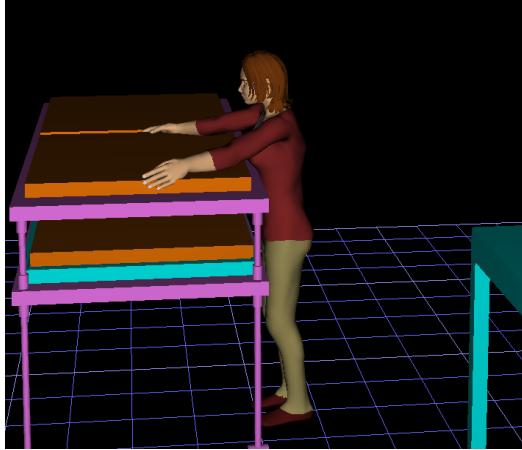


Figure 9.1: 5th percentile Female reaching for high rack

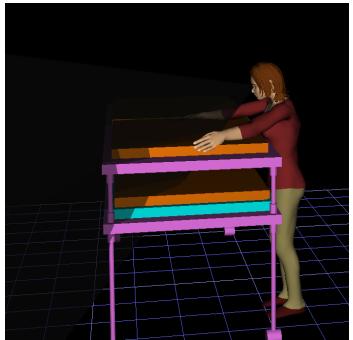


Figure 9.2: Reach Zone



Figure 9.3: Eye Cone

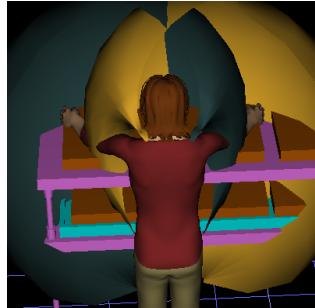


Figure 9.4: Eye View

Joint/Axis (sorted by name)	% Capable	Moment (Nm)	Muscle Effect	Jack Angle (deg)	Strength Mean (Nm)	Strength Std Dev (Nm)
R Wrist Flx	100	0.7	EXTN	0.0	5.9	1.9
L Wrist Flx	100	0.7	EXTN	-1.0	5.5	1.8
R Wrist Dev	99	-1.5	RAD	-0.0	8.2	2.6
L Wrist Dev	99	-1.4	RAD	10.1	7.3	2.3
R Wr SuPr	100	0.3	--	-0.0	--	--
L Wr SuPr	100	0.3	--	-0.7	--	--
R Elbow	100	-8.3	FLXN	5.0	31.0	8.1
L Elbow	100	-8.5	FLXN	12.3	29.8	7.8
R Sh AbAd	98	-20.3	ABD	75.3	42.8	11.2
L Sh AbAd	97	-20.4	ABD	75.3	39.2	10.3
R Sh FwBk	100	-2.3	FWD	63.8	45.3	15.4
L Sh FwBk	100	-2.5	FWD	63.8	41.9	14.3
R Sh Hmrl	100	-0.8	LAT	-51.1	24.1	6.3
L Sh Hmrl	100	-1.2	LAT	-51.1	22.4	5.8
Trunk Flx	98	-11.2	EXTN	0.0	142.7	40.2

Table 4: % Capability of 5th percentile female

## **APPENDIX C**

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Female 5%ile	Height: 146 cm	Gender: Female
	Weight: 47 kg	Age: 35

## Notes

### Job Breakdown

Total Working Time/Shift:

Unaccounted Time/Shift:

Repetitions	Duration	Total Time
-------------	----------	------------

Masking Process

Board from Rack

- Getting Board Low (95%M)
- Getting Board Mid (95%M)
- Getting Board Mid (5%F)
- Getting Board (5%F)

Part from Trolley

- Getting Part (95%M)
- Getting Part (5%F)

Finishing

- Pushing Trolley
- Open Oven Door (95%M)
- Close Oven Door (95%M)

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Female 5%ile	Height: 146 cm	Gender: Female
	Weight: 47 kg	Age: 35

### Peak Loads Calculated Across the Job

Peak Hand Load: 400.2 N  
 (Masking Process : Finishing : Open Oven Door (95%))

Peak L4-L5 Flexor/Extensor Moment: -124.2 Nm  
 (Masking Process : Finishing : Open Oven Door (95%))

Peak L4-L5 Twisting Moment:

Peak L4-L5 Lateral Moment:

Peak L4-L5 Total Compression: 2897.2 N  
 (Masking Process : Finishing : Open Oven Door (95%))

Peak L4-L5 Anterior/Posterior Reaction Shear: 446.2 N  
 (Masking Process : Finishing : Close Oven Door (95%))

Peak L4-L5 Lateral Reaction Shear:

Peak L4-L5 Anterior/Posterior Joint Shear: -442.4 N  
 (Masking Process : Finishing : Open Oven Door (95%))

Peak Right Shoulder Flexor/Extensor Moment: -22.6 N  
 (Masking Process : Finishing : Close Oven Door (95%))

Peak Left Shoulder Flexor/Extensor Moment: -22.6 N  
 (Masking Process : Finishing : Close Oven Door (95%))

Peak Right Elbow Flexor/Extensor Moment: -10.2 N  
 (Masking Process : Finishing : Close Oven Door (95%))

Peak Left Elbow Flexor/Extensor Moment: -10.2 N  
 (Masking Process : Finishing : Close Oven Door (95%))

### Cumulative Loads Totaled Over the Job

Cumulative L4-L5 Extensor Moment: 0.000 MNms  
 (0.000E+0 Nms)

Cumulative L4-L5 Flexor Moment: 0.000 MNs  
 (0.000E+0 Nms)

Cumulative L4-L5 Twisting Moment:

Cumulative L4-L5 Lateral Moment:

Cumulative L4-L5 Total Compression: 0.000 MNs  
 (0.000E+0 Ns)

Cumulative L4-L5 Anterior Reaction Shear: 0.000 MNs  
 (0.000E+0 Ns)

Cumulative L4-L5 Posterior Reaction Shear: 0.000 MNs  
 (0.000E+0 Ns)

Cumulative L4-L5 Lateral Reaction Shear:

Cumulative L4-L5 Anterior Joint Shear: 0.000 MNs  
 (0.000E+0 Ns)

Cumulative L4-L5 Posterior Joint Shear: 0.000 MNs  
 (0.000E+0 Ns)

Cumulative Right Shoulder Extensor Moment: 0.000 MNms  
 (0.000E+0 Nms)

Cumulative Right Shoulder Flexor Moment: 0.000 MNs  
 (0.000E+0 Nms)

Cumulative Left Shoulder Extensor Moment: 0.000 MNms  
 (0.000E+0 Nms)

Cumulative Left Shoulder Flexor Moment: 0.000 MNs  
 (0.000E+0 Nms)

Cumulative Right Elbow Extensor Moment: 0.000 MNms  
 (0.000E+0 Nms)

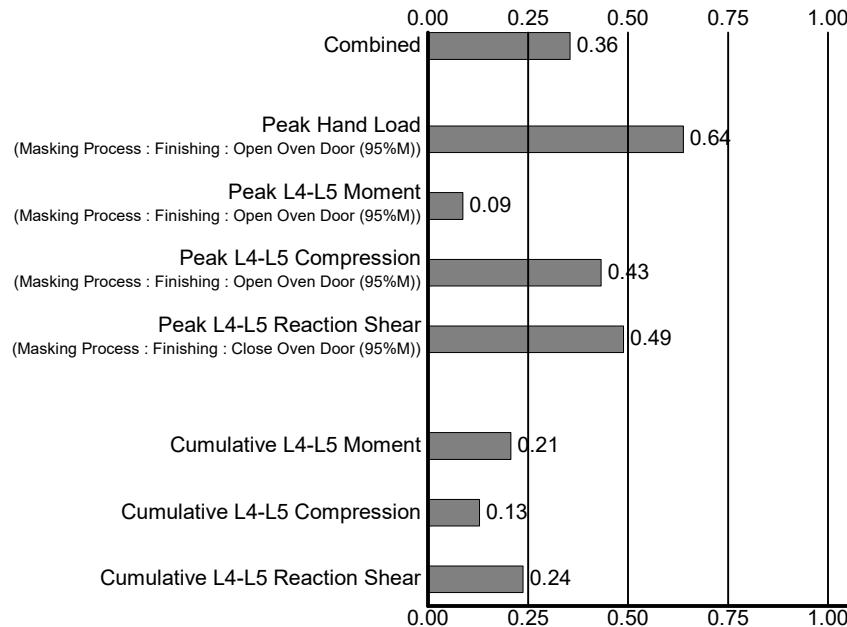
Cumulative Right Elbow Flexor Moment: 0.000 MNs  
 (0.000E+0 Nms)

Cumulative Left Elbow Extensor Moment: 0.000 MNms  
 (0.000E+0 Nms)

Cumulative Left Elbow Flexor Moment: 0.000 MNs  
 (0.000E+0 Nms)

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Female 5%ile	Height: 146 cm	Gender: Female
	Weight: 47 kg	Age: 35

### Low Back Pain Reporting Index



Site: Job Name: Analyst: Anthropometrics: Female 5%ile	Department: Workstation ID: Date: 14 Mar, 2021 Height: 146 cm	Job Classification: Shift: Worker ID: Gender: Female
		Age: 35

### Summary of Joint Moments: Shoulder (Nm)

	RIGHT			LEFT		
	RMx	RMy	RMz	RMx	RMy	RMz
(Unaccounted)	0.0	0.0	0.0	0.0	0.0	0.0
Masking Process						
Board from Rack						
Getting Board Low (95%M)	0.0	0.0	4.1 EX	0.0	0.0	4.1 EX
Getting Board Mid (95%M)	0.0	0.0	6.2 EX	0.0	0.0	6.2 EX
Getting Board Mid (5%F)	0.0	0.0	11.3 EX	0.0	0.0	11.3 EX
Getting Board (5%F)	0.0	0.0	8.7 EX	0.0	0.0	8.7 EX
Part from Trolley						
Getting Part (95%M)	0.0	0.0	1.3 EX	0.0	0.0	1.3 EX
Getting Part (5%F)	0.0	0.0	1.0 EX	0.0	0.0	1.0 EX
Finishing						
Pushing Trolley	0.0	0.0	1.4 FL	0.0	0.0	1.4 FL
Open Oven Door (95%M)	0.0	0.0	12.8 FL	0.0	0.0	12.8 FL
Close Oven Door (95%M)	0.0	0.0	22.6 EX	0.0	0.0	22.6 EX

### Summary of Joint Moments: Elbow (Nm)

	RIGHT			LEFT		
	RMx	RMy	RMz	RMx	RMy	RMz
(Unaccounted)	0.0	0.0	0.0	0.0	0.0	0.0
Masking Process						
Board from Rack						
Getting Board Low (95%M)	0.0	0.0	3.6 EX	0.0	0.0	3.6 EX
Getting Board Mid (95%M)	0.0	0.0	6.1 EX	0.0	0.0	6.1 EX
Getting Board Mid (5%F)	0.0	0.0	7.2 EX	0.0	0.0	7.2 EX
Getting Board (5%F)	0.0	0.0	5.4 EX	0.0	0.0	5.4 EX
Part from Trolley						
Getting Part (95%M)	0.0	0.0	1.7 EX	0.0	0.0	1.7 EX
Getting Part (5%F)	0.0	0.0	1.9 EX	0.0	0.0	1.9 EX
Finishing						
Pushing Trolley	0.0	0.0	1.1 FL	0.0	0.0	1.1 FL
Open Oven Door (95%M)	0.0	0.0	1.2 FL	0.0	0.0	1.2 FL
Close Oven Door (95%M)	0.0	0.0	10.2 EX	0.0	0.0	10.2 EX

### Summary of Joint Moments: Lumbar (Nm)

	RMx	RMy	RMz
(Unaccounted)	0.0	0.0	5.2 EX
Masking Process			
Board from Rack			
Getting Board Low (95%M)	0.0	0.0	21.3 EX
Getting Board Mid (95%M)	0.0	0.0	4.0 FL
Getting Board Mid (5%F)	0.0	0.0	27.7 FL
Getting Board (5%F)	0.0	0.0	10.0 FL
Part from Trolley			
Getting Part (95%M)	0.0	0.0	1.0 EX
Getting Part (5%F)	0.0	0.0	2.0 FL
Finishing			
Pushing Trolley	0.0	0.0	17.0 EX
Open Oven Door (95%M)	0.0	0.0	124.2 FL
Close Oven Door (95%M)	0.0	0.0	103.0 EX

### Summary of Joint Moments: Hip (Nm)

	RIGHT			LEFT		
	RMx	RMy	RMz	RMx	RMy	RMz
(Unaccounted)	0.0	0.0	22.9 EX	0.0	0.0	22.9 EX
Masking Process						
Board from Rack						
Getting Board Low (95%M)	0.0	0.0	14.3 EX	0.0	0.0	14.3 EX
Getting Board Mid (95%M)	0.0	0.0	10.4 EX	0.0	0.0	10.4 EX
Getting Board Mid (5%F)	0.0	0.0	34.9 EX	0.0	0.0	12.7 FL
Getting Board (5%F)	0.0	0.0	5.2 EX	0.0	0.0	5.2 EX
Part from Trolley						
Getting Part (95%M)	0.0	0.0	12.8 EX	0.0	0.0	12.8 EX
Getting Part (5%F)	0.0	0.0	17.2 EX	0.0	0.0	17.2 EX

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Female 5%ile	Height: 146 cm	Gender: Female
	Weight: 47 kg	Age: 35

### Summary of Joint Moments: Hip (Nm) cont'd...

	RIGHT			LEFT		
	RMx	RMy	RMz	RMx	RMy	RMz
Finishing						
Pushing Trolley	0.0	0.0	33.4 EX	0.0	0.0	17.4 FL
Open Oven Door (95%M)	0.0	0.0	123.6 EX	0.0	0.0	251.8 EX
Close Oven Door (95%M)	0.0	0.0	158.9 FL	0.0	0.0	16.7 FL

### Summary of Joint Moments: Knee (Nm)

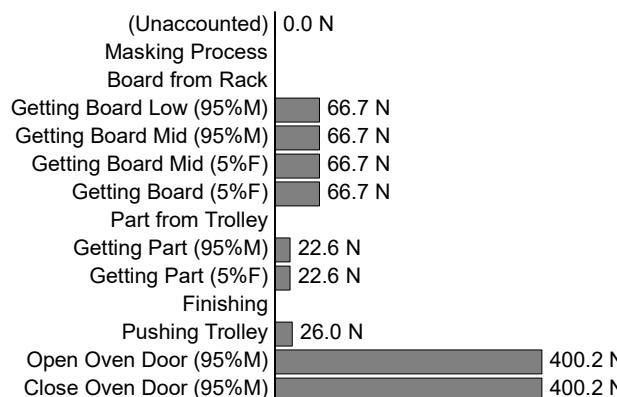
	RIGHT			LEFT		
	RMx	RMy	RMz	RMx	RMy	RMz
(Unaccounted)						
Masking Process	0.0	0.0	22.9 FL	0.0	0.0	22.9 FL
Board from Rack						
Getting Board Low (95%M)	0.0	0.0	19.8 EX	0.0	0.0	19.8 EX
Getting Board Mid (95%M)	0.0	0.0	3.9 EX	0.0	0.0	3.9 EX
Getting Board Mid (5%F)	0.0	0.0	15.6 FL	0.0	0.0	0.3 FL
Getting Board (5%F)	0.0	0.0	9.8 FL	0.0	0.0	9.8 FL
Part from Trolley						
Getting Part (95%M)	0.0	0.0	4.5 FL	0.0	0.0	4.5 FL
Getting Part (5%F)	0.0	0.0	12.0 FL	0.0	0.0	12.0 FL
Finishing						
Pushing Trolley	0.0	0.0	27.4 FL	0.0	0.0	0.8 FL
Open Oven Door (95%M)	0.0	0.0	63.0 FL	0.0	0.0	142.6 FL
Close Oven Door (95%M)	0.0	0.0	108.0 EX	0.0	0.0	11.0 EX

### Summary of Joint Moments: Ankle (Nm)

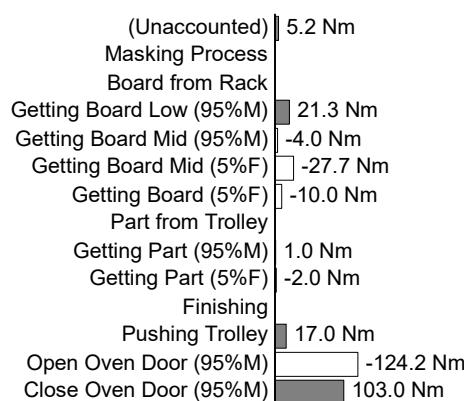
	RIGHT			LEFT		
	RMx	RMy	RMz	RMx	RMy	RMz
(Unaccounted)						
Masking Process	0.0	0.0	22.9 EX	0.0	0.0	22.9 EX
Board from Rack						
Getting Board Low (95%M)	0.0	0.0	19.5 EX	0.0	0.0	19.5 EX
Getting Board Mid (95%M)	0.0	0.0	19.5 EX	0.0	0.0	19.5 EX
Getting Board Mid (5%F)	0.0	0.0	20.1 EX	0.0	0.0	18.9 EX
Getting Board (5%F)	0.0	0.0	12.0 EX	0.0	0.0	12.0 EX
Part from Trolley						
Getting Part (95%M)	0.0	0.0	21.4 EX	0.0	0.0	21.4 EX
Getting Part (5%F)	0.0	0.0	21.7 EX	0.0	0.0	21.7 EX
Finishing						
Pushing Trolley	0.0	0.0	19.2 EX	0.0	0.0	24.9 EX
Open Oven Door (95%M)	0.0	0.0	32.2 EX	0.0	0.0	47.2 EX
Close Oven Door (95%M)	0.0	0.0	8.8 EX	0.0	0.0	0.5 EX

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Female 5%ile	Height: 146 cm	Gender: Female
	Weight: 47 kg	Age: 35

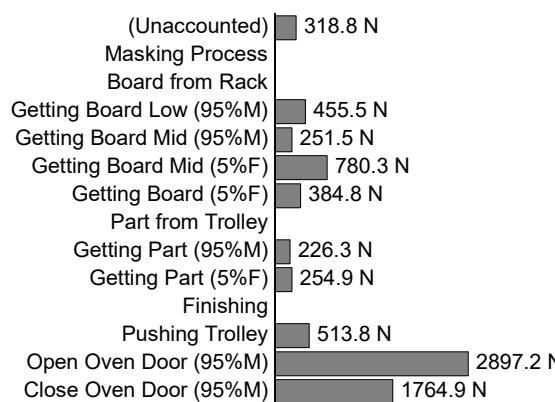
### Job Summary - Hand Load Profile



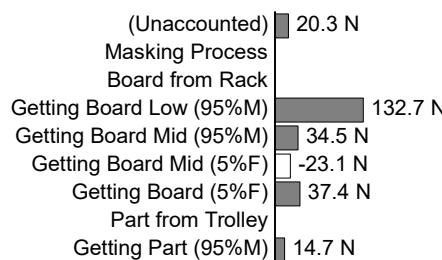
### Job Summary - L4-L5 Flexor/Extensor Moment Profile



### Job Summary - L4-L5 Total Compression Profile

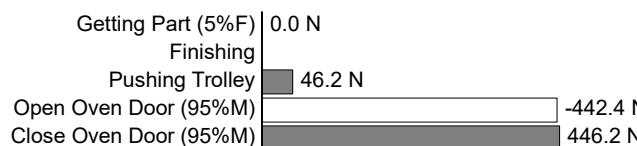


### Job Summary - L4-L5 Anterior/Posterior Reaction Shear Profile

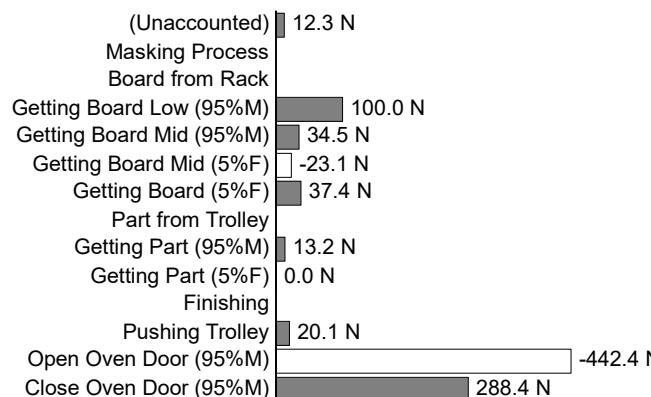


Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Female 5%ile	Height: 146 cm	Gender: Female
	Weight: 47 kg	Age: 35

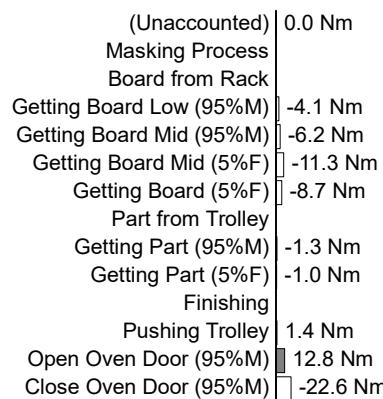
#### Job Summary - L4-L5 Anterior/Posterior Reaction Shear Profile cont'd...



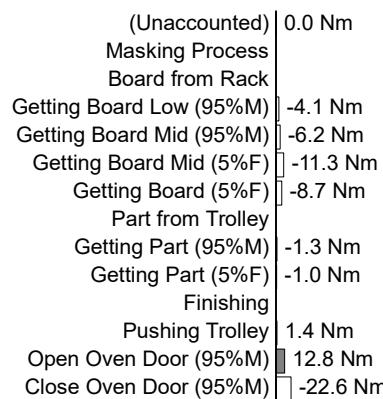
#### Job Summary - L4-L5 Anterior/Posterior Joint Shear Profile



#### Job Summary - Right Shoulder Flexor/Extensor Moment Profile



#### Job Summary - Left Shoulder Flexor/Extensor Moment Profile



Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Female 5%ile	Height: 146 cm	Gender: Female
	Weight: 47 kg	Age: 35

#### Job Summary - Cumulative L4-L5 Flexor/Extensor Moment Profile

(Unaccounted)	0.000 MNms (0.000E0 Nms)
Masking Process	
Board from Rack	
Getting Board Low (95%M)	0.000 MNms (0.000E0 Nms)
Getting Board Mid (95%M)	0.000 MNms (0.000E0 Nms)
Getting Board Mid (5%F)	0.000 MNms (0.000E0 Nms)
Getting Board (5%F)	0.000 MNms (0.000E0 Nms)
Part from Trolley	
Getting Part (95%M)	0.000 MNms (0.000E0 Nms)
Getting Part (5%F)	0.000 MNms (0.000E0 Nms)
Finishing	
Pushing Trolley	0.000 MNms (0.000E0 Nms)
Open Oven Door (95%M)	0.000 MNms (0.000E0 Nms)
Close Oven Door (95%M)	0.000 MNms (0.000E0 Nms)

#### Job Summary - Cumulative L4-L5 Total Compression Profile

(Unaccounted)	0.000 MNs (0.000E0 Ns)
Masking Process	
Board from Rack	
Getting Board Low (95%M)	0.000 MNs (0.000E0 Ns)
Getting Board Mid (95%M)	0.000 MNs (0.000E0 Ns)
Getting Board Mid (5%F)	0.000 MNs (0.000E0 Ns)
Getting Board (5%F)	0.000 MNs (0.000E0 Ns)
Part from Trolley	
Getting Part (95%M)	0.000 MNs (0.000E0 Ns)
Getting Part (5%F)	0.000 MNs (0.000E0 Ns)
Finishing	
Pushing Trolley	0.000 MNs (0.000E0 Ns)
Open Oven Door (95%M)	0.000 MNs (0.000E0 Ns)
Close Oven Door (95%M)	0.000 MNs (0.000E0 Ns)

#### Job Summary - Cumulative L4-L5 Anterior/Posterior Reaction Shear Profile

(Unaccounted)	0.000 MNs (0.000E0 Ns)
Masking Process	
Board from Rack	
Getting Board Low (95%M)	0.000 MNs (0.000E0 Ns)
Getting Board Mid (95%M)	0.000 MNs (0.000E0 Ns)
Getting Board Mid (5%F)	0.000 MNs (0.000E0 Ns)
Getting Board (5%F)	0.000 MNs (0.000E0 Ns)
Part from Trolley	
Getting Part (95%M)	0.000 MNs (0.000E0 Ns)
Getting Part (5%F)	0.000 MNs (0.000E0 Ns)
Finishing	
Pushing Trolley	0.000 MNs (0.000E0 Ns)
Open Oven Door (95%M)	0.000 MNs (0.000E0 Ns)
Close Oven Door (95%M)	0.000 MNs (0.000E0 Ns)

#### Job Summary - Cumulative L4-L5 Anterior/Posterior Joint Shear Profile

(Unaccounted)	0.000 MNs (0.000E0 Ns)
Masking Process	
Board from Rack	
Getting Board Low (95%M)	0.000 MNs (0.000E0 Ns)
Getting Board Mid (95%M)	0.000 MNs (0.000E0 Ns)
Getting Board Mid (5%F)	0.000 MNs (0.000E0 Ns)
Getting Board (5%F)	0.000 MNs (0.000E0 Ns)
Part from Trolley	
Getting Part (95%M)	0.000 MNs (0.000E0 Ns)

Site: Job Name: Analyst: Anthropometrics: Female 5%ile	Department: Workstation ID: Date: 14 Mar, 2021 Height: 146 cm	Job Classification: Shift: Worker ID: Gender: Female Age: 35
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#### Job Summary - Cumulative L4-L5 Anterior/Posterior Joint Shear Profile cont'd...

Getting Part (5%F) Finishing	0.000 MNs (0.000E0 Ns)
Pushing Trolley	0.000 MNs (0.000E0 Ns)
Open Oven Door (95%M)	0.000 MNs (0.000E0 Ns)
Close Oven Door (95%M)	0.000 MNs (0.000E0 Ns)

#### Job Summary - Cumulative Right Shoulder Flexor/Extensor Moment Profile

(Unaccounted)	0.000 MNms (0.000E0 Nms)
Masking Process	
Board from Rack	
Getting Board Low (95%M)	0.000 MNms (0.000E0 Nms)
Getting Board Mid (95%M)	0.000 MNms (0.000E0 Nms)
Getting Board Mid (5%F)	0.000 MNms (0.000E0 Nms)
Getting Board (5%F) Part from Trolley	0.000 MNms (0.000E0 Nms)
Getting Part (95%M)	0.000 MNms (0.000E0 Nms)
Getting Part (5%F) Finishing	0.000 MNms (0.000E0 Nms)
Pushing Trolley	0.000 MNms (0.000E0 Nms)
Open Oven Door (95%M)	0.000 MNms (0.000E0 Nms)
Close Oven Door (95%M)	0.000 MNms (0.000E0 Nms)

#### Job Summary - Cumulative Left Shoulder Flexor/Extensor Moment Profile

(Unaccounted)	0.000 MNms (0.000E0 Nms)
Masking Process	
Board from Rack	
Getting Board Low (95%M)	0.000 MNms (0.000E0 Nms)
Getting Board Mid (95%M)	0.000 MNms (0.000E0 Nms)
Getting Board Mid (5%F)	0.000 MNms (0.000E0 Nms)
Getting Board (5%F) Part from Trolley	0.000 MNms (0.000E0 Nms)
Getting Part (95%M)	0.000 MNms (0.000E0 Nms)
Getting Part (5%F) Finishing	0.000 MNms (0.000E0 Nms)
Pushing Trolley	0.000 MNms (0.000E0 Nms)
Open Oven Door (95%M)	0.000 MNms (0.000E0 Nms)
Close Oven Door (95%M)	0.000 MNms (0.000E0 Nms)

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Female 5%ile	Height: 146 cm	Gender: Female
	Weight: 47 kg	Age: 35

## 2D Action Summary (Masking Process : Board from Rack : Getting Board Low (95%M))

Trunk Angle: 53.0°

### Left Hand

Force: 33.4 N  
Angle in xy-plane: 90°

### Right Hand

Force: 33.4 N  
Angle in xy-plane: 90°

R.D. Forward: 40.1 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 36.9 cm

R.D. Forward: 40.1 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 36.9 cm

### L4-L5 Moment

Extensor: 21.3 Nm

### L4-L5 Compression

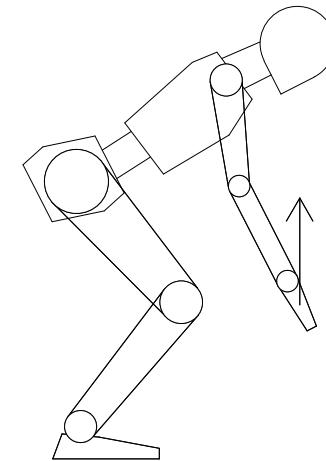
Total: 455 N

### Reaction Shear

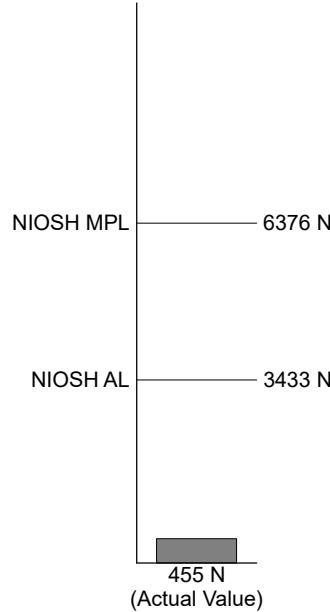
Anterior: 133 N

### Joint Shear

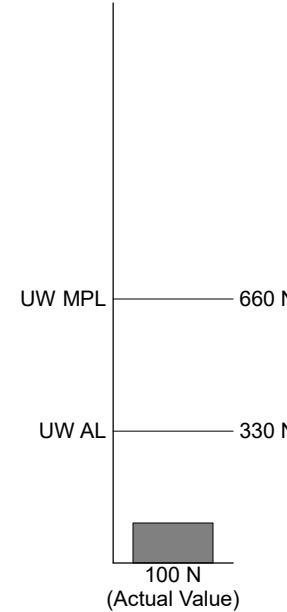
Anterior: 100 N



### Spine Compression Limits



### Spine Joint Shear Limits



Site: Job Name: Analyst: Anthropometrics: Female 5%ile	Department: Workstation ID: Date: 14 Mar, 2021 Height: 146 cm	Job Classification: Shift: Worker ID: Gender: Female
		Age: 35

### Joint Moment Strength Data

% of Population Not Capable			Calculated Moment (Nm)
R Elbow	Flexor/Extensor Supinator/Pronator	0.3	3.6 EX 0.0
L Elbow	Flexor/Extensor Supinator/Pronator	0.3	3.6 EX 0.0
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor		4.1 EX 0.0 0.0
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor		4.1 EX 0.0 0.0
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	0.1	21.3 EX 0.0 0.0
		25%	

### Female Strength Data

		Mean Population Moment (Nm)	S.D. (Nm)	Angle (°)	Reference
R Elbow	Flexor/Extensor Supinator/Pronator	20 DNA	6	90	Askew et al. (1987)
L Elbow	Flexor/Extensor Supinator/Pronator	20 DNA	6	90	Askew et al. (1987)
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	DNA DNA DNA			
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	DNA DNA DNA			
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	299 DNA DNA	65	0	Troup & Chapman (1969)

(DNA = Data Not Available)

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Female 5%ile	Height: 146 cm	Gender: Female
	Weight: 47 kg	Age: 35

## 2D Action Details (Masking Process : Board from Rack : Getting Board Low (95%M))

Table of Segment Positions

SEGMENT	ABS ANGLE* (°) xy plane    yz plane	CGx (m)	CGy (m)	CGz (m)	LENGTH (m)
Right Foot	-40.0	0.066	0.042	0.000	0.131
Right Leg	-129.0	0.138	0.235	0.000	0.342
Right Thigh	-49.0	0.100	0.501	0.000	0.352
Left Foot	-40.0	0.066	0.042	0.000	0.131
Left Leg	-129.0	0.138	0.235	0.000	0.342
Left Thigh	-49.0	0.100	0.501	0.000	0.352
Right Hand	-63.0	0.463	0.398	0.000	0.067
Right Forearm	-63.0	0.395	0.533	0.000	0.207
Right Arm	-83.0	0.338	0.742	0.000	0.232
Left Hand	-63.0	0.463	0.398	0.000	0.067
Left Forearm	-63.0	0.395	0.533	0.000	0.207
Left Arm	-83.0	0.338	0.742	0.000	0.232
Head	27.0	0.471	0.924	0.000	0.129
Pelvis	27.0	0.028	0.630	0.000	0.087
Torso	37.0	0.217	0.760	0.000	0.350

\* NOTE: THE ABS ANGLES ARE ALL ABSOLUTE VALUES WITH 0° BEING HORIZONTAL TO THE RIGHT.

Table of Reaction Forces and Moments acting on each Segment

SEGMENT	REACTION FORCES						WEIGHT (N)	MOMENTS						
	Proximal End			Distal End				Proximal End			Distal End			
	RFx (N)	RFy (N)	RFz (N)	RFx (N)	RFy (N)	RFz (N)		RMx (Nm)	RMy (Nm)	RMz (Nm)	RMx (Nm)	RMy (Nm)	RMz (Nm)	
Right Foot	0.0	-191.6	0.0	0.0	0.0	0.0	5.5	0.0	0.0	-19.5	0.0	0.0	0.0	
Right Leg	0.0	-170.4	0.0	0.0	191.6	0.0	21.2	0.0	0.0	19.8	0.0	0.0	19.5	
Right Thigh	0.0	-117.4	0.0	0.0	170.4	0.0	53.0	0.0	0.0	-14.3	0.0	0.0	-19.8	
Left Foot	0.0	-191.6	0.0	0.0	0.0	0.0	5.5	0.0	0.0	-19.5	0.0	0.0	0.0	
Left Leg	0.0	-170.4	0.0	0.0	191.6	0.0	21.2	0.0	0.0	19.8	0.0	0.0	19.5	
Left Thigh	0.0	-117.4	0.0	0.0	170.4	0.0	53.0	0.0	0.0	-14.3	0.0	0.0	-19.8	
Right Hand	0.0	-31.0	0.0	0.0	0.0	0.0	2.3	0.0	0.0	-1.0	0.0	0.0	0.0	
Right Forearm	0.0	-23.9	0.0	0.0	31.0	0.0	7.1	0.0	0.0	-3.6	0.0	0.0	1.0	
Right Arm	0.0	-10.1	0.0	0.0	23.9	0.0	13.8	0.0	0.0	-4.1	0.0	0.0	3.6	
Left Hand	0.0	-31.0	0.0	0.0	0.0	0.0	2.3	0.0	0.0	-1.0	0.0	0.0	0.0	
Left Forearm	0.0	-23.9	0.0	0.0	31.0	0.0	7.1	0.0	0.0	-3.6	0.0	0.0	1.0	
Left Arm	0.0	-10.1	0.0	0.0	23.9	0.0	13.8	0.0	0.0	-4.1	0.0	0.0	3.6	
Head	0.0	36.0	0.0	0.0	0.0	0.0	36.0	0.0	0.0	4.1	0.0	0.0	0.0	
Pelvis	0.0	234.4	0.0	0.0	-166.1	0.0	68.2	0.0	0.0	36.1	0.0	0.0	-21.3	
Torso	0.0	166.1	0.0	0.0	-15.8	0.0	150.3	0.0	0.0	21.3	0.0	0.0	4.1	

Table of Joint Coordinates

MARKER	X	Y	Z
Right Foot	0.116	0.000	0.000
Right Ankle	0.016	0.084	0.000
Right Knee	0.231	0.350	0.000
Right Hip	0.000	0.616	0.000
Right Hand	0.478	0.369	0.000
Right Wrist	0.448	0.428	0.000
Right Elbow	0.354	0.612	0.000
Right Shoulder	0.326	0.843	0.000
Left Foot	0.116	0.000	0.000
Left Ankle	0.016	0.084	0.000
Left Knee	0.231	0.350	0.000
Left Hip	0.000	0.616	0.000
Left Hand	0.478	0.369	0.000
Left Wrist	0.448	0.428	0.000
Left Elbow	0.354	0.612	0.000
Left Shoulder	0.326	0.843	0.000
L4-L5	0.077	0.655	0.000
Head	0.471	0.924	0.000
C7	0.357	0.866	0.000

Site: Job Name: Analyst: Anthropometrics: Female 5%ile	Department: Workstation ID: Date: 14 Mar, 2021 Height: 146 cm	Job Classification: Shift: Worker ID: Gender: Female Age: 35
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## 2D Action Summary (Masking Process : Board from Rack : Getting Board Mid (95%M))

Trunk Angle: 12.0°

### Left Hand

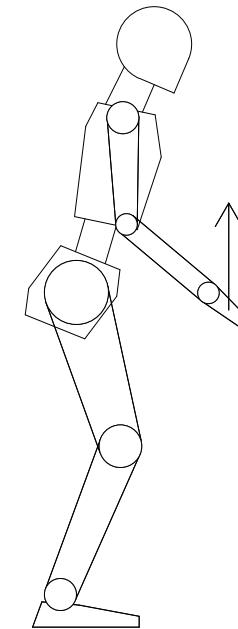
Force: 33.4 N  
Angle in xy-plane: 90°

### Right Hand

Force: 33.4 N  
Angle in xy-plane: 90°

R.D. Forward: 28.2 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 71.7 cm

R.D. Forward: 28.2 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 71.7 cm



### L4-L5 Moment

Flexor: -4.0 Nm

### L4-L5 Compression

Total: 252 N

### Reaction Shear

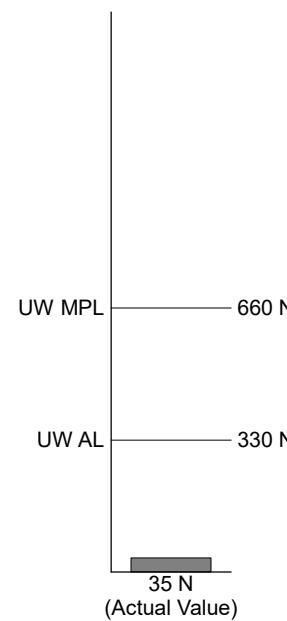
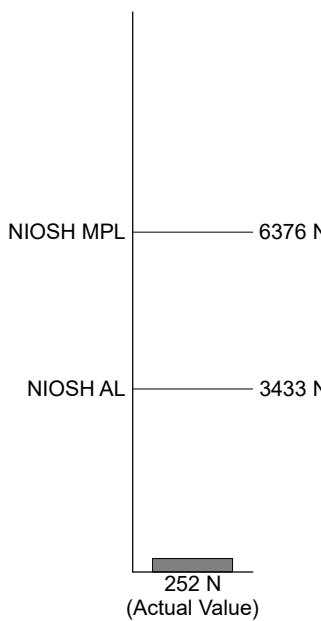
Anterior: 35 N

### Joint Shear

Anterior: 35 N

### Spine Compression Limits

### Spine Joint Shear Limits



Site: Job Name: Analyst: Anthropometrics: Female 5%ile	Department: Workstation ID: Date: 14 Mar, 2021 Height: 146 cm	Job Classification: Shift: Worker ID: Gender: Female Age: 35
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### Joint Moment Strength Data

		% of Population Not Capable	Calculated Moment (Nm)
R Elbow	Flexor/Extensor Supinator/Pronator	1.0	6.1 EX 0.0
L Elbow	Flexor/Extensor Supinator/Pronator	1.0	6.1 EX 0.0
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor		6.2 EX 0.0 0.0
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor		6.2 EX 0.0 0.0
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	0.1	4.0 FL 0.0 0.0
			25%

### Female Strength Data

		Mean Population Moment (Nm)	S.D. (Nm)	Angle (°)	Reference
R Elbow	Flexor/Extensor Supinator/Pronator	20 DNA	6	90	Askew et al. (1987)
L Elbow	Flexor/Extensor Supinator/Pronator	20 DNA	6	90	Askew et al. (1987)
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	DNA DNA DNA			
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	DNA DNA DNA			
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	213 DNA DNA	50	0	Troup & Chapman (1969)

(DNA = Data Not Available)

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Female 5%ile	Height: 146 cm	Gender: Female
	Weight: 47 kg	Age: 35

## 2D Action Details (Masking Process : Board from Rack : Getting Board Mid (95%M))

**Table of Segment Positions**

SEGMENT	ABS ANGLE* (°) xy plane    yz plane	CGx (m)	CGy (m)	CGz (m)	LENGTH (m)
Right Foot	-40.0	0.019	0.042	0.000	0.131
Right Leg	-112.0	0.042	0.264	0.000	0.342
Right Thigh	-74.0	0.042	0.593	0.000	0.352
Left Foot	-40.0	0.019	0.042	0.000	0.131
Left Leg	-112.0	0.042	0.264	0.000	0.342
Left Thigh	-74.0	0.042	0.593	0.000	0.352
Right Hand	-40.0	0.290	0.738	0.000	0.067
Right Forearm	-40.0	0.173	0.836	0.000	0.207
Right Arm	-88.0	0.101	1.024	0.000	0.232
Left Hand	-40.0	0.290	0.738	0.000	0.067
Left Forearm	-40.0	0.173	0.836	0.000	0.207
Left Arm	-88.0	0.101	1.024	0.000	0.232
Head	67.0	0.156	1.281	0.000	0.129
Pelvis	68.0	0.012	0.769	0.000	0.087
Torso	78.0	0.069	0.991	0.000	0.350

\* NOTE: THE ABS ANGLES ARE ALL ABSOLUTE VALUES WITH 0° BEING HORIZONTAL TO THE RIGHT.

**Table of Reaction Forces and Moments acting on each Segment**

SEGMENT	REACTION FORCES						WEIGHT (N)	MOMENTS						
	Proximal End			Distal End				Proximal End			Distal End			
	RFx (N)	RFy (N)	RFz (N)	RFx (N)	RFy (N)	RFz (N)		RMx (Nm)	RMy (Nm)	RMz (Nm)	RMx (Nm)	RMy (Nm)	RMz (Nm)	
Right Foot	0.0	-191.6	0.0	0.0	0.0	0.0	5.5	0.0	0.0	-19.5	0.0	0.0	0.0	
Right Leg	0.0	-170.4	0.0	0.0	191.6	0.0	21.2	0.0	0.0	3.9	0.0	0.0	19.5	
Right Thigh	0.0	-117.4	0.0	0.0	170.4	0.0	53.0	0.0	0.0	-10.4	0.0	0.0	-3.9	
Left Foot	0.0	-191.6	0.0	0.0	0.0	0.0	5.5	0.0	0.0	-19.5	0.0	0.0	0.0	
Left Leg	0.0	-170.4	0.0	0.0	191.6	0.0	21.2	0.0	0.0	3.9	0.0	0.0	19.5	
Left Thigh	0.0	-117.4	0.0	0.0	170.4	0.0	53.0	0.0	0.0	-10.4	0.0	0.0	-3.9	
Right Hand	0.0	-31.0	0.0	0.0	0.0	0.0	2.3	0.0	0.0	-1.6	0.0	0.0	0.0	
Right Forearm	0.0	-23.9	0.0	0.0	31.0	0.0	7.1	0.0	0.0	-6.1	0.0	0.0	1.6	
Right Arm	0.0	-10.1	0.0	0.0	23.9	0.0	13.8	0.0	0.0	-6.2	0.0	0.0	6.1	
Left Hand	0.0	-31.0	0.0	0.0	0.0	0.0	2.3	0.0	0.0	-1.6	0.0	0.0	0.0	
Left Forearm	0.0	-23.9	0.0	0.0	31.0	0.0	7.1	0.0	0.0	-6.1	0.0	0.0	1.6	
Left Arm	0.0	-10.1	0.0	0.0	23.9	0.0	13.8	0.0	0.0	-6.2	0.0	0.0	6.1	
Head	0.0	36.0	0.0	0.0	0.0	0.0	36.0	0.0	0.0	1.8	0.0	0.0	0.0	
Pelvis	0.0	234.4	0.0	0.0	-166.1	0.0	68.2	0.0	0.0	2.2	0.0	0.0	4.0	
Torso	0.0	166.1	0.0	0.0	-15.8	0.0	150.3	0.0	0.0	-4.0	0.0	0.0	10.6	

**Table of Joint Coordinates**

MARKER	X	Y	Z
Right Foot	0.069	0.000	0.000
Right Ankle	-0.031	0.084	0.000
Right Knee	0.097	0.401	0.000
Right Hip	0.000	0.740	0.000
Right Hand	0.315	0.717	0.000
Right Wrist	0.264	0.760	0.000
Right Elbow	0.105	0.893	0.000
Right Shoulder	0.097	1.125	0.000
Left Foot	0.069	0.000	0.000
Left Ankle	-0.031	0.084	0.000
Left Knee	0.097	0.401	0.000
Left Hip	0.000	0.740	0.000
Left Hand	0.315	0.717	0.000
Left Wrist	0.264	0.760	0.000
Left Elbow	0.105	0.893	0.000
Left Shoulder	0.097	1.125	0.000
L4-L5	0.033	0.820	0.000
Head	0.156	1.281	0.000
C7	0.105	1.162	0.000

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Female 5%ile	Height: 146 cm	Gender: Female
	Weight: 47 kg	Age: 35

## 2D Action Summary (Masking Process : Board from Rack : Getting Board Mid (5%F))

Trunk Angle: -8.0°

### Left Hand

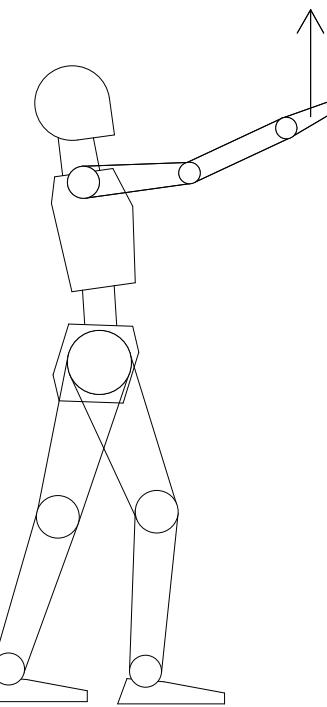
Force: 33.4 N  
Angle in xy-plane: 90°

### Right Hand

Force: 33.4 N  
Angle in xy-plane: 90°

R.D. Forward: 43.6 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 128.5 cm

R.D. Forward: 43.6 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 128.5 cm



### L4-L5 Moment

Flexor: -27.7 Nm

### L4-L5 Compression

Total: 780 N

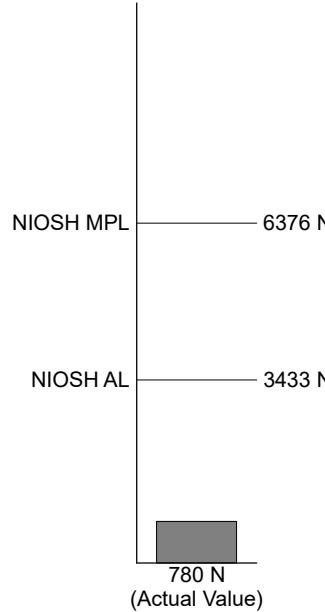
### Reaction Shear

Posterior: -23 N

### Joint Shear

Posterior: -23 N

### Spine Compression Limits



### Spine Joint Shear Limit (none available)



Site: Job Name: Analyst: Anthropometrics: Female 5%ile	Department: Workstation ID: Date: 14 Mar, 2021 Height: 146 cm	Job Classification: Shift: Worker ID: Gender: Female Age: 35
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### Joint Moment Strength Data

		% of Population Not Capable	Calculated Moment (Nm)
R Elbow	Flexor/Extensor Supinator/Pronator	1.7	7.2 EX 0.0
L Elbow	Flexor/Extensor Supinator/Pronator	1.7	7.2 EX 0.0
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor		11.3 EX 0.0 0.0
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor		11.3 EX 0.0 0.0
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	0.1	27.7 FL 0.0 0.0
			25%

### Female Strength Data

		Mean Population Moment (Nm)	S.D. (Nm)	Angle (°)	Reference
R Elbow	Flexor/Extensor Supinator/Pronator	20 DNA	6	90	Askew et al. (1987)
L Elbow	Flexor/Extensor Supinator/Pronator	20 DNA	6	90	Askew et al. (1987)
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	DNA DNA DNA			
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	DNA DNA DNA			
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	213 DNA DNA	50	0	Troup & Chapman (1969)

(DNA = Data Not Available)

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Female 5%ile	Height: 146 cm	Gender: Female
	Weight: 47 kg	Age: 35

## 2D Action Details (Masking Process : Board from Rack : Getting Board Mid (5%F))

**Table of Segment Positions**

SEGMENT	ABS ANGLE* (°) xy plane    yz plane	CGx (m)	CGy (m)	CGz (m)	LENGTH (m)
Right Foot	-40.0	0.153	0.042	0.000	0.131
Right Leg	-94.0	0.116	0.278	0.000	0.342
Right Thigh	-69.0	0.055	0.612	0.000	0.352
Left Foot	-40.0	-0.147	0.047	0.000	0.131
Left Leg	-108.0	-0.137	0.273	0.000	0.342
Left Thigh	-105.0	-0.039	0.607	0.000	0.352
Right Hand	25.0	0.409	1.271	0.000	0.067
Right Forearm	25.0	0.272	1.207	0.000	0.207
Right Arm	5.0	0.061	1.158	0.000	0.232
Left Hand	25.0	0.409	1.271	0.000	0.067
Left Forearm	25.0	0.272	1.207	0.000	0.207
Left Arm	5.0	0.061	1.158	0.000	0.232
Head	98.0	-0.064	1.315	0.000	0.129
Pelvis	88.0	0.001	0.785	0.000	0.087
Torso	98.0	-0.021	1.014	0.000	0.350

\* NOTE: THE ABS ANGLES ARE ALL ABSOLUTE VALUES WITH 0° BEING HORIZONTAL TO THE RIGHT.

**Table of Reaction Forces and Moments acting on each Segment**

SEGMENT	REACTION FORCES						WEIGHT (N)	MOMENTS						
	Proximal End			Distal End				Proximal End			Distal End			
	RFx (N)	RFy (N)	RFz (N)	RFx (N)	RFy (N)	RFz (N)		RMx (Nm)	RMy (Nm)	RMz (Nm)	RMx (Nm)	RMy (Nm)	RMz (Nm)	
Right Foot	0.0	-197.3	0.0	0.0	0.0	0.0	5.5	0.0	0.0	-20.1	0.0	0.0	0.0	
Right Leg	0.0	-176.1	0.0	0.0	197.3	0.0	21.2	0.0	0.0	-15.6	0.0	0.0	20.1	
Right Thigh	0.0	-123.0	0.0	0.0	176.1	0.0	53.0	0.0	0.0	-34.9	0.0	0.0	15.6	
Left Foot	0.0	-186.0	0.0	0.0	0.0	0.0	5.5	0.0	0.0	-18.9	0.0	0.0	0.0	
Left Leg	0.0	-164.8	0.0	0.0	186.0	0.0	21.2	0.0	0.0	-0.3	0.0	0.0	18.9	
Left Thigh	0.0	-111.8	0.0	0.0	164.8	0.0	53.0	0.0	0.0	12.7	0.0	0.0	0.3	
Right Hand	0.0	-31.0	0.0	0.0	0.0	0.0	2.3	0.0	0.0	-1.9	0.0	0.0	0.0	
Right Forearm	0.0	-23.9	0.0	0.0	31.0	0.0	7.1	0.0	0.0	-7.2	0.0	0.0	1.9	
Right Arm	0.0	-10.1	0.0	0.0	23.9	0.0	13.8	0.0	0.0	-11.3	0.0	0.0	7.2	
Left Hand	0.0	-31.0	0.0	0.0	0.0	0.0	2.3	0.0	0.0	-1.9	0.0	0.0	0.0	
Left Forearm	0.0	-23.9	0.0	0.0	31.0	0.0	7.1	0.0	0.0	-7.2	0.0	0.0	1.9	
Left Arm	0.0	-10.1	0.0	0.0	23.9	0.0	13.8	0.0	0.0	-11.3	0.0	0.0	7.2	
Head	0.0	36.0	0.0	0.0	0.0	0.0	36.0	0.0	0.0	-0.6	0.0	0.0	0.0	
Pelvis	0.0	234.4	0.0	0.0	-166.1	0.0	68.2	0.0	0.0	-27.1	0.0	0.0	27.7	
Torso	0.0	166.1	0.0	0.0	-15.8	0.0	150.3	0.0	0.0	-27.7	0.0	0.0	23.3	

**Table of Joint Coordinates**

MARKER	X	Y	Z
Right Foot	0.203	0.000	0.000
Right Ankle	0.102	0.084	0.000
Right Knee	0.126	0.425	0.000
Right Hip	0.000	0.754	0.000
Right Hand	0.439	1.285	0.000
Right Wrist	0.378	1.257	0.000
Right Elbow	0.191	1.170	0.000
Right Shoulder	-0.040	1.149	0.000
Left Foot	-0.097	0.005	0.000
Left Ankle	-0.197	0.089	0.000
Left Knee	-0.091	0.414	0.000
Left Hip	0.000	0.754	0.000
Left Hand	0.439	1.285	0.000
Left Wrist	0.378	1.257	0.000
Left Elbow	0.191	1.170	0.000
Left Shoulder	-0.040	1.149	0.000
L4-L5	0.003	0.841	0.000
Head	-0.064	1.315	0.000
C7	-0.046	1.187	0.000

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Female 5%ile	Height: 146 cm	Gender: Female
	Weight: 47 kg	Age: 35

## 2D Action Summary (Masking Process : Board from Rack : Getting Board (5%F))

Trunk Angle: 13.0°

### Left Hand

Force: 33.4 N  
Angle in xy-plane: 90°

### Right Hand

Force: 33.4 N  
Angle in xy-plane: 90°

R.D. Forward: 43.9 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 153.5 cm

R.D. Forward: 43.9 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 153.5 cm

### L4-L5 Moment

Flexor: -10.0 Nm

### L4-L5 Compression

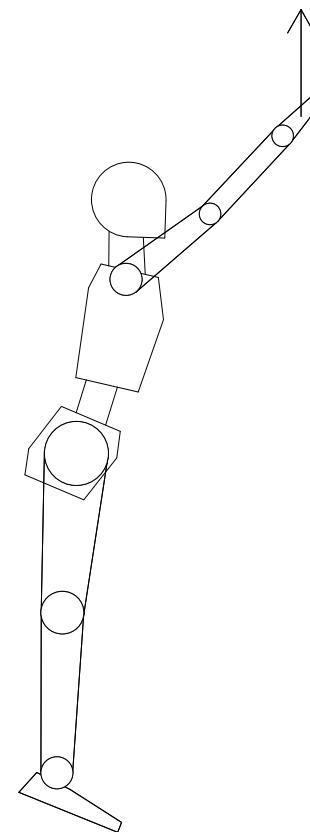
Total: 385 N

### Reaction Shear

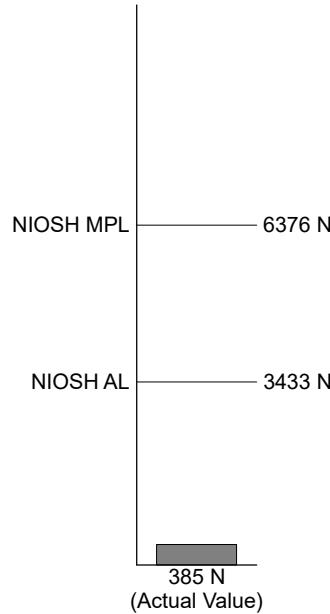
Anterior: 37 N

### Joint Shear

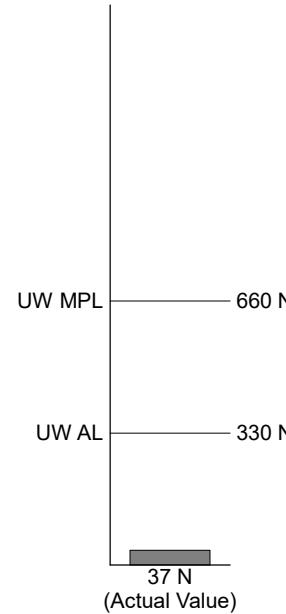
Anterior: 37 N



### Spine Compression Limits



### Spine Joint Shear Limits



Site: Job Name: Analyst: Anthropometrics: Female 5%ile	Department: Workstation ID: Date: 14 Mar, 2021 Height: 146 cm	Job Classification: Shift: Worker ID: Gender: Female Age: 35
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### Joint Moment Strength Data

% of Population Not Capable			Calculated Moment (Nm)
R Elbow	Flexor/Extensor Supinator/Pronator	0.8	5.4 EX 0.0
L Elbow	Flexor/Extensor Supinator/Pronator	0.8	5.4 EX 0.0
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor		8.7 EX 0.0 0.0
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor		8.7 EX 0.0 0.0
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	0.1	10.0 FL 0.0 0.0
		25%	

### Female Strength Data

		Mean Population Moment (Nm)	S.D. (Nm)	Angle (°)	Reference
R Elbow	Flexor/Extensor Supinator/Pronator	20 DNA	6	90	Askew et al. (1987)
L Elbow	Flexor/Extensor Supinator/Pronator	20 DNA	6	90	Askew et al. (1987)
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	DNA DNA DNA			
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	DNA DNA DNA			
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	213 DNA DNA	50	0	Troup & Chapman (1969)

(DNA = Data Not Available)

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Female 5%ile	Height: 146 cm	Gender: Female
	Weight: 47 kg	Age: 35

## 2D Action Details (Masking Process : Board from Rack : Getting Board (5%F))

Table of Segment Positions

SEGMENT	ABS ANGLE* (°) xy plane    yz plane	CGx (m)	CGy (m)	CGz (m)	LENGTH (m)
Right Foot	-62.0	-0.012	0.058	0.000	0.131
Right Leg	-92.0	-0.036	0.309	0.000	0.342
Right Thigh	-95.0	-0.013	0.656	0.000	0.352
Left Foot	-62.0	-0.012	0.058	0.000	0.131
Left Leg	-92.0	-0.036	0.309	0.000	0.342
Left Thigh	-95.0	-0.013	0.656	0.000	0.352
Right Hand	47.0	0.451	1.511	0.000	0.067
Right Forearm	47.0	0.348	1.400	0.000	0.207
Right Arm	38.0	0.184	1.254	0.000	0.232
Left Hand	47.0	0.451	1.511	0.000	0.067
Left Forearm	47.0	0.348	1.400	0.000	0.207
Left Arm	38.0	0.184	1.254	0.000	0.232
Head	88.0	0.117	1.358	0.000	0.129
Pelvis	67.0	0.012	0.837	0.000	0.087
Torso	77.0	0.073	1.059	0.000	0.350

\* NOTE: THE ABS ANGLES ARE ALL ABSOLUTE VALUES WITH 0° BEING HORIZONTAL TO THE RIGHT.

Table of Reaction Forces and Moments acting on each Segment

SEGMENT	REACTION FORCES						WEIGHT (N)	MOMENTS						
	Proximal End			Distal End				Proximal End			Distal End			
	RFx (N)	RFy (N)	RFz (N)	RFx (N)	RFy (N)	RFz (N)		RMx (Nm)	RMy (Nm)	RMz (Nm)	RMx (Nm)	RMy (Nm)	RMz (Nm)	
Right Foot	0.0	-191.6	0.0	0.0	0.0	0.0	5.5	0.0	0.0	-12.0	0.0	0.0	0.0	
Right Leg	0.0	-170.4	0.0	0.0	191.6	0.0	21.2	0.0	0.0	-9.8	0.0	0.0	12.0	
Right Thigh	0.0	-117.4	0.0	0.0	170.4	0.0	53.0	0.0	0.0	-5.2	0.0	0.0	9.8	
Left Foot	0.0	-191.6	0.0	0.0	0.0	0.0	5.5	0.0	0.0	-12.0	0.0	0.0	0.0	
Left Leg	0.0	-170.4	0.0	0.0	191.6	0.0	21.2	0.0	0.0	-9.8	0.0	0.0	12.0	
Left Thigh	0.0	-117.4	0.0	0.0	170.4	0.0	53.0	0.0	0.0	-5.2	0.0	0.0	9.8	
Right Hand	0.0	-31.0	0.0	0.0	0.0	0.0	2.3	0.0	0.0	-1.5	0.0	0.0	0.0	
Right Forearm	0.0	-23.9	0.0	0.0	31.0	0.0	7.1	0.0	0.0	-5.4	0.0	0.0	1.5	
Right Arm	0.0	-10.1	0.0	0.0	23.9	0.0	13.8	0.0	0.0	-8.7	0.0	0.0	5.4	
Left Hand	0.0	-31.0	0.0	0.0	0.0	0.0	2.3	0.0	0.0	-1.5	0.0	0.0	0.0	
Left Forearm	0.0	-23.9	0.0	0.0	31.0	0.0	7.1	0.0	0.0	-5.4	0.0	0.0	1.5	
Left Arm	0.0	-10.1	0.0	0.0	23.9	0.0	13.8	0.0	0.0	-8.7	0.0	0.0	5.4	
Head	0.0	36.0	0.0	0.0	0.0	0.0	36.0	0.0	0.0	0.2	0.0	0.0	0.0	
Pelvis	0.0	234.4	0.0	0.0	-166.1	0.0	68.2	0.0	0.0	-3.6	0.0	0.0	10.0	
Torso	0.0	166.1	0.0	0.0	-15.8	0.0	150.3	0.0	0.0	-10.0	0.0	0.0	17.2	

Table of Joint Coordinates

MARKER	X	Y	Z
Right Foot	0.019	0.000	0.000
Right Ankle	-0.043	0.116	0.000
Right Knee	-0.031	0.457	0.000
Right Hip	0.000	0.808	0.000
Right Hand	0.473	1.535	0.000
Right Wrist	0.428	1.486	0.000
Right Elbow	0.287	1.335	0.000
Right Shoulder	0.104	1.192	0.000
Left Foot	0.019	0.000	0.000
Left Ankle	-0.043	0.116	0.000
Left Knee	-0.031	0.457	0.000
Left Hip	0.000	0.808	0.000
Left Hand	0.473	1.535	0.000
Left Wrist	0.428	1.486	0.000
Left Elbow	0.287	1.335	0.000
Left Shoulder	0.104	1.192	0.000
L4-L5	0.034	0.888	0.000
Head	0.117	1.358	0.000
C7	0.113	1.229	0.000

Site: Job Name: Analyst: Anthropometrics: Female 5%ile	Department: Workstation ID: Date: 14 Mar, 2021 Height: 146 cm	Job Classification: Shift: Worker ID: Gender: Female Age: 35
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## 2D Action Summary (Masking Process : Part from Trolley : Getting Part (95%M))

Trunk Angle: 4.0°

### Left Hand

Force: 11.3 N  
Angle in xy-plane: 90°

### Right Hand

Force: 11.3 N  
Angle in xy-plane: 90°

R.D. Forward: 37.5 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 84.6 cm

R.D. Forward: 37.5 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 84.6 cm

### L4-L5 Moment

Extensor: 1.0 Nm

### L4-L5 Compression

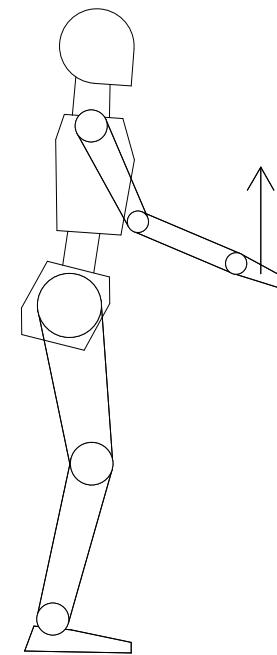
Total: 226 N

### Reaction Shear

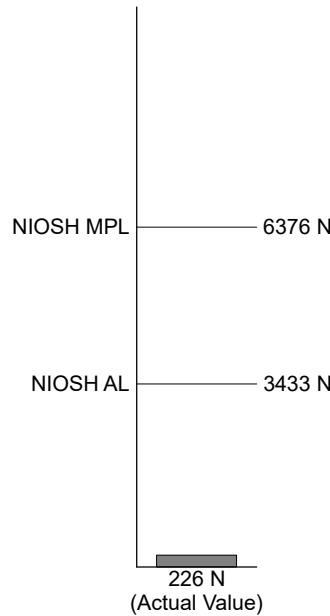
Anterior: 15 N

### Joint Shear

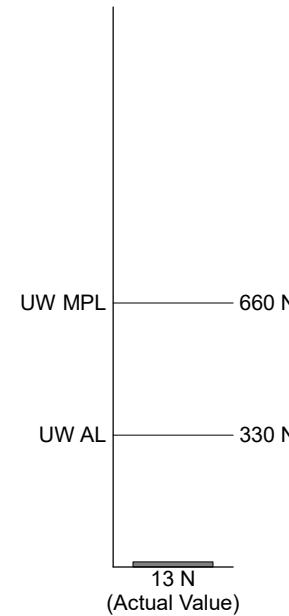
Anterior: 13 N



### Spine Compression Limits



### Spine Joint Shear Limits



Site: Job Name: Analyst: Anthropometrics: Female 5%ile	Department: Workstation ID: Date: 14 Mar, 2021 Height: 146 cm	Job Classification: Shift: Worker ID: Gender: Female Age: 35
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### Joint Moment Strength Data

% of Population Not Capable			Calculated Moment (Nm)
R Elbow	Flexor/Extensor Supinator/Pronator	0.1	1.7 EX 0.0
L Elbow	Flexor/Extensor Supinator/Pronator	0.1	1.7 EX 0.0
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor		1.3 EX 0.0 0.0
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor		1.3 EX 0.0 0.0
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	0.1	1.0 EX 0.0 0.0
		25%	

### Female Strength Data

		Mean Population Moment (Nm)	S.D. (Nm)	Angle (°)	Reference
R Elbow	Flexor/Extensor Supinator/Pronator	20 DNA	6	90	Askew et al. (1987)
L Elbow	Flexor/Extensor Supinator/Pronator	20 DNA	6	90	Askew et al. (1987)
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	DNA DNA DNA			
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	DNA DNA DNA			
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	299 DNA DNA	65	0	Troup & Chapman (1969)

(DNA = Data Not Available)

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Female 5%ile	Height: 146 cm	Gender: Female
	Weight: 47 kg	Age: 35

## 2D Action Details (Masking Process : Part from Trolley : Getting Part (95%M))

Table of Segment Positions

SEGMENT	ABS ANGLE* (°) xy plane    yz plane	CGx (m)	CGy (m)	CGz (m)	LENGTH (m)
Right Foot	-41.0	0.016	0.043	0.000	0.131
Right Leg	-104.0	0.013	0.274	0.000	0.342
Right Thigh	-82.0	0.021	0.616	0.000	0.352
Left Foot	-41.0	0.016	0.043	0.000	0.131
Left Leg	-104.0	0.013	0.274	0.000	0.342
Left Thigh	-82.0	0.021	0.616	0.000	0.352
Right Hand	-23.0	0.366	0.859	0.000	0.067
Right Forearm	-23.0	0.226	0.918	0.000	0.207
Right Arm	-64.0	0.087	1.070	0.000	0.232
Left Hand	-23.0	0.366	0.859	0.000	0.067
Left Forearm	-23.0	0.226	0.918	0.000	0.207
Left Arm	-64.0	0.087	1.070	0.000	0.232
Head	86.0	0.054	1.328	0.000	0.129
Pelvis	76.0	0.008	0.797	0.000	0.087
Torso	86.0	0.033	1.025	0.000	0.350

\* NOTE: THE ABS ANGLES ARE ALL ABSOLUTE VALUES WITH 0° BEING HORIZONTAL TO THE RIGHT.

Table of Reaction Forces and Moments acting on each Segment

SEGMENT	REACTION FORCES						WEIGHT (N)	MOMENTS						
	Proximal End			Distal End				Proximal End			Distal End			
	RFx (N)	RFy (N)	RFz (N)	RFx (N)	RFy (N)	RFz (N)		RMx (Nm)	RMy (Nm)	RMz (Nm)	RMx (Nm)	RMy (Nm)	RMz (Nm)	
Right Foot	0.0	-213.7	0.0	0.0	0.0	0.0	5.5	0.0	0.0	-21.4	0.0	0.0	0.0	
Right Leg	0.0	-192.5	0.0	0.0	213.7	0.0	21.2	0.0	0.0	-4.5	0.0	0.0	21.4	
Right Thigh	0.0	-139.5	0.0	0.0	192.5	0.0	53.0	0.0	0.0	-12.8	0.0	0.0	4.5	
Left Foot	0.0	-213.7	0.0	0.0	0.0	0.0	5.5	0.0	0.0	-21.4	0.0	0.0	0.0	
Left Leg	0.0	-192.5	0.0	0.0	213.7	0.0	21.2	0.0	0.0	-4.5	0.0	0.0	21.4	
Left Thigh	0.0	-139.5	0.0	0.0	192.5	0.0	53.0	0.0	0.0	-12.8	0.0	0.0	4.5	
Right Hand	0.0	-9.0	0.0	0.0	0.0	0.0	2.3	0.0	0.0	-0.6	0.0	0.0	0.0	
Right Forearm	0.0	-1.8	0.0	0.0	9.0	0.0	7.1	0.0	0.0	-1.7	0.0	0.0	0.6	
Right Arm	0.0	12.0	0.0	0.0	1.8	0.0	13.8	0.0	0.0	-1.3	0.0	0.0	1.7	
Left Hand	0.0	-9.0	0.0	0.0	0.0	0.0	2.3	0.0	0.0	-0.6	0.0	0.0	0.0	
Left Forearm	0.0	-1.8	0.0	0.0	9.0	0.0	7.1	0.0	0.0	-1.7	0.0	0.0	0.6	
Left Arm	0.0	12.0	0.0	0.0	1.8	0.0	13.8	0.0	0.0	-1.3	0.0	0.0	1.7	
Head	0.0	36.0	0.0	0.0	0.0	0.0	36.0	0.0	0.0	0.3	0.0	0.0	0.0	
Pelvis	0.0	278.5	0.0	0.0	-210.3	0.0	68.2	0.0	0.0	5.9	0.0	0.0	-1.0	
Torso	0.0	210.3	0.0	0.0	-60.0	0.0	150.3	0.0	0.0	1.0	0.0	0.0	2.3	

Table of Joint Coordinates

MARKER	X	Y	Z
Right Foot	0.065	0.000	0.000
Right Ankle	-0.034	0.086	0.000
Right Knee	0.049	0.418	0.000
Right Hip	0.000	0.767	0.000
Right Hand	0.396	0.846	0.000
Right Wrist	0.335	0.872	0.000
Right Elbow	0.145	0.953	0.000
Right Shoulder	0.043	1.161	0.000
Left Foot	0.065	0.000	0.000
Left Ankle	-0.034	0.086	0.000
Left Knee	0.049	0.418	0.000
Left Hip	0.000	0.767	0.000
Left Hand	0.396	0.846	0.000
Left Wrist	0.335	0.872	0.000
Left Elbow	0.145	0.953	0.000
Left Shoulder	0.043	1.161	0.000
L4-L5	0.021	0.851	0.000
Head	0.054	1.328	0.000
C7	0.045	1.200	0.000

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Female 5%ile	Height: 146 cm	Gender: Female
	Weight: 47 kg	Age: 35

## 2D Action Summary (Masking Process : Part from Trolley : Getting Part (5%F))

Trunk Angle: 0.0°

### Left Hand

Force: 11.3 N  
Angle in xy-plane: 90°

### Right Hand

Force: 11.3 N  
Angle in xy-plane: 90°

R.D. Forward: 47.4 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 110.9 cm

R.D. Forward: 47.4 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 110.9 cm

### L4-L5 Moment

Flexor: -2.0 Nm

### L4-L5 Compression

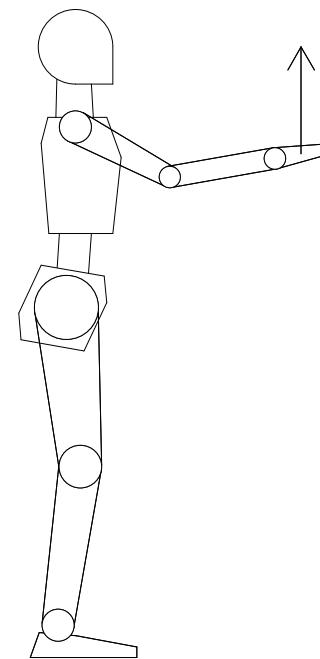
Total: 255 N

### Reaction Shear

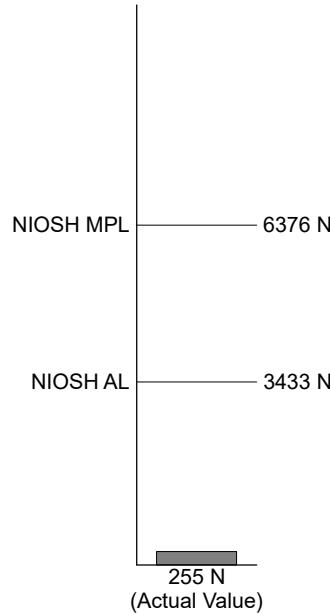
Posterior: 0 N

### Joint Shear

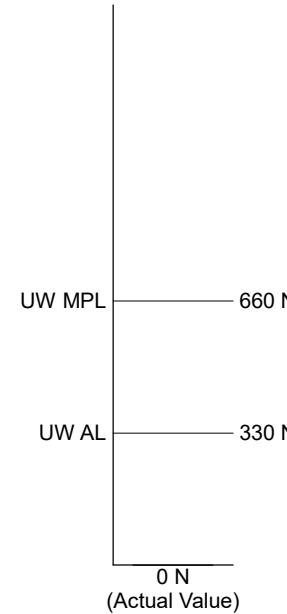
Posterior: 0 N



### Spine Compression Limits



### Spine Joint Shear Limits



Site: Job Name: Analyst: Anthropometrics: Female 5%ile	Department: Workstation ID: Date: 14 Mar, 2021 Height: 146 cm	Job Classification: Shift: Worker ID: Gender: Female Age: 35
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### Joint Moment Strength Data

% of Population Not Capable			Calculated Moment (Nm)
R Elbow	Flexor/Extensor Supinator/Pronator	0.1	1.9 EX 0.0
L Elbow	Flexor/Extensor Supinator/Pronator	0.1	1.9 EX 0.0
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor		1.0 EX 0.0 0.0
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor		1.0 EX 0.0 0.0
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	0.1	2.0 FL 0.0 0.0
		25%	

### Female Strength Data

		Mean Population Moment (Nm)	S.D. (Nm)	Angle (°)	Reference
R Elbow	Flexor/Extensor Supinator/Pronator	20 DNA	6	90	Askew et al. (1987)
L Elbow	Flexor/Extensor Supinator/Pronator	20 DNA	6	90	Askew et al. (1987)
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	DNA DNA DNA			
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	DNA DNA DNA			
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	213 DNA DNA	50	0	Troup & Chapman (1969)

(DNA = Data Not Available)

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Female 5%ile	Height: 146 cm	Gender: Female
	Weight: 47 kg	Age: 35

## 2D Action Details (Masking Process : Part from Trolley : Getting Part (5%F))

Table of Segment Positions

SEGMENT	ABS ANGLE* (°) xy plane    yz plane	CGx (m)	CGy (m)	CGz (m)	LENGTH (m)
Right Foot	-40.0	0.033	0.042	0.000	0.131
Right Leg	-98.0	0.010	0.276	0.000	0.342
Right Thigh	-85.0	0.013	0.622	0.000	0.352
Left Foot	-40.0	0.033	0.042	0.000	0.131
Left Leg	-98.0	0.010	0.276	0.000	0.342
Left Thigh	-85.0	0.013	0.622	0.000	0.352
Right Hand	10.0	0.457	1.103	0.000	0.067
Right Forearm	10.0	0.308	1.077	0.000	0.207
Right Arm	-28.0	0.104	1.123	0.000	0.232
Left Hand	10.0	0.457	1.103	0.000	0.067
Left Forearm	10.0	0.308	1.077	0.000	0.207
Left Arm	-28.0	0.104	1.123	0.000	0.232
Head	90.0	0.015	1.338	0.000	0.129
Pelvis	80.0	0.005	0.805	0.000	0.087
Torso	90.0	0.015	1.034	0.000	0.350

\* NOTE: THE ABS ANGLES ARE ALL ABSOLUTE VALUES WITH 0° BEING HORIZONTAL TO THE RIGHT.

Table of Reaction Forces and Moments acting on each Segment

SEGMENT	REACTION FORCES						WEIGHT (N)	MOMENTS						
	Proximal End			Distal End				Proximal End			Distal End			
	RFx (N)	RFy (N)	RFz (N)	RFx (N)	RFy (N)	RFz (N)		RMx (Nm)	RMy (Nm)	RMz (Nm)	RMx (Nm)	RMy (Nm)	RMz (Nm)	
Right Foot	0.0	-213.7	0.0	0.0	0.0	0.0	5.5	0.0	0.0	-21.7	0.0	0.0	0.0	
Right Leg	0.0	-192.5	0.0	0.0	213.7	0.0	21.2	0.0	0.0	-12.0	0.0	0.0	21.7	
Right Thigh	0.0	-139.5	0.0	0.0	192.5	0.0	53.0	0.0	0.0	-17.2	0.0	0.0	12.0	
Left Foot	0.0	-213.7	0.0	0.0	0.0	0.0	5.5	0.0	0.0	-21.7	0.0	0.0	0.0	
Left Leg	0.0	-192.5	0.0	0.0	213.7	0.0	21.2	0.0	0.0	-12.0	0.0	0.0	21.7	
Left Thigh	0.0	-139.5	0.0	0.0	192.5	0.0	53.0	0.0	0.0	-17.2	0.0	0.0	12.0	
Right Hand	0.0	-9.0	0.0	0.0	0.0	0.0	2.3	0.0	0.0	-0.7	0.0	0.0	0.0	
Right Forearm	0.0	-1.8	0.0	0.0	9.0	0.0	7.1	0.0	0.0	-1.9	0.0	0.0	0.7	
Right Arm	0.0	12.0	0.0	0.0	1.8	0.0	13.8	0.0	0.0	-1.0	0.0	0.0	1.9	
Left Hand	0.0	-9.0	0.0	0.0	0.0	0.0	2.3	0.0	0.0	-0.7	0.0	0.0	0.0	
Left Forearm	0.0	-1.8	0.0	0.0	9.0	0.0	7.1	0.0	0.0	-1.9	0.0	0.0	0.7	
Left Arm	0.0	12.0	0.0	0.0	1.8	0.0	13.8	0.0	0.0	-1.0	0.0	0.0	1.9	
Head	0.0	36.0	0.0	0.0	0.0	0.0	36.0	0.0	0.0	0.0	0.0	0.0	0.0	
Pelvis	0.0	278.5	0.0	0.0	-210.3	0.0	68.2	0.0	0.0	1.5	0.0	0.0	2.0	
Torso	0.0	210.3	0.0	0.0	-60.0	0.0	150.3	0.0	0.0	-2.0	0.0	0.0	2.0	

Table of Joint Coordinates

MARKER	X	Y	Z
Right Foot	0.083	0.000	0.000
Right Ankle	-0.017	0.084	0.000
Right Knee	0.031	0.423	0.000
Right Hip	0.000	0.774	0.000
Right Hand	0.489	1.109	0.000
Right Wrist	0.424	1.098	0.000
Right Elbow	0.220	1.062	0.000
Right Shoulder	0.015	1.171	0.000
Left Foot	0.083	0.000	0.000
Left Ankle	-0.017	0.084	0.000
Left Knee	0.031	0.423	0.000
Left Hip	0.000	0.774	0.000
Left Hand	0.489	1.109	0.000
Left Wrist	0.424	1.098	0.000
Left Elbow	0.220	1.062	0.000
Left Shoulder	0.015	1.171	0.000
L4-L5	0.015	0.859	0.000
Head	0.015	1.338	0.000
C7	0.015	1.209	0.000

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Female 5%ile	Height: 146 cm	Gender: Female
	Weight: 47 kg	Age: 35

## 2D Action Summary (Masking Process : Finishing : Pushing Trolley)

Trunk Angle: 5.0°

### Left Hand

Force: 13.0 N  
Angle in xy-plane: 0°

### Right Hand

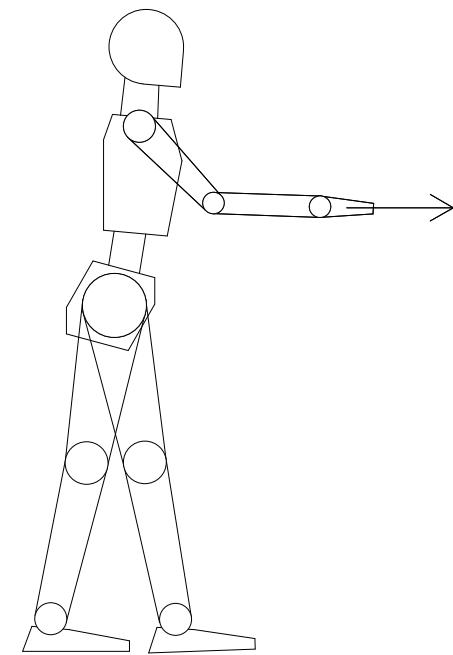
Force: 13.0 N  
Angle in xy-plane: 0°

R.D. Forward: 46.2 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 98.2 cm

R.D. Forward: 46.2 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 98.2 cm

### L4-L5 Moment

Extensor: 17.0 Nm



### L4-L5 Compression

Total: 514 N

### Reaction Shear

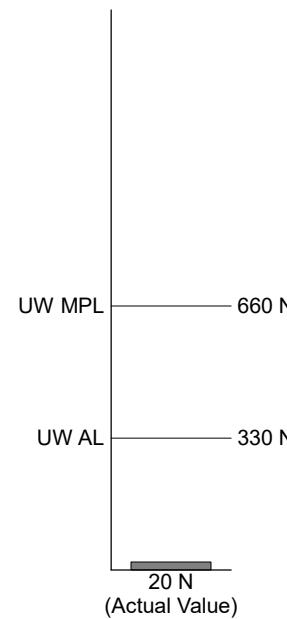
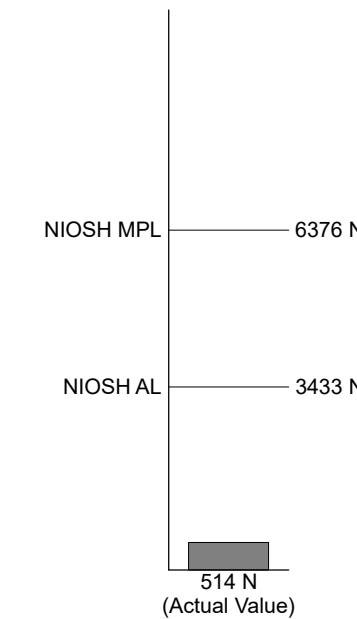
Anterior: 46 N

### Joint Shear

Anterior: 20 N

### Spine Compression Limits

### Spine Joint Shear Limits



Site: Job Name: Analyst: Anthropometrics: Female 5%ile	Department: Workstation ID: Date: 14 Mar, 2021 Height: 146 cm	Job Classification: Shift: Worker ID: Gender: Female
		Age: 35

### Joint Moment Strength Data

% of Population Not Capable			Calculated Moment (Nm)
R Elbow	Flexor/Extensor Supinator/Pronator	0.1	1.1 FL 0.0
L Elbow	Flexor/Extensor Supinator/Pronator	0.1	1.1 FL 0.0
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	0.1	1.4 FL 0.0 0.0
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	0.1	1.4 FL 0.0 0.0
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	0.1	17.0 EX 0.0 0.0
		25%	

### Female Strength Data

		Mean Population Moment (Nm)	S.D. (Nm)	Angle (°)	Reference
R Elbow	Flexor/Extensor Supinator/Pronator	32 DNA	8	90	Askew et al. (1987)
L Elbow	Flexor/Extensor Supinator/Pronator	32 DNA	8	90	Askew et al. (1987)
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	32 DNA DNA	6	45	Koski & McGill (1994)
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	32 DNA DNA	6	45	Koski & McGill (1994)
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	299 DNA DNA	65	0	Troup & Chapman (1969)

(DNA = Data Not Available)

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Female 5%ile	Height: 146 cm	Gender: Female
	Weight: 47 kg	Age: 35

## 2D Action Details (Masking Process : Finishing : Pushing Trolley)

Table of Segment Positions

SEGMENT	ABS ANGLE* (°) xy plane    yz plane	CGx (m)	CGy (m)	CGz (m)	LENGTH (m)
Right Foot	-38.0	0.184	0.043	0.000	0.131
Right Leg	-79.0	0.095	0.273	0.000	0.342
Right Thigh	-79.0	0.029	0.615	0.000	0.352
Left Foot	-40.0	-0.088	0.042	0.000	0.131
Left Leg	-103.0	-0.094	0.273	0.000	0.342
Left Thigh	-100.0	-0.026	0.614	0.000	0.352
Right Hand	-2.0	0.451	0.983	0.000	0.067
Right Forearm	-2.0	0.300	0.988	0.000	0.207
Right Arm	-46.0	0.120	1.086	0.000	0.232
Left Hand	-2.0	0.451	0.983	0.000	0.067
Left Forearm	-2.0	0.300	0.988	0.000	0.207
Left Arm	-46.0	0.120	1.086	0.000	0.232
Head	85.0	0.064	1.325	0.000	0.129
Pelvis	75.0	0.008	0.795	0.000	0.087
Torso	85.0	0.038	1.022	0.000	0.350

\* NOTE: THE ABS ANGLES ARE ALL ABSOLUTE VALUES WITH 0° BEING HORIZONTAL TO THE RIGHT.

Table of Reaction Forces and Moments acting on each Segment

SEGMENT	REACTION FORCES						WEIGHT (N)	MOMENTS						
	Proximal End			Distal End				Proximal End			Distal End			
	RFx (N)	RFy (N)	RFz (N)	RFx (N)	RFy (N)	RFz (N)		RMx (Nm)	RMy (Nm)	RMz (Nm)	RMx (Nm)	RMy (Nm)	RMz (Nm)	
Right Foot	11.1	-191.8	0.0	0.0	0.0	0.0	5.5	0.0	0.0	-19.2	0.0	0.0	0.0	
Right Leg	11.1	-170.6	0.0	-11.1	191.8	0.0	21.2	0.0	0.0	-27.4	0.0	0.0	19.2	
Right Thigh	11.1	-117.5	0.0	-11.1	170.6	0.0	53.0	0.0	0.0	-33.4	0.0	0.0	27.4	
Left Foot	14.9	-258.2	0.0	0.0	0.0	0.0	5.5	0.0	0.0	-24.9	0.0	0.0	0.0	
Left Leg	14.9	-237.0	0.0	-14.9	258.2	0.0	21.2	0.0	0.0	-0.8	0.0	0.0	24.9	
Left Thigh	14.9	-184.0	0.0	-14.9	237.0	0.0	53.0	0.0	0.0	17.4	0.0	0.0	0.8	
Right Hand	-13.0	2.3	0.0	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	
Right Forearm	-13.0	9.5	0.0	13.0	-2.3	0.0	7.1	0.0	0.0	1.1	0.0	0.0	0.0	
Right Arm	-13.0	23.3	0.0	13.0	-9.5	0.0	13.8	0.0	0.0	1.4	0.0	0.0	-1.1	
Left Hand	-13.0	2.3	0.0	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	
Left Forearm	-13.0	9.5	0.0	13.0	-2.3	0.0	7.1	0.0	0.0	1.1	0.0	0.0	0.0	
Left Arm	-13.0	23.3	0.0	13.0	-9.5	0.0	13.8	0.0	0.0	1.4	0.0	0.0	-1.1	
Head	0.0	36.0	0.0	0.0	0.0	0.0	36.0	0.0	0.0	0.4	0.0	0.0	0.0	
Pelvis	-26.0	301.1	0.0	26.0	-232.8	0.0	68.2	0.0	0.0	25.0	0.0	0.0	-17.0	
Torso	-26.0	232.8	0.0	26.0	-82.5	0.0	150.3	0.0	0.0	17.0	0.0	0.0	-3.2	

Table of Joint Coordinates

MARKER	X	Y	Z
Right Foot	0.236	0.002	0.000
Right Ankle	0.132	0.083	0.000
Right Knee	0.067	0.419	0.000
Right Hip	0.000	0.764	0.000
Right Hand	0.484	0.982	0.000
Right Wrist	0.418	0.984	0.000
Right Elbow	0.211	0.991	0.000
Right Shoulder	0.050	1.158	0.000
Left Foot	-0.038	0.000	0.000
Left Ankle	-0.138	0.084	0.000
Left Knee	-0.061	0.417	0.000
Left Hip	0.000	0.764	0.000
Left Hand	0.484	0.982	0.000
Left Wrist	0.418	0.984	0.000
Left Elbow	0.211	0.991	0.000
Left Shoulder	0.050	1.158	0.000
L4-L5	0.022	0.848	0.000
Head	0.064	1.325	0.000
C7	0.053	1.197	0.000

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Female 5%ile	Height: 146 cm	Gender: Female
	Weight: 47 kg	Age: 35

## 2D Action Summary (Masking Process : Finishing : Open Oven Door (95%M))

Trunk Angle: -13.0°

### Left Hand

Force: 200.1 N  
Angle in xy-plane: 180°

### Right Hand

Force: 200.1 N  
Angle in xy-plane: 180°

R.D. Forward: 43.2 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 110.5 cm

R.D. Forward: 43.2 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 110.5 cm

### L4-L5 Moment

Flexor: -124.2 Nm

### L4-L5 Compression

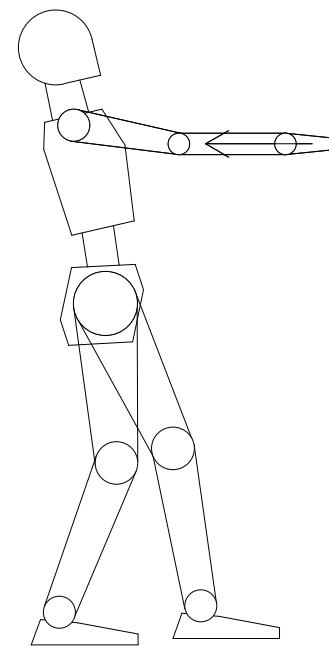
Total: 2897 N

### Reaction Shear

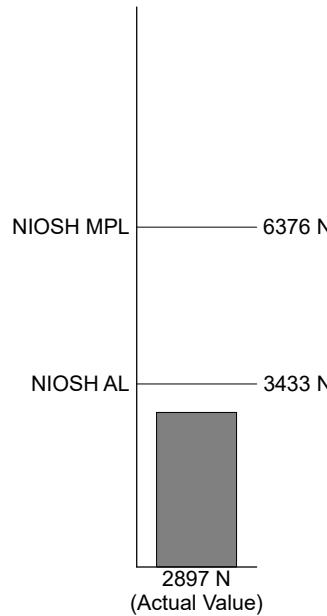
Posterior: -442 N

### Joint Shear

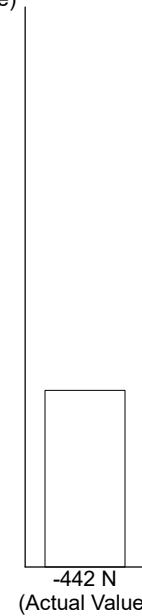
Posterior: -442 N



### Spine Compression Limits



### Spine Joint Shear Limit (none available)



Site: Job Name: Analyst: Anthropometrics: Female 5%ile	Department: Workstation ID: Date: 14 Mar, 2021 Height: 146 cm	Job Classification: Shift: Worker ID: Gender: Female Age: 35
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### Joint Moment Strength Data

% of Population Not Capable			Calculated Moment (Nm)
R Elbow	Flexor/Extensor Supinator/Pronator	0.1	1.2 FL 0.0
L Elbow	Flexor/Extensor Supinator/Pronator	0.1	1.2 FL 0.0
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	0.1	12.8 FL 0.0 0.0
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	0.1	12.8 FL 0.0 0.0
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	3.8	124.2 FL 0.0 0.0
		25%	

### Female Strength Data

		Mean Population Moment (Nm)	S.D. (Nm)	Angle (°)	Reference
R Elbow	Flexor/Extensor Supinator/Pronator	32 DNA	8	90	Askew et al. (1987)
L Elbow	Flexor/Extensor Supinator/Pronator	32 DNA	8	90	Askew et al. (1987)
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	32 DNA DNA	6	45	Koski & McGill (1994)
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	32 DNA DNA	6	45	Koski & McGill (1994)
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	213 DNA DNA	50	0	Troup & Chapman (1969)

(DNA = Data Not Available)

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Female 5%ile	Height: 146 cm	Gender: Female
	Weight: 47 kg	Age: 35

## 2D Action Details (Masking Process : Finishing : Open Oven Door (95%M))

Table of Segment Positions

SEGMENT	ABS ANGLE* (°) xy plane    yz plane	CGx (m)	CGy (m)	CGz (m)	LENGTH (m)
Right Foot	-40.0	-0.048	0.042	0.000	0.131
Right Leg	-111.0	-0.029	0.265	0.000	0.342
Right Thigh	-86.0	0.011	0.603	0.000	0.352
Left Foot	-40.0	0.258	0.057	0.000	0.131
Left Leg	-80.0	0.175	0.290	0.000	0.342
Left Thigh	-65.0	0.064	0.617	0.000	0.352
Right Hand	0.0	0.395	1.105	0.000	0.067
Right Forearm	0.0	0.243	1.105	0.000	0.207
Right Arm	-10.0	0.025	1.127	0.000	0.232
Left Hand	0.0	0.395	1.105	0.000	0.067
Left Forearm	0.0	0.243	1.105	0.000	0.207
Left Arm	-10.0	0.025	1.127	0.000	0.232
Head	103.0	-0.112	1.308	0.000	0.129
Pelvis	93.0	-0.002	0.786	0.000	0.087
Torso	103.0	-0.044	1.012	0.000	0.350

\* NOTE: THE ABS ANGLES ARE ALL ABSOLUTE VALUES WITH 0° BEING HORIZONTAL TO THE RIGHT.

Table of Reaction Forces and Moments acting on each Segment

SEGMENT	REACTION FORCES						WEIGHT (N)	MOMENTS						
	Proximal End			Distal End				Proximal End			Distal End			
	RFx (N)	RFy (N)	RFz (N)	RFx (N)	RFy (N)	RFz (N)		RMx (Nm)	RMy (Nm)	RMz (Nm)	RMx (Nm)	RMy (Nm)	RMz (Nm)	
Right Foot	-162.7	-181.9	0.0	0.0	0.0	0.0	5.5	0.0	0.0	-32.2	0.0	0.0	0.0	
Right Leg	-162.7	-160.7	0.0	162.7	181.9	0.0	21.2	0.0	0.0	-63.0	0.0	0.0	32.2	
Right Thigh	-162.7	-107.6	0.0	162.7	160.7	0.0	53.0	0.0	0.0	-123.6	0.0	0.0	63.0	
Left Foot	-237.6	-268.1	0.0	0.0	0.0	0.0	5.5	0.0	0.0	-47.2	0.0	0.0	0.0	
Left Leg	-237.6	-246.9	0.0	237.6	268.1	0.0	21.2	0.0	0.0	-142.6	0.0	0.0	47.2	
Left Thigh	-237.6	-193.9	0.0	237.6	246.9	0.0	53.0	0.0	0.0	-251.8	0.0	0.0	142.6	
Right Hand	200.1	2.3	0.0	0.0	0.0	0.0	2.3	0.0	0.0	0.1	0.0	0.0	0.0	
Right Forearm	200.1	9.5	0.0	-200.1	-2.3	0.0	7.1	0.0	0.0	1.2	0.0	0.0	-0.1	
Right Arm	200.1	23.3	0.0	-200.1	-9.5	0.0	13.8	0.0	0.0	12.8	0.0	0.0	-1.2	
Left Hand	200.1	2.3	0.0	0.0	0.0	0.0	2.3	0.0	0.0	0.1	0.0	0.0	0.0	
Left Forearm	200.1	9.5	0.0	-200.1	-2.3	0.0	7.1	0.0	0.0	1.2	0.0	0.0	-0.1	
Left Arm	200.1	23.3	0.0	-200.1	-9.5	0.0	13.8	0.0	0.0	12.8	0.0	0.0	-1.2	
Head	0.0	36.0	0.0	0.0	0.0	0.0	36.0	0.0	0.0	-1.0	0.0	0.0	0.0	
Pelvis	400.2	301.1	0.0	-400.2	-232.8	0.0	68.2	0.0	0.0	-160.1	0.0	0.0	124.2	
Torso	400.2	232.8	0.0	-400.2	-82.5	0.0	150.3	0.0	0.0	-124.2	0.0	0.0	-24.6	

Table of Joint Coordinates

MARKER	X	Y	Z
Right Foot	0.002	0.000	0.000
Right Ankle	-0.098	0.084	0.000
Right Knee	0.025	0.404	0.000
Right Hip	0.000	0.755	0.000
Right Hand	0.427	1.105	0.000
Right Wrist	0.361	1.105	0.000
Right Elbow	0.154	1.105	0.000
Right Shoulder	-0.075	1.145	0.000
Left Foot	0.309	0.015	0.000
Left Ankle	0.208	0.099	0.000
Left Knee	0.149	0.436	0.000
Left Hip	0.000	0.755	0.000
Left Hand	0.427	1.105	0.000
Left Wrist	0.361	1.105	0.000
Left Elbow	0.154	1.105	0.000
Left Shoulder	-0.075	1.145	0.000
L4-L5	-0.005	0.842	0.000
Head	-0.112	1.308	0.000
C7	-0.083	1.182	0.000

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Female 5%ile	Height: 146 cm	Gender: Female
	Weight: 47 kg	Age: 35

## 2D Action Summary (Masking Process : Finishing : Close Oven Door (95%M))

Trunk Angle: 21.0°

### Left Hand

Force: 200.1 N  
Angle in xy-plane: 4°

### Right Hand

Force: 200.1 N  
Angle in xy-plane: 4°

R.D. Forward: 60.5 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 99.3 cm

R.D. Forward: 60.5 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 99.3 cm

### L4-L5 Moment

Extensor: 103.0 Nm

### L4-L5 Compression

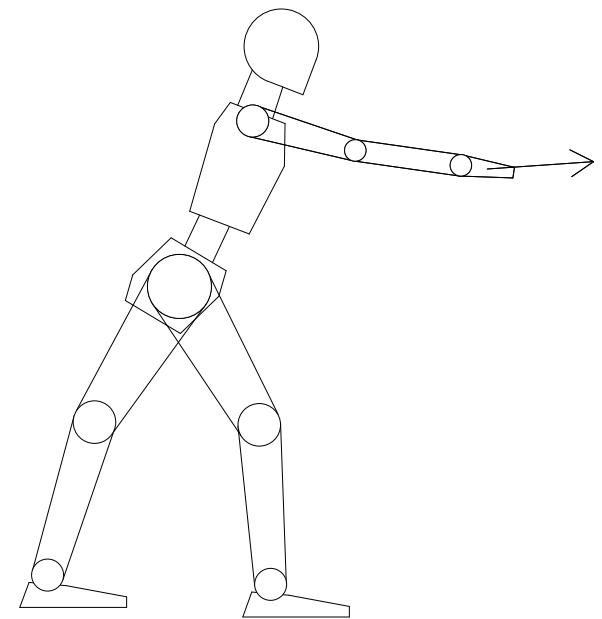
Total: 1765 N

### Reaction Shear

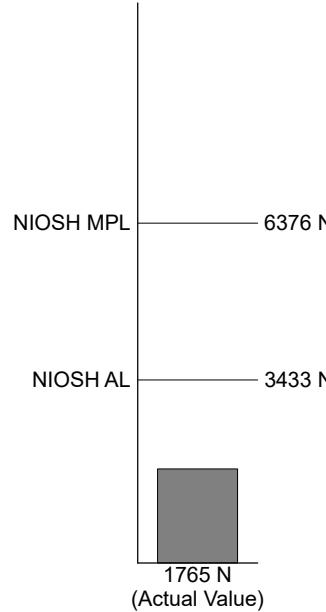
Anterior: 446 N

### Joint Shear

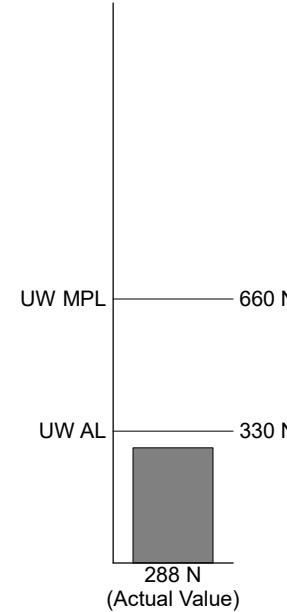
Anterior: 288 N



### Spine Compression Limits



### Spine Joint Shear Limits



Site: Job Name: Analyst: Anthropometrics: Female 5%ile	Department: Workstation ID: Date: 14 Mar, 2021 Height: 146 cm	Job Classification: Shift: Worker ID: Gender: Female Age: 35
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### Joint Moment Strength Data

		% of Population Not Capable	Calculated Moment (Nm)
R Elbow	Flexor/Extensor Supinator/Pronator	5.2	10.2 EX 0.0
L Elbow	Flexor/Extensor Supinator/Pronator	5.2	10.2 EX 0.0
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor		22.6 EX 0.0 0.0
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor		22.6 EX 0.0 0.0
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	0.1	103.0 EX 0.0 0.0
			25%

### Female Strength Data

		Mean Population Moment (Nm)	S.D. (Nm)	Angle (°)	Reference
R Elbow	Flexor/Extensor Supinator/Pronator	20 DNA	6	90	Askew et al. (1987)
L Elbow	Flexor/Extensor Supinator/Pronator	20 DNA	6	90	Askew et al. (1987)
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	DNA DNA DNA			
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	DNA DNA DNA			
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	299 DNA DNA	65	0	Troup & Chapman (1969)

(DNA = Data Not Available)

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Female 5%ile	Height: 146 cm	Gender: Female
	Weight: 47 kg	Age: 35

## 2D Action Details (Masking Process : Finishing : Close Oven Door (95%M))

Table of Segment Positions

SEGMENT	ABS ANGLE* (°) xy plane    yz plane	CGx (m)	CGy (m)	CGz (m)	LENGTH (m)
Right Foot	-40.0	0.250	0.042	0.000	0.131
Right Leg	-86.0	0.186	0.278	0.000	0.342
Right Thigh	-60.0	0.076	0.598	0.000	0.352
Left Foot	-40.0	-0.236	0.063	0.000	0.131
Left Leg	-107.0	-0.230	0.290	0.000	0.342
Left Thigh	-122.0	-0.081	0.601	0.000	0.352
Right Hand	-8.0	0.618	0.998	0.000	0.067
Right Forearm	-8.0	0.468	1.019	0.000	0.207
Right Arm	-16.0	0.254	1.068	0.000	0.232
Left Hand	-8.0	0.618	0.998	0.000	0.067
Left Forearm	-8.0	0.468	1.019	0.000	0.207
Left Arm	-16.0	0.254	1.068	0.000	0.232
Head	69.0	0.216	1.252	0.000	0.129
Pelvis	59.0	0.016	0.757	0.000	0.087
Torso	69.0	0.107	0.968	0.000	0.350

\* NOTE: THE ABS ANGLES ARE ALL ABSOLUTE VALUES WITH 0° BEING HORIZONTAL TO THE RIGHT.

Table of Reaction Forces and Moments acting on each Segment

SEGMENT	REACTION FORCES						WEIGHT (N)	MOMENTS						
	Proximal End			Distal End				Proximal End			Distal End			
	RFx (N)	RFy (N)	RFz (N)	RFx (N)	RFy (N)	RFz (N)		RMx (Nm)	RMy (Nm)	RMz (Nm)	RMx (Nm)	RMy (Nm)	RMz (Nm)	
Right Foot	369.5	-395.3	0.0	0.0	0.0	0.0	5.5	0.0	0.0	-8.8	0.0	0.0	0.0	
Right Leg	369.5	-374.1	0.0	-369.5	395.3	0.0	21.2	0.0	0.0	108.0	0.0	0.0	8.8	
Right Thigh	369.5	-321.1	0.0	-369.5	374.1	0.0	53.0	0.0	0.0	158.9	0.0	0.0	-108.0	
Left Foot	29.8	-26.7	0.0	0.0	0.0	0.0	5.5	0.0	0.0	-0.5	0.0	0.0	0.0	
Left Leg	29.8	-5.5	0.0	-29.8	26.7	0.0	21.2	0.0	0.0	11.0	0.0	0.0	0.5	
Left Thigh	29.8	47.5	0.0	-29.8	5.5	0.0	53.0	0.0	0.0	16.7	0.0	0.0	-11.0	
Right Hand	-199.6	-11.7	0.0	0.0	0.0	0.0	2.3	0.0	0.0	-2.7	0.0	0.0	0.0	
Right Forearm	-199.6	-4.5	0.0	199.6	11.7	0.0	7.1	0.0	0.0	-10.2	0.0	0.0	2.7	
Right Arm	-199.6	9.3	0.0	199.6	4.5	0.0	13.8	0.0	0.0	-22.6	0.0	0.0	10.2	
Left Hand	-199.6	-11.7	0.0	0.0	0.0	0.0	2.3	0.0	0.0	-2.7	0.0	0.0	0.0	
Left Forearm	-199.6	-4.5	0.0	199.6	11.7	0.0	7.1	0.0	0.0	-10.2	0.0	0.0	2.7	
Left Arm	-199.6	9.3	0.0	199.6	4.5	0.0	13.8	0.0	0.0	-22.6	0.0	0.0	10.2	
Head	0.0	36.0	0.0	0.0	0.0	0.0	36.0	0.0	0.0	1.7	0.0	0.0	0.0	
Pelvis	-399.3	273.2	0.0	399.3	-204.9	0.0	68.2	0.0	0.0	143.0	0.0	0.0	-103.0	
Torso	-399.3	204.9	0.0	399.3	-54.6	0.0	150.3	0.0	0.0	103.0	0.0	0.0	43.6	

Table of Joint Coordinates

MARKER	X	Y	Z
Right Foot	0.300	0.000	0.000
Right Ankle	0.200	0.084	0.000
Right Knee	0.176	0.425	0.000
Right Hip	0.000	0.730	0.000
Right Hand	0.650	0.993	0.000
Right Wrist	0.584	1.003	0.000
Right Elbow	0.380	1.032	0.000
Right Shoulder	0.156	1.096	0.000
Left Foot	-0.186	0.020	0.000
Left Ankle	-0.287	0.105	0.000
Left Knee	-0.187	0.432	0.000
Left Hip	0.000	0.730	0.000
Left Hand	0.650	0.993	0.000
Left Wrist	0.584	1.003	0.000
Left Elbow	0.380	1.032	0.000
Left Shoulder	0.156	1.096	0.000
L4-L5	0.045	0.805	0.000
Head	0.216	1.252	0.000
C7	0.170	1.131	0.000

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Male 95%ile	Height: 190 cm	Gender: Male
	Weight: 100 kg	Age: 35

## Notes

### Job Breakdown

Total Working Time/Shift:

Unaccounted Time/Shift:

Repetitions	Duration	Total Time
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Masking Process

Board from Rack

- Getting Board Low (95%M)
- Getting Board Mid (95%M)
- Getting Board Mid (5%F)
- Getting Board (5%F)

Part from Trolley

- Getting Part (95%M)
- Getting Part (5%F)

Finishing

- Pushing Trolley
- Open Oven Door
- Close Oven Door 3

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Male 95%ile	Height: 190 cm	Gender: Male
	Weight: 100 kg	Age: 35

### Peak Loads Calculated Across the Job

Peak Hand Load: 400.2 N  
 (Masking Process : Finishing : Open Oven Door)

Peak L4-L5 Flexor/Extensor Moment: 193.8 Nm  
 (Masking Process : Finishing : Close Oven Door 3)

Peak L4-L5 Twisting Moment:

Peak L4-L5 Lateral Moment:

Peak L4-L5 Total Compression: 4375.8 N  
 (Masking Process : Finishing : Open Oven Door)

Peak L4-L5 Anterior/Posterior Reaction Shear: 551.2 N  
 (Masking Process : Finishing : Close Oven Door 3)

Peak L4-L5 Lateral Reaction Shear:

Peak L4-L5 Anterior/Posterior Joint Shear: -508.3 N  
 (Masking Process : Finishing : Open Oven Door)

Peak Right Shoulder Flexor/Extensor Moment: 24.5 N  
 (Masking Process : Finishing : Open Oven Door)

Peak Left Shoulder Flexor/Extensor Moment: 24.5 N  
 (Masking Process : Finishing : Open Oven Door)

Peak Right Elbow Flexor/Extensor Moment: -11.0 N  
 (Masking Process : Finishing : Close Oven Door 3)

Peak Left Elbow Flexor/Extensor Moment: -11.0 N  
 (Masking Process : Finishing : Close Oven Door 3)

### Cumulative Loads Totaled Over the Job

Cumulative L4-L5 Extensor Moment: 0.000 MNms  
 (0.000E+0 Nms)

Cumulative L4-L5 Flexor Moment: 0.000 MNs  
 (0.000E+0 Nms)

Cumulative L4-L5 Twisting Moment:

Cumulative L4-L5 Lateral Moment:

Cumulative L4-L5 Total Compression: 0.000 MNs  
 (0.000E+0 Ns)

Cumulative L4-L5 Anterior Reaction Shear: 0.000 MNs  
 (0.000E+0 Ns)

Cumulative L4-L5 Posterior Reaction Shear: 0.000 MNs  
 (0.000E+0 Ns)

Cumulative L4-L5 Lateral Reaction Shear:

Cumulative L4-L5 Anterior Joint Shear: 0.000 MNs  
 (0.000E+0 Ns)

Cumulative L4-L5 Posterior Joint Shear: 0.000 MNs  
 (0.000E+0 Ns)

Cumulative Right Shoulder Extensor Moment: 0.000 MNms  
 (0.000E+0 Nms)

Cumulative Right Shoulder Flexor Moment: 0.000 MNs  
 (0.000E+0 Nms)

Cumulative Left Shoulder Extensor Moment: 0.000 MNms  
 (0.000E+0 Nms)

Cumulative Left Shoulder Flexor Moment: 0.000 MNs  
 (0.000E+0 Nms)

Cumulative Right Elbow Extensor Moment: 0.000 MNms  
 (0.000E+0 Nms)

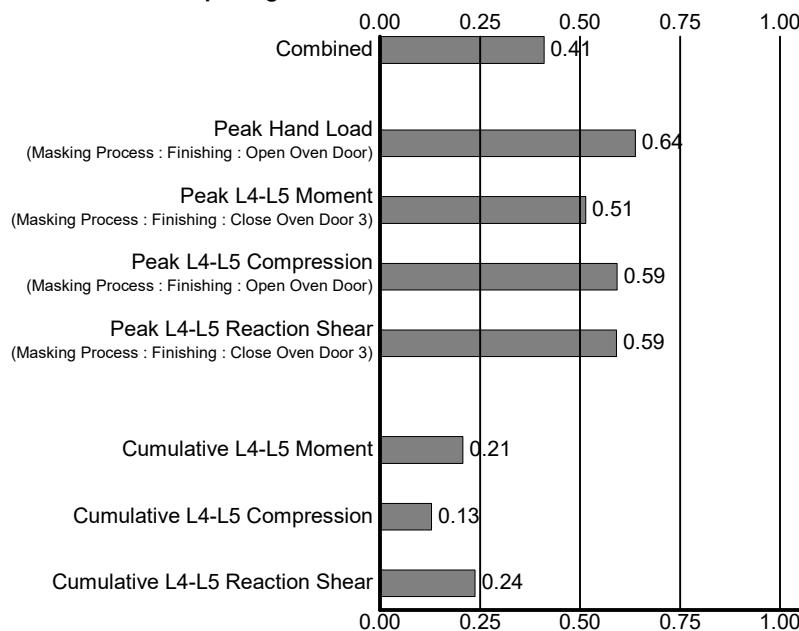
Cumulative Right Elbow Flexor Moment: 0.000 MNs  
 (0.000E+0 Nms)

Cumulative Left Elbow Extensor Moment: 0.000 MNms  
 (0.000E+0 Nms)

Cumulative Left Elbow Flexor Moment: 0.000 MNs  
 (0.000E+0 Nms)

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Male 95%ile	Height: 190 cm	Gender: Male
	Weight: 100 kg	Age: 35

### Low Back Pain Reporting Index



Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Male 95%ile	Height: 190 cm	Gender: Male
	Weight: 100 kg	Age: 35

### Summary of Joint Moments: Shoulder (Nm)

	RIGHT			LEFT		
	RMx	RMy	RMz	RMx	RMy	RMz
(Unaccounted)	0.0	0.0	0.0	0.0	0.0	0.0
Masking Process						
Board from Rack						
Getting Board Low (95%M)	0.0	0.0	3.7 EX	0.0	0.0	3.7 EX
Getting Board Mid (95%M)	0.0	0.0	6.2 EX	0.0	0.0	6.2 EX
Getting Board Mid (5%F)	0.0	0.0	7.3 EX	0.0	0.0	7.3 EX
Getting Board (5%F)	0.0	0.0	5.5 EX	0.0	0.0	5.5 EX
Part from Trolley						
Getting Part (95%M)	0.0	0.0	2.7 FL	0.0	0.0	2.7 FL
Getting Part (5%F)	0.0	0.0	5.7 FL	0.0	0.0	5.7 FL
Finishing						
Pushing Trolley	0.0	0.0	7.8 FL	0.0	0.0	7.8 FL
Open Oven Door	0.0	0.0	24.5 FL	0.0	0.0	24.5 FL
Close Oven Door 3	0.0	0.0	22.2 EX	0.0	0.0	22.2 EX

### Summary of Joint Moments: Elbow (Nm)

	RIGHT			LEFT		
	RMx	RMy	RMz	RMx	RMy	RMz
(Unaccounted)	0.0	0.0	0.0	0.0	0.0	0.0
Masking Process						
Board from Rack						
Getting Board Low (95%M)	0.0	0.0	3.7 EX	0.0	0.0	3.7 EX
Getting Board Mid (95%M)	0.0	0.0	6.2 EX	0.0	0.0	6.2 EX
Getting Board Mid (5%F)	0.0	0.0	7.3 EX	0.0	0.0	7.3 EX
Getting Board (5%F)	0.0	0.0	5.5 EX	0.0	0.0	5.5 EX
Part from Trolley						
Getting Part (95%M)	0.0	0.0	0.3 EX	0.0	0.0	0.3 EX
Getting Part (5%F)	0.0	0.0	0.3 EX	0.0	0.0	0.3 EX
Finishing						
Pushing Trolley	0.0	0.0	3.5 FL	0.0	0.0	3.5 FL
Open Oven Door	0.0	0.0	3.7 FL	0.0	0.0	3.7 FL
Close Oven Door 3	0.0	0.0	11.0 EX	0.0	0.0	11.0 EX

### Summary of Joint Moments: Lumbar (Nm)

	RMx	RMy	RMz
(Unaccounted)	0.0	0.0	15.8 EX
Masking Process			
Board from Rack			
Getting Board Low (95%M)	0.0	0.0	113.1 EX
Getting Board Mid (95%M)	0.0	0.0	21.1 EX
Getting Board Mid (5%F)	0.0	0.0	35.3 FL
Getting Board (5%F)	0.0	0.0	20.2 EX
Part from Trolley			
Getting Part (95%M)	0.0	0.0	17.3 EX
Getting Part (5%F)	0.0	0.0	11.5 EX
Finishing			
Pushing Trolley	0.0	0.0	43.7 EX
Open Oven Door	0.0	0.0	177.9 FL
Close Oven Door 3	0.0	0.0	193.8 EX

### Summary of Joint Moments: Hip (Nm)

	RIGHT			LEFT		
	RMx	RMy	RMz	RMx	RMy	RMz
(Unaccounted)	0.0	0.0	65.2 EX	0.0	0.0	65.2 EX
Masking Process						
Board from Rack						
Getting Board Low (95%M)	0.0	0.0	48.5 EX	0.0	0.0	48.5 EX
Getting Board Mid (95%M)	0.0	0.0	34.6 EX	0.0	0.0	34.6 EX
Getting Board Mid (5%F)	0.0	0.0	100.7 EX	0.0	0.0	43.1 FL
Getting Board (5%F)	0.0	0.0	16.2 EX	0.0	0.0	16.2 EX
Part from Trolley						
Getting Part (95%M)	0.0	0.0	38.5 EX	0.0	0.0	38.5 EX
Getting Part (5%F)	0.0	0.0	51.0 EX	0.0	0.0	51.0 EX

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Male 95%ile	Height: 190 cm	Gender: Male
	Weight: 100 kg	Age: 35

### Summary of Joint Moments: Hip (Nm) cont'd...

	RIGHT			LEFT		
	RMx	RMy	RMz	RMx	RMy	RMz
Finishing						
Pushing Trolley	0.0	0.0	104.5 EX	0.0	0.0	31.1 FL
Open Oven Door	0.0	0.0	217.5 EX	0.0	0.0	343.2 EX
Close Oven Door 3	0.0	0.0	29.9 FL	0.0	0.0	91.2 FL

### Summary of Joint Moments: Knee (Nm)

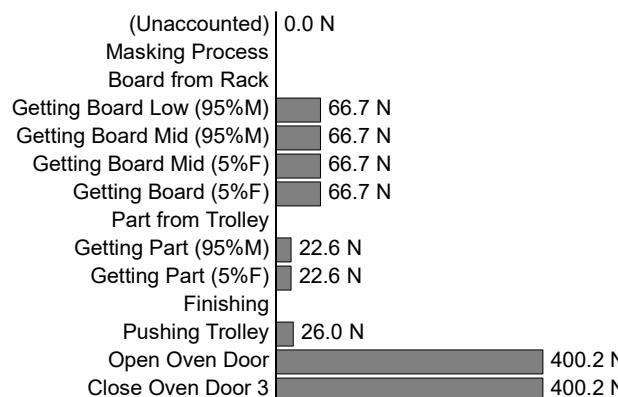
	RIGHT			LEFT		
	RMx	RMy	RMz	RMx	RMy	RMz
(Unaccounted)						
Masking Process	0.0	0.0	65.2 FL	0.0	0.0	65.2 FL
Board from Rack						
Getting Board Low (95%M)	0.0	0.0	59.1 EX	0.0	0.0	59.1 EX
Getting Board Mid (95%M)	0.0	0.0	10.6 EX	0.0	0.0	10.6 EX
Getting Board Mid (5%F)	0.0	0.0	45.3 FL	0.0	0.0	1.8 FL
Getting Board (5%F)	0.0	0.0	30.5 FL	0.0	0.0	30.5 FL
Part from Trolley						
Getting Part (95%M)	0.0	0.0	14.3 FL	0.0	0.0	14.3 FL
Getting Part (5%F)	0.0	0.0	35.8 FL	0.0	0.0	35.8 FL
Finishing						
Pushing Trolley	0.0	0.0	82.3 FL	0.0	0.0	13.4 FL
Open Oven Door	0.0	0.0	104.9 FL	0.0	0.0	196.5 FL
Close Oven Door 3	0.0	0.0	54.7 EX	0.0	0.0	38.9 EX

### Summary of Joint Moments: Ankle (Nm)

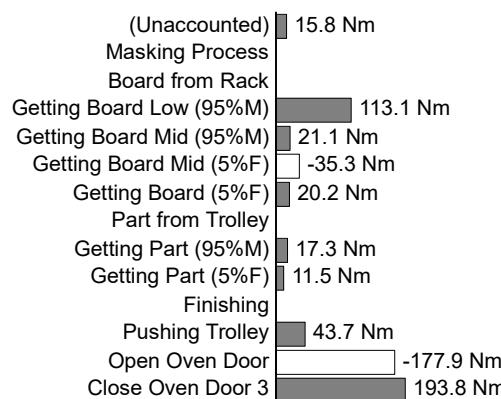
	RIGHT			LEFT		
	RMx	RMy	RMz	RMx	RMy	RMz
(Unaccounted)						
Masking Process	0.0	0.0	65.2 EX	0.0	0.0	65.2 EX
Board from Rack						
Getting Board Low (95%M)	0.0	0.0	60.7 EX	0.0	0.0	60.7 EX
Getting Board Mid (95%M)	0.0	0.0	60.7 EX	0.0	0.0	60.7 EX
Getting Board Mid (5%F)	0.0	0.0	57.9 EX	0.0	0.0	63.4 EX
Getting Board (5%F)	0.0	0.0	37.2 EX	0.0	0.0	37.2 EX
Part from Trolley						
Getting Part (95%M)	0.0	0.0	62.7 EX	0.0	0.0	62.7 EX
Getting Part (5%F)	0.0	0.0	63.6 EX	0.0	0.0	63.6 EX
Finishing						
Pushing Trolley	0.0	0.0	54.8 EX	0.0	0.0	74.2 EX
Open Oven Door	0.0	0.0	94.2 EX	0.0	0.0	81.4 EX
Close Oven Door 3	0.0	0.0	65.8 EX	0.0	0.0	15.6 EX

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Male 95%ile	Height: 190 cm	Gender: Male
	Weight: 100 kg	Age: 35

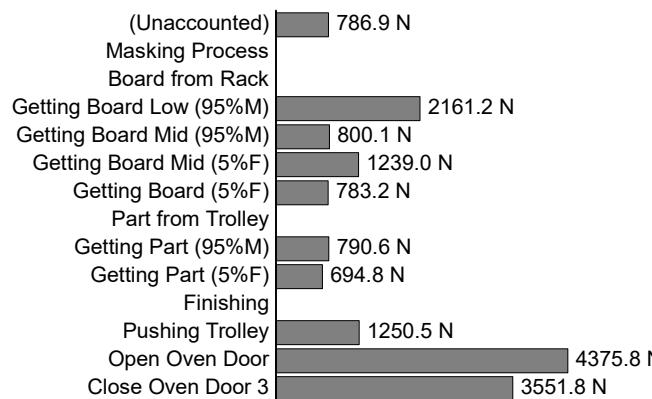
### Job Summary - Hand Load Profile



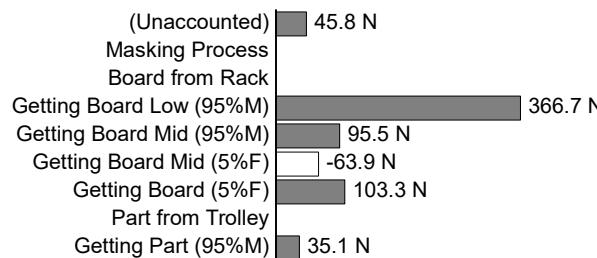
### Job Summary - L4-L5 Flexor/Extensor Moment Profile



### Job Summary - L4-L5 Total Compression Profile

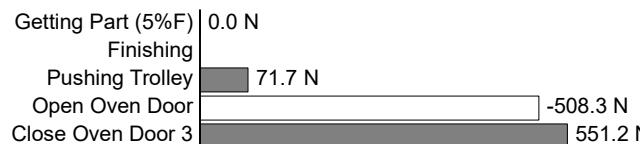


### Job Summary - L4-L5 Anterior/Posterior Reaction Shear Profile

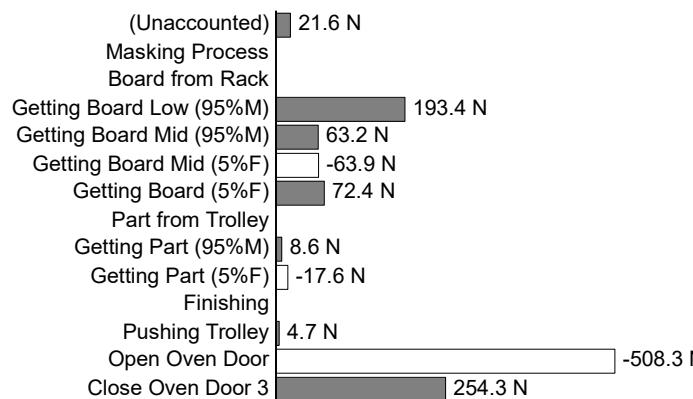


Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Male 95%ile	Height: 190 cm	Gender: Male
	Weight: 100 kg	Age: 35

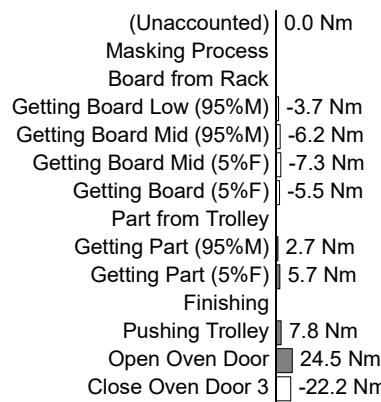
#### Job Summary - L4-L5 Anterior/Posterior Reaction Shear Profile cont'd...



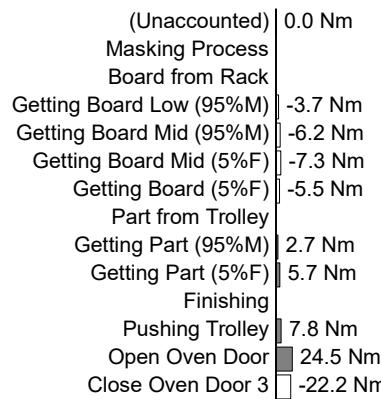
#### Job Summary - L4-L5 Anterior/Posterior Joint Shear Profile



#### Job Summary - Right Shoulder Flexor/Extensor Moment Profile



#### Job Summary - Left Shoulder Flexor/Extensor Moment Profile



Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Male 95%ile	Height: 190 cm	Gender: Male
	Weight: 100 kg	Age: 35

#### Job Summary - Cumulative L4-L5 Flexor/Extensor Moment Profile

(Unaccounted)	0.000 MNms (0.000E0 Nms)
Masking Process	
Board from Rack	
Getting Board Low (95%M)	0.000 MNms (0.000E0 Nms)
Getting Board Mid (95%M)	0.000 MNms (0.000E0 Nms)
Getting Board Mid (5%F)	0.000 MNms (0.000E0 Nms)
Getting Board (5%F)	0.000 MNms (0.000E0 Nms)
Part from Trolley	
Getting Part (95%M)	0.000 MNms (0.000E0 Nms)
Getting Part (5%F)	0.000 MNms (0.000E0 Nms)
Finishing	
Pushing Trolley	0.000 MNms (0.000E0 Nms)
Open Oven Door	0.000 MNms (0.000E0 Nms)
Close Oven Door 3	0.000 MNms (0.000E0 Nms)

#### Job Summary - Cumulative L4-L5 Total Compression Profile

(Unaccounted)	0.000 MNs (0.000E0 Ns)
Masking Process	
Board from Rack	
Getting Board Low (95%M)	0.000 MNs (0.000E0 Ns)
Getting Board Mid (95%M)	0.000 MNs (0.000E0 Ns)
Getting Board Mid (5%F)	0.000 MNs (0.000E0 Ns)
Getting Board (5%F)	0.000 MNs (0.000E0 Ns)
Part from Trolley	
Getting Part (95%M)	0.000 MNs (0.000E0 Ns)
Getting Part (5%F)	0.000 MNs (0.000E0 Ns)
Finishing	
Pushing Trolley	0.000 MNs (0.000E0 Ns)
Open Oven Door	0.000 MNs (0.000E0 Ns)
Close Oven Door 3	0.000 MNs (0.000E0 Ns)

#### Job Summary - Cumulative L4-L5 Anterior/Posterior Reaction Shear Profile

(Unaccounted)	0.000 MNs (0.000E0 Ns)
Masking Process	
Board from Rack	
Getting Board Low (95%M)	0.000 MNs (0.000E0 Ns)
Getting Board Mid (95%M)	0.000 MNs (0.000E0 Ns)
Getting Board Mid (5%F)	0.000 MNs (0.000E0 Ns)
Getting Board (5%F)	0.000 MNs (0.000E0 Ns)
Part from Trolley	
Getting Part (95%M)	0.000 MNs (0.000E0 Ns)
Getting Part (5%F)	0.000 MNs (0.000E0 Ns)
Finishing	
Pushing Trolley	0.000 MNs (0.000E0 Ns)
Open Oven Door	0.000 MNs (0.000E0 Ns)
Close Oven Door 3	0.000 MNs (0.000E0 Ns)

#### Job Summary - Cumulative L4-L5 Anterior/Posterior Joint Shear Profile

(Unaccounted)	0.000 MNs (0.000E0 Ns)
Masking Process	
Board from Rack	
Getting Board Low (95%M)	0.000 MNs (0.000E0 Ns)
Getting Board Mid (95%M)	0.000 MNs (0.000E0 Ns)
Getting Board Mid (5%F)	0.000 MNs (0.000E0 Ns)
Getting Board (5%F)	0.000 MNs (0.000E0 Ns)
Part from Trolley	
Getting Part (95%M)	0.000 MNs (0.000E0 Ns)

Site: Job Name: Analyst: Anthropometrics: Male 95%ile	Department: Workstation ID: Date: 14 Mar, 2021 Height: 190 cm	Job Classification: Shift: Worker ID: Gender: Male Age: 35
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#### Job Summary - Cumulative L4-L5 Anterior/Posterior Joint Shear Profile cont'd...

Getting Part (5%F) Finishing	0.000 MNs (0.000E0 Ns)
Pushing Trolley	0.000 MNs (0.000E0 Ns)
Open Oven Door	0.000 MNs (0.000E0 Ns)
Close Oven Door 3	0.000 MNs (0.000E0 Ns)

#### Job Summary - Cumulative Right Shoulder Flexor/Extensor Moment Profile

(Unaccounted)	0.000 MNms (0.000E0 Nms)
Masking Process	
Board from Rack	
Getting Board Low (95%M)	0.000 MNms (0.000E0 Nms)
Getting Board Mid (95%M)	0.000 MNms (0.000E0 Nms)
Getting Board Mid (5%F)	0.000 MNms (0.000E0 Nms)
Getting Board (5%F)	0.000 MNms (0.000E0 Nms)
Part from Trolley	
Getting Part (95%M)	0.000 MNms (0.000E0 Nms)
Getting Part (5%F)	0.000 MNms (0.000E0 Nms)
Finishing	
Pushing Trolley	0.000 MNms (0.000E0 Nms)
Open Oven Door	0.000 MNms (0.000E0 Nms)
Close Oven Door 3	0.000 MNms (0.000E0 Nms)

#### Job Summary - Cumulative Left Shoulder Flexor/Extensor Moment Profile

(Unaccounted)	0.000 MNms (0.000E0 Nms)
Masking Process	
Board from Rack	
Getting Board Low (95%M)	0.000 MNms (0.000E0 Nms)
Getting Board Mid (95%M)	0.000 MNms (0.000E0 Nms)
Getting Board Mid (5%F)	0.000 MNms (0.000E0 Nms)
Getting Board (5%F)	0.000 MNms (0.000E0 Nms)
Part from Trolley	
Getting Part (95%M)	0.000 MNms (0.000E0 Nms)
Getting Part (5%F)	0.000 MNms (0.000E0 Nms)
Finishing	
Pushing Trolley	0.000 MNms (0.000E0 Nms)
Open Oven Door	0.000 MNms (0.000E0 Nms)
Close Oven Door 3	0.000 MNms (0.000E0 Nms)

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Male 95%ile	Height: 190 cm	Gender: Male
	Weight: 100 kg	Age: 35

## 2D Action Summary (Masking Process : Board from Rack : Getting Board Low (95%M))

Trunk Angle: 53.0°

### Left Hand

Force: 33.4 N  
Angle in xy-plane: 90°

### Right Hand

Force: 33.4 N  
Angle in xy-plane: 90°

R.D. Forward: 53.6 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 48.4 cm

R.D. Forward: 53.6 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 48.4 cm

### L4-L5 Moment

Extensor: 113.1 Nm

### L4-L5 Compression

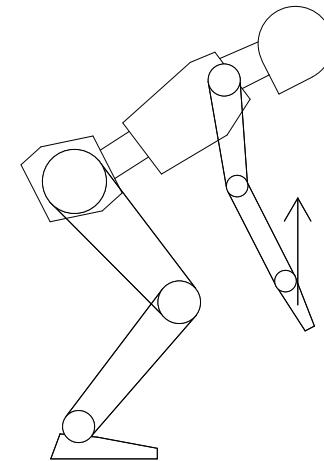
Total: 2161 N

### Reaction Shear

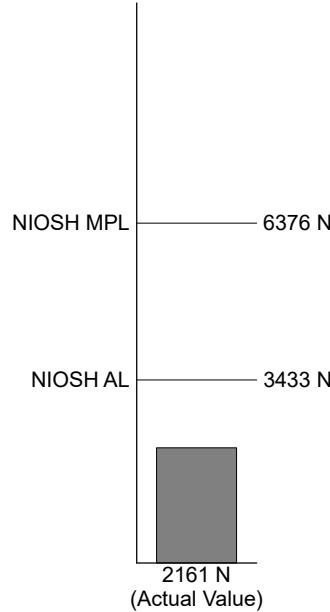
Anterior: 367 N

### Joint Shear

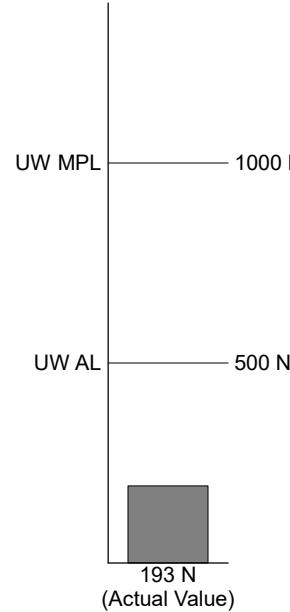
Anterior: 193 N



### Spine Compression Limits



### Spine Joint Shear Limits



Site: Job Name: Analyst: Anthropometrics: Male 95%ile	Department: Workstation ID: Date: 14 Mar, 2021 Height: 190 cm	Job Classification: Shift: Worker ID: Gender: Male
		Age: 35

### Joint Moment Strength Data

% of Population Not Capable			Calculated Moment (Nm)
R Elbow	Flexor/Extensor Supinator/Pronator	0.1	3.7 EX 0.0
L Elbow	Flexor/Extensor Supinator/Pronator	0.1	3.7 EX 0.0
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor		3.7 EX 0.0 0.0
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor		3.7 EX 0.0 0.0
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	0.1	113.1 EX 0.0 0.0
			25%

### Male Strength Data

		Mean Population Moment (Nm)	S.D. (Nm)	Angle (°)	Reference
R Elbow	Flexor/Extensor Supinator/Pronator	41 DNA	11	90	Askew et al. (1987)
L Elbow	Flexor/Extensor Supinator/Pronator	41 DNA	11	90	Askew et al. (1987)
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	DNA DNA DNA			
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	DNA DNA DNA			
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	480 DNA DNA	93	0	Troup & Chapman (1969)

(DNA = Data Not Available)

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Male 95%ile	Height: 190 cm	Gender: Male
	Weight: 100 kg	Age: 35

## 2D Action Details (Masking Process : Board from Rack : Getting Board Low (95%M))

**Table of Segment Positions**

SEGMENT	ABS ANGLE* (°) xy plane    yz plane	CGx (m)	CGy (m)	CGz (m)	LENGTH (m)
Right Foot	-40.0	0.088	0.057	0.000	0.176
Right Leg	-129.0	0.181	0.311	0.000	0.449
Right Thigh	-49.0	0.131	0.660	0.000	0.462
Left Foot	-40.0	0.088	0.057	0.000	0.176
Left Leg	-129.0	0.181	0.311	0.000	0.449
Left Thigh	-49.0	0.131	0.660	0.000	0.462
Right Hand	-63.0	0.590	0.520	0.000	0.082
Right Forearm	-63.0	0.502	0.694	0.000	0.270
Right Arm	-83.0	0.428	0.970	0.000	0.308
Left Hand	-63.0	0.590	0.520	0.000	0.082
Left Forearm	-63.0	0.502	0.694	0.000	0.270
Left Arm	-83.0	0.428	0.970	0.000	0.308
Head	27.0	0.602	1.211	0.000	0.166
Pelvis	27.0	0.026	0.824	0.000	0.082
Torso	37.0	0.264	0.992	0.000	0.478

\* NOTE: THE ABS ANGLES ARE ALL ABSOLUTE VALUES WITH 0° BEING HORIZONTAL TO THE RIGHT.

**Table of Reaction Forces and Moments acting on each Segment**

SEGMENT	REACTION FORCES						WEIGHT (N)	MOMENTS						
	Proximal End			Distal End				Proximal End			Distal End			
	RFx (N)	RFy (N)	RFz (N)	RFx (N)	RFy (N)	RFz (N)		RMx (Nm)	RMy (Nm)	RMz (Nm)	RMx (Nm)	RMy (Nm)	RMz (Nm)	
Right Foot	0.0	-443.4	0.0	0.0	0.0	0.0	13.7	0.0	0.0	-60.7	0.0	0.0	0.0	
Right Leg	0.0	-397.3	0.0	0.0	443.4	0.0	46.1	0.0	0.0	59.1	0.0	0.0	60.7	
Right Thigh	0.0	-299.2	0.0	0.0	397.3	0.0	98.1	0.0	0.0	-48.5	0.0	0.0	-59.1	
Left Foot	0.0	-443.4	0.0	0.0	0.0	0.0	13.7	0.0	0.0	-60.7	0.0	0.0	0.0	
Left Leg	0.0	-397.3	0.0	0.0	443.4	0.0	46.1	0.0	0.0	59.1	0.0	0.0	60.7	
Left Thigh	0.0	-299.2	0.0	0.0	397.3	0.0	98.1	0.0	0.0	-48.5	0.0	0.0	-59.1	
Right Hand	0.0	-27.5	0.0	0.0	0.0	0.0	5.9	0.0	0.0	-1.1	0.0	0.0	0.0	
Right Forearm	0.0	-11.8	0.0	0.0	27.5	0.0	15.7	0.0	0.0	-3.7	0.0	0.0	1.1	
Right Arm	0.0	15.7	0.0	0.0	11.8	0.0	27.5	0.0	0.0	-3.7	0.0	0.0	3.7	
Left Hand	0.0	-27.5	0.0	0.0	0.0	0.0	5.9	0.0	0.0	-1.1	0.0	0.0	0.0	
Left Forearm	0.0	-11.8	0.0	0.0	27.5	0.0	15.7	0.0	0.0	-3.7	0.0	0.0	1.1	
Left Arm	0.0	15.7	0.0	0.0	11.8	0.0	27.5	0.0	0.0	-3.7	0.0	0.0	3.7	
Head	0.0	79.5	0.0	0.0	0.0	0.0	79.5	0.0	0.0	11.7	0.0	0.0	0.0	
Pelvis	0.0	598.4	0.0	0.0	-459.1	0.0	139.3	0.0	0.0	150.4	0.0	0.0	-113.1	
Torso	0.0	459.1	0.0	0.0	-110.9	0.0	348.3	0.0	0.0	113.1	0.0	0.0	-4.4	

**Table of Joint Coordinates**

MARKER	X	Y	Z
Right Foot	0.155	0.000	0.000
Right Ankle	0.020	0.113	0.000
Right Knee	0.303	0.462	0.000
Right Hip	0.000	0.811	0.000
Right Hand	0.609	0.484	0.000
Right Wrist	0.571	0.557	0.000
Right Elbow	0.449	0.797	0.000
Right Shoulder	0.412	1.103	0.000
Left Foot	0.155	0.000	0.000
Left Ankle	0.020	0.113	0.000
Left Knee	0.303	0.462	0.000
Left Hip	0.000	0.811	0.000
Left Hand	0.609	0.484	0.000
Left Wrist	0.571	0.557	0.000
Left Elbow	0.449	0.797	0.000
Left Shoulder	0.412	1.103	0.000
L4-L5	0.073	0.848	0.000
Head	0.602	1.211	0.000
C7	0.455	1.136	0.000

Site: Job Name: Analyst: Anthropometrics: Male 95%ile	Department: Workstation ID: Date: 14 Mar, 2021 Height: 190 cm	Job Classification: Shift: Worker ID: Gender: Male Age: 35
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## 2D Action Summary (Masking Process : Board from Rack : Getting Board Mid (95%M))

Trunk Angle: 12.0°

### Left Hand

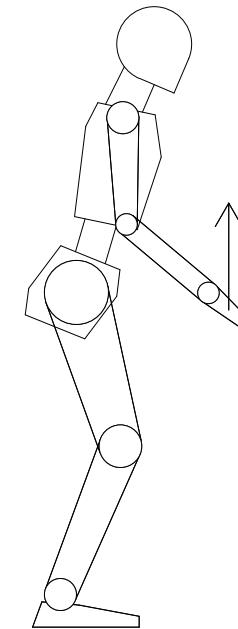
Force: 33.4 N  
Angle in xy-plane: 90°

### Right Hand

Force: 33.4 N  
Angle in xy-plane: 90°

R.D. Forward: 36.8 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 93.0 cm

R.D. Forward: 36.8 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 93.0 cm



### L4-L5 Moment

Extensor: 21.1 Nm

### L4-L5 Compression

Total: 800 N

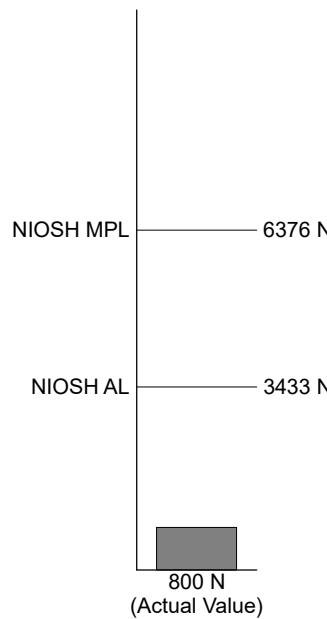
### Reaction Shear

Anterior: 95 N

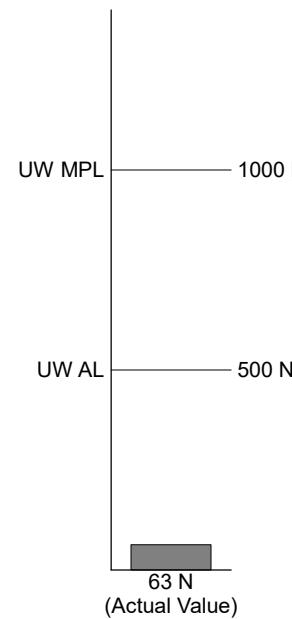
### Joint Shear

Anterior: 63 N

### Spine Compression Limits



### Spine Joint Shear Limits



Site: Job Name: Analyst: Anthropometrics: Male 95%ile	Department: Workstation ID: Date: 14 Mar, 2021 Height: 190 cm	Job Classification: Shift: Worker ID: Gender: Male
		Age: 35

### Joint Moment Strength Data

% of Population Not Capable			Calculated Moment (Nm)
R Elbow	Flexor/Extensor Supinator/Pronator	0.1	6.2 EX 0.0
L Elbow	Flexor/Extensor Supinator/Pronator	0.1	6.2 EX 0.0
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor		6.2 EX 0.0 0.0
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor		6.2 EX 0.0 0.0
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	0.1	21.1 EX 0.0 0.0
			25%

### Male Strength Data

		Mean Population Moment (Nm)	S.D. (Nm)	Angle (°)	Reference
R Elbow	Flexor/Extensor Supinator/Pronator	41 DNA	11	90	Askew et al. (1987)
L Elbow	Flexor/Extensor Supinator/Pronator	41 DNA	11	90	Askew et al. (1987)
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	DNA DNA DNA			
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	DNA DNA DNA			
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	480 DNA DNA	93	0	Troup & Chapman (1969)

(DNA = Data Not Available)

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Male 95%ile	Height: 190 cm	Gender: Male
	Weight: 100 kg	Age: 35

## 2D Action Details (Masking Process : Board from Rack : Getting Board Mid (95%M))

**Table of Segment Positions**

SEGMENT	ABS ANGLE* (°) xy plane    yz plane	CGx (m)	CGy (m)	CGz (m)	LENGTH (m)
Right Foot	-40.0	0.026	0.057	0.000	0.176
Right Leg	-112.0	0.055	0.349	0.000	0.449
Right Thigh	-74.0	0.055	0.782	0.000	0.462
Left Foot	-40.0	0.026	0.057	0.000	0.176
Left Leg	-112.0	0.055	0.349	0.000	0.449
Left Thigh	-74.0	0.055	0.782	0.000	0.462
Right Hand	-40.0	0.368	0.957	0.000	0.082
Right Forearm	-40.0	0.218	1.082	0.000	0.270
Right Arm	-88.0	0.124	1.330	0.000	0.308
Left Hand	-40.0	0.368	0.957	0.000	0.082
Left Forearm	-40.0	0.218	1.082	0.000	0.270
Left Arm	-88.0	0.124	1.330	0.000	0.308
Head	67.0	0.195	1.670	0.000	0.166
Pelvis	68.0	0.011	1.001	0.000	0.082
Torso	78.0	0.080	1.284	0.000	0.478

\* NOTE: THE ABS ANGLES ARE ALL ABSOLUTE VALUES WITH 0° BEING HORIZONTAL TO THE RIGHT.

**Table of Reaction Forces and Moments acting on each Segment**

SEGMENT	REACTION FORCES						WEIGHT (N)	MOMENTS						
	Proximal End			Distal End				Proximal End			Distal End			
	RFx (N)	RFy (N)	RFz (N)	RFx (N)	RFy (N)	RFz (N)		RMx (Nm)	RMy (Nm)	RMz (Nm)	RMx (Nm)	RMy (Nm)	RMz (Nm)	
Right Foot	0.0	-443.4	0.0	0.0	0.0	0.0	13.7	0.0	0.0	-60.7	0.0	0.0	0.0	
Right Leg	0.0	-397.3	0.0	0.0	443.4	0.0	46.1	0.0	0.0	10.6	0.0	0.0	60.7	
Right Thigh	0.0	-299.2	0.0	0.0	397.3	0.0	98.1	0.0	0.0	-34.6	0.0	0.0	-10.6	
Left Foot	0.0	-443.4	0.0	0.0	0.0	0.0	13.7	0.0	0.0	-60.7	0.0	0.0	0.0	
Left Leg	0.0	-397.3	0.0	0.0	443.4	0.0	46.1	0.0	0.0	10.6	0.0	0.0	60.7	
Left Thigh	0.0	-299.2	0.0	0.0	397.3	0.0	98.1	0.0	0.0	-34.6	0.0	0.0	-10.6	
Right Hand	0.0	-27.5	0.0	0.0	0.0	0.0	5.9	0.0	0.0	-1.9	0.0	0.0	0.0	
Right Forearm	0.0	-11.8	0.0	0.0	27.5	0.0	15.7	0.0	0.0	-6.2	0.0	0.0	1.9	
Right Arm	0.0	15.7	0.0	0.0	11.8	0.0	27.5	0.0	0.0	-6.2	0.0	0.0	6.2	
Left Hand	0.0	-27.5	0.0	0.0	0.0	0.0	5.9	0.0	0.0	-1.9	0.0	0.0	0.0	
Left Forearm	0.0	-11.8	0.0	0.0	27.5	0.0	15.7	0.0	0.0	-6.2	0.0	0.0	1.9	
Left Arm	0.0	15.7	0.0	0.0	11.8	0.0	27.5	0.0	0.0	-6.2	0.0	0.0	6.2	
Head	0.0	79.5	0.0	0.0	0.0	0.0	79.5	0.0	0.0	5.1	0.0	0.0	0.0	
Pelvis	0.0	598.4	0.0	0.0	-459.1	0.0	139.3	0.0	0.0	36.7	0.0	0.0	-21.1	
Torso	0.0	459.1	0.0	0.0	-110.9	0.0	348.3	0.0	0.0	21.1	0.0	0.0	7.2	

**Table of Joint Coordinates**

MARKER	X	Y	Z
Right Foot	0.094	0.000	0.000
Right Ankle	-0.041	0.113	0.000
Right Knee	0.127	0.530	0.000
Right Hip	0.000	0.974	0.000
Right Hand	0.399	0.930	0.000
Right Wrist	0.336	0.983	0.000
Right Elbow	0.130	1.157	0.000
Right Shoulder	0.119	1.464	0.000
Left Foot	0.094	0.000	0.000
Left Ankle	-0.041	0.113	0.000
Left Knee	0.127	0.530	0.000
Left Hip	0.000	0.974	0.000
Left Hand	0.399	0.930	0.000
Left Wrist	0.336	0.983	0.000
Left Elbow	0.130	1.157	0.000
Left Shoulder	0.119	1.464	0.000
L4-L5	0.031	1.050	0.000
Head	0.195	1.670	0.000
C7	0.130	1.517	0.000

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Male 95%ile	Height: 190 cm	Gender: Male
	Weight: 100 kg	Age: 35

## 2D Action Summary (Masking Process : Board from Rack : Getting Board Mid (5%F))

Trunk Angle: -8.0°

### Left Hand

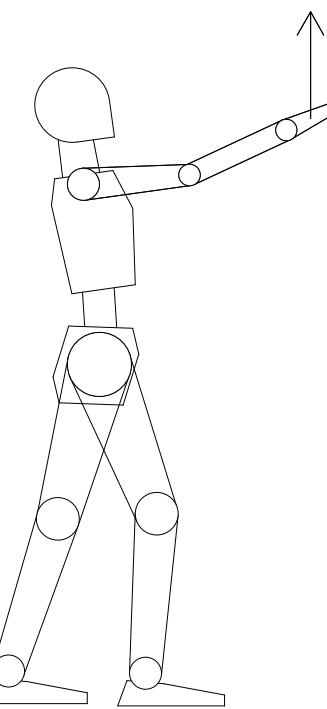
Force: 33.4 N  
Angle in xy-plane: 90°

### Right Hand

Force: 33.4 N  
Angle in xy-plane: 90°

R.D. Forward: 56.7 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 167.0 cm

R.D. Forward: 56.7 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 167.0 cm



### L4-L5 Moment

Flexor: -35.3 Nm

### L4-L5 Compression

Total: 1239 N

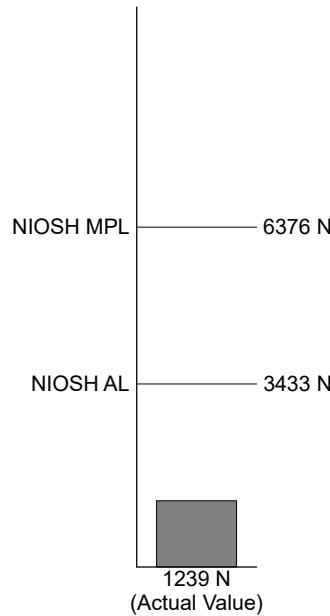
### Reaction Shear

Posterior: -64 N

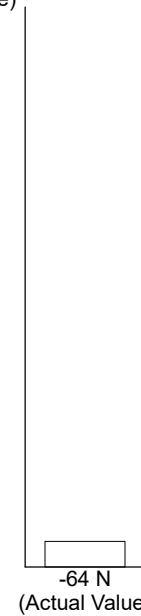
### Joint Shear

Posterior: -64 N

### Spine Compression Limits



### Spine Joint Shear Limit (none available)



Site: Job Name: Analyst: Anthropometrics: Male 95%ile	Department: Workstation ID: Date: 14 Mar, 2021 Height: 190 cm	Job Classification: Shift: Worker ID: Gender: Male
		Age: 35

### Joint Moment Strength Data

% of Population Not Capable			Calculated Moment (Nm)
R Elbow	Flexor/Extensor Supinator/Pronator	0.1	7.3 EX 0.0
L Elbow	Flexor/Extensor Supinator/Pronator	0.1	7.3 EX 0.0
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor		7.3 EX 0.0 0.0
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor		7.3 EX 0.0 0.0
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	0.1	35.3 FL 0.0 0.0
			25%

### Male Strength Data

		Mean Population Moment (Nm)	S.D. (Nm)	Angle (°)	Reference
R Elbow	Flexor/Extensor Supinator/Pronator	41 DNA	11	90	Askew et al. (1987)
L Elbow	Flexor/Extensor Supinator/Pronator	41 DNA	11	90	Askew et al. (1987)
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	DNA DNA DNA			
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	DNA DNA DNA			
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	369 DNA DNA	69	0	Troup & Chapman (1969)

(DNA = Data Not Available)

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Male 95%ile	Height: 190 cm	Gender: Male
	Weight: 100 kg	Age: 35

## 2D Action Details (Masking Process : Board from Rack : Getting Board Mid (5%F))

Table of Segment Positions

SEGMENT	ABS ANGLE* (°) xy plane    yz plane	CGx (m)	CGy (m)	CGz (m)	LENGTH (m)
Right Foot	-40.0	0.202	0.057	0.000	0.176
Right Leg	-94.0	0.152	0.367	0.000	0.449
Right Thigh	-69.0	0.072	0.806	0.000	0.462
Left Foot	-40.0	-0.191	0.062	0.000	0.176
Left Leg	-108.0	-0.180	0.361	0.000	0.449
Left Thigh	-105.0	-0.052	0.799	0.000	0.462
Right Hand	25.0	0.533	1.653	0.000	0.082
Right Forearm	25.0	0.356	1.570	0.000	0.270
Right Arm	5.0	0.078	1.506	0.000	0.308
Left Hand	25.0	0.533	1.653	0.000	0.082
Left Forearm	25.0	0.356	1.570	0.000	0.270
Left Arm	5.0	0.078	1.506	0.000	0.308
Head	98.0	-0.087	1.712	0.000	0.166
Pelvis	88.0	0.001	1.022	0.000	0.082
Torso	98.0	-0.030	1.311	0.000	0.478

\* NOTE: THE ABS ANGLES ARE ALL ABSOLUTE VALUES WITH 0° BEING HORIZONTAL TO THE RIGHT.

Table of Reaction Forces and Moments acting on each Segment

SEGMENT	REACTION FORCES						WEIGHT (N)	MOMENTS						
	Proximal End			Distal End				Proximal End			Distal End			
	RFx (N)	RFy (N)	RFz (N)	RFx (N)	RFy (N)	RFz (N)		RMx (Nm)	RMy (Nm)	RMz (Nm)	RMx (Nm)	RMy (Nm)	RMz (Nm)	
Right Foot	0.0	-423.0	0.0	0.0	0.0	0.0	13.7	0.0	0.0	-57.9	0.0	0.0	0.0	
Right Leg	0.0	-376.9	0.0	0.0	423.0	0.0	46.1	0.0	0.0	-45.3	0.0	0.0	57.9	
Right Thigh	0.0	-278.8	0.0	0.0	376.9	0.0	98.1	0.0	0.0	-100.7	0.0	0.0	45.3	
Left Foot	0.0	-463.8	0.0	0.0	0.0	0.0	13.7	0.0	0.0	-63.4	0.0	0.0	0.0	
Left Leg	0.0	-417.7	0.0	0.0	463.8	0.0	46.1	0.0	0.0	-1.8	0.0	0.0	63.4	
Left Thigh	0.0	-319.6	0.0	0.0	417.7	0.0	98.1	0.0	0.0	43.1	0.0	0.0	1.8	
Right Hand	0.0	-27.5	0.0	0.0	0.0	0.0	5.9	0.0	0.0	-2.3	0.0	0.0	0.0	
Right Forearm	0.0	-11.8	0.0	0.0	27.5	0.0	15.7	0.0	0.0	-7.3	0.0	0.0	2.3	
Right Arm	0.0	15.7	0.0	0.0	11.8	0.0	27.5	0.0	0.0	-7.3	0.0	0.0	7.3	
Left Hand	0.0	-27.5	0.0	0.0	0.0	0.0	5.9	0.0	0.0	-2.3	0.0	0.0	0.0	
Left Forearm	0.0	-11.8	0.0	0.0	27.5	0.0	15.7	0.0	0.0	-7.3	0.0	0.0	2.3	
Left Arm	0.0	15.7	0.0	0.0	11.8	0.0	27.5	0.0	0.0	-7.3	0.0	0.0	7.3	
Head	0.0	79.5	0.0	0.0	0.0	0.0	79.5	0.0	0.0	-1.8	0.0	0.0	0.0	
Pelvis	0.0	598.4	0.0	0.0	-459.1	0.0	139.3	0.0	0.0	-33.8	0.0	0.0	35.3	
Torso	0.0	459.1	0.0	0.0	-110.9	0.0	348.3	0.0	0.0	-35.3	0.0	0.0	16.4	

Table of Joint Coordinates

MARKER	X	Y	Z
Right Foot	0.269	0.000	0.000
Right Ankle	0.134	0.113	0.000
Right Knee	0.166	0.561	0.000
Right Hip	0.000	0.993	0.000
Right Hand	0.570	1.670	0.000
Right Wrist	0.495	1.635	0.000
Right Elbow	0.251	1.521	0.000
Right Shoulder	-0.056	1.494	0.000
Left Foot	-0.124	0.006	0.000
Left Ankle	-0.258	0.119	0.000
Left Knee	-0.120	0.546	0.000
Left Hip	0.000	0.993	0.000
Left Hand	0.570	1.670	0.000
Left Wrist	0.495	1.635	0.000
Left Elbow	0.251	1.521	0.000
Left Shoulder	-0.056	1.494	0.000
L4-L5	0.003	1.075	0.000
Head	-0.087	1.712	0.000
C7	-0.064	1.548	0.000

Site: Job Name: Analyst: Anthropometrics: Male 95%ile	Department: Workstation ID: Date: 14 Mar, 2021 Height: 190 cm	Job Classification: Shift: Worker ID: Gender: Male Age: 35
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## 2D Action Summary (Masking Process : Board from Rack : Getting Board (5%F))

Trunk Angle: 13.0°

### Left Hand

Force: 33.4 N  
Angle in xy-plane: 90°

### Right Hand

Force: 33.4 N  
Angle in xy-plane: 90°

R.D. Forward: 57.8 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 200.0 cm

R.D. Forward: 57.8 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 200.0 cm

### L4-L5 Moment

Extensor: 20.2 Nm

### L4-L5 Compression

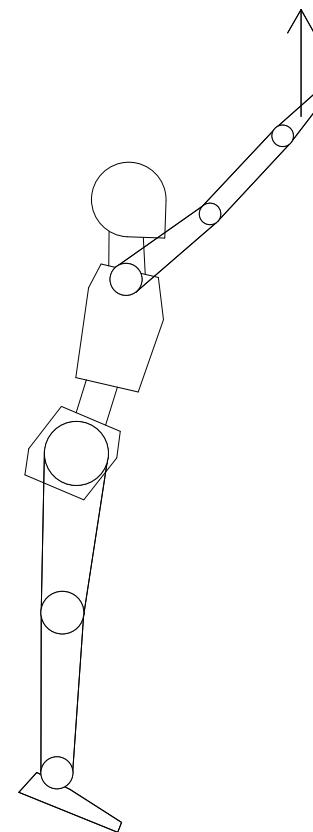
Total: 783 N

### Reaction Shear

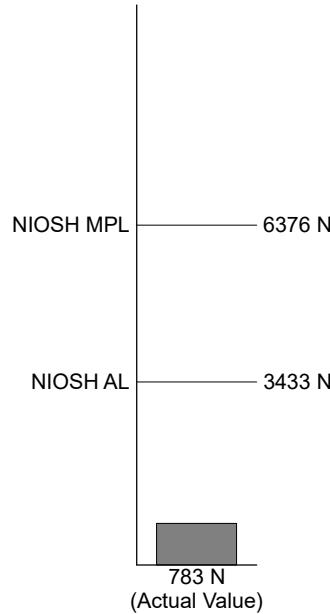
Anterior: 103 N

### Joint Shear

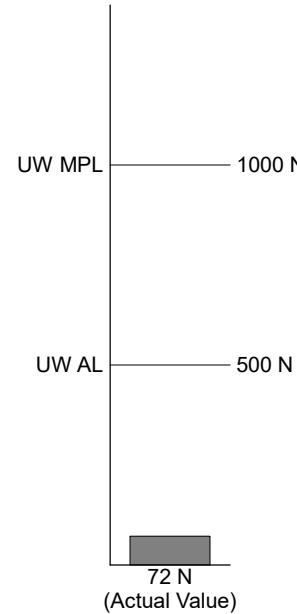
Anterior: 72 N



### Spine Compression Limits



### Spine Joint Shear Limits



Site: Job Name: Analyst: Anthropometrics: Male 95%ile	Department: Workstation ID: Date: 14 Mar, 2021 Height: 190 cm	Job Classification: Shift: Worker ID: Gender: Male
		Age: 35

### Joint Moment Strength Data

% of Population Not Capable			Calculated Moment (Nm)
R Elbow	Flexor/Extensor Supinator/Pronator	0.1	5.5 EX 0.0
L Elbow	Flexor/Extensor Supinator/Pronator	0.1	5.5 EX 0.0
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor		5.5 EX 0.0 0.0
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor		5.5 EX 0.0 0.0
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	0.1	20.2 EX 0.0 0.0
			25%

### Male Strength Data

		Mean Population Moment (Nm)	S.D. (Nm)	Angle (°)	Reference
R Elbow	Flexor/Extensor Supinator/Pronator	41 DNA	11	90	Askew et al. (1987)
L Elbow	Flexor/Extensor Supinator/Pronator	41 DNA	11	90	Askew et al. (1987)
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	DNA DNA DNA			
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	DNA DNA DNA			
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	480 DNA DNA	93	0	Troup & Chapman (1969)

(DNA = Data Not Available)

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Male 95%ile	Height: 190 cm	Gender: Male
	Weight: 100 kg	Age: 35

## 2D Action Details (Masking Process : Board from Rack : Getting Board (5%F))

Table of Segment Positions

SEGMENT	ABS ANGLE* (°) xy plane    yz plane	CGx (m)	CGy (m)	CGz (m)	LENGTH (m)
Right Foot	-62.0	-0.015	0.078	0.000	0.176
Right Leg	-92.0	-0.047	0.410	0.000	0.449
Right Thigh	-95.0	-0.017	0.865	0.000	0.462
Left Foot	-62.0	-0.015	0.078	0.000	0.176
Left Leg	-92.0	-0.047	0.410	0.000	0.449
Left Thigh	-95.0	-0.017	0.865	0.000	0.462
Right Hand	47.0	0.582	1.970	0.000	0.082
Right Forearm	47.0	0.449	1.828	0.000	0.270
Right Arm	38.0	0.233	1.636	0.000	0.308
Left Hand	47.0	0.582	1.970	0.000	0.082
Left Forearm	47.0	0.449	1.828	0.000	0.270
Left Arm	38.0	0.233	1.636	0.000	0.308
Head	88.0	0.145	1.771	0.000	0.166
Pelvis	67.0	0.012	1.092	0.000	0.082
Torso	77.0	0.086	1.373	0.000	0.478

\* NOTE: THE ABS ANGLES ARE ALL ABSOLUTE VALUES WITH 0° BEING HORIZONTAL TO THE RIGHT.

Table of Reaction Forces and Moments acting on each Segment

SEGMENT	REACTION FORCES						WEIGHT (N)	MOMENTS						
	Proximal End			Distal End				Proximal End			Distal End			
	RFx (N)	RFy (N)	RFz (N)	RFx (N)	RFy (N)	RFz (N)		RMx (Nm)	RMy (Nm)	RMz (Nm)	RMx (Nm)	RMy (Nm)	RMz (Nm)	
Right Foot	0.0	-443.4	0.0	0.0	0.0	0.0	13.7	0.0	0.0	-37.2	0.0	0.0	0.0	
Right Leg	0.0	-397.3	0.0	0.0	443.4	0.0	46.1	0.0	0.0	-30.5	0.0	0.0	37.2	
Right Thigh	0.0	-299.2	0.0	0.0	397.3	0.0	98.1	0.0	0.0	-16.2	0.0	0.0	30.5	
Left Foot	0.0	-443.4	0.0	0.0	0.0	0.0	13.7	0.0	0.0	-37.2	0.0	0.0	0.0	
Left Leg	0.0	-397.3	0.0	0.0	443.4	0.0	46.1	0.0	0.0	-30.5	0.0	0.0	37.2	
Left Thigh	0.0	-299.2	0.0	0.0	397.3	0.0	98.1	0.0	0.0	-16.2	0.0	0.0	30.5	
Right Hand	0.0	-27.5	0.0	0.0	0.0	0.0	5.9	0.0	0.0	-1.7	0.0	0.0	0.0	
Right Forearm	0.0	-11.8	0.0	0.0	27.5	0.0	15.7	0.0	0.0	-5.5	0.0	0.0	1.7	
Right Arm	0.0	15.7	0.0	0.0	11.8	0.0	27.5	0.0	0.0	-5.5	0.0	0.0	5.5	
Left Hand	0.0	-27.5	0.0	0.0	0.0	0.0	5.9	0.0	0.0	-1.7	0.0	0.0	0.0	
Left Forearm	0.0	-11.8	0.0	0.0	27.5	0.0	15.7	0.0	0.0	-5.5	0.0	0.0	1.7	
Left Arm	0.0	15.7	0.0	0.0	11.8	0.0	27.5	0.0	0.0	-5.5	0.0	0.0	5.5	
Head	0.0	79.5	0.0	0.0	0.0	0.0	79.5	0.0	0.0	0.5	0.0	0.0	0.0	
Pelvis	0.0	598.4	0.0	0.0	-459.1	0.0	139.3	0.0	0.0	36.5	0.0	0.0	-20.2	
Torso	0.0	459.1	0.0	0.0	-110.9	0.0	348.3	0.0	0.0	20.2	0.0	0.0	10.5	

Table of Joint Coordinates

MARKER	X	Y	Z
Right Foot	0.027	0.000	0.000
Right Ankle	-0.056	0.155	0.000
Right Knee	-0.040	0.604	0.000
Right Hip	0.000	1.065	0.000
Right Hand	0.610	2.000	0.000
Right Wrist	0.554	1.940	0.000
Right Elbow	0.370	1.743	0.000
Right Shoulder	0.127	1.553	0.000
Left Foot	0.027	0.000	0.000
Left Ankle	-0.056	0.155	0.000
Left Knee	-0.040	0.604	0.000
Left Hip	0.000	1.065	0.000
Left Hand	0.610	2.000	0.000
Left Wrist	0.554	1.940	0.000
Left Elbow	0.370	1.743	0.000
Left Shoulder	0.127	1.553	0.000
L4-L5	0.032	1.140	0.000
Head	0.145	1.771	0.000
C7	0.140	1.606	0.000

Site: Job Name: Analyst: Anthropometrics: Male 95%ile	Department: Workstation ID: Date: 14 Mar, 2021 Height: 190 cm	Job Classification: Shift: Worker ID: Gender: Male Age: 35
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## 2D Action Summary (Masking Process : Part from Trolley : Getting Part (95%M))

Trunk Angle: 4.0°

### Left Hand

Force: 11.3 N  
Angle in xy-plane: 90°

### Right Hand

Force: 11.3 N  
Angle in xy-plane: 90°

R.D. Forward: 48.8 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 109.7 cm

R.D. Forward: 48.8 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 109.7 cm

### L4-L5 Moment

Extensor: 17.3 Nm

### L4-L5 Compression

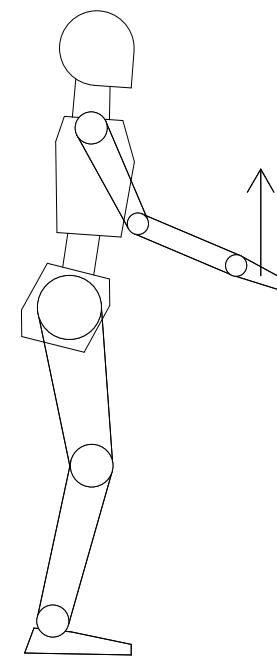
Total: 791 N

### Reaction Shear

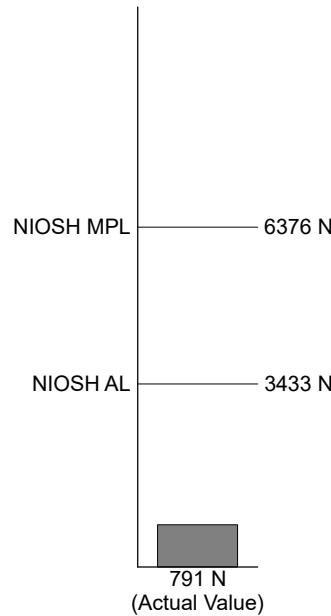
Anterior: 35 N

### Joint Shear

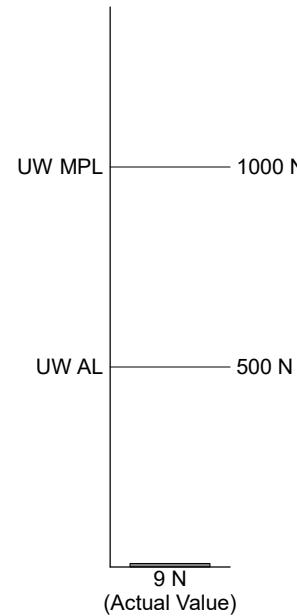
Anterior: 9 N



### Spine Compression Limits



### Spine Joint Shear Limits



Site: Job Name: Analyst: Anthropometrics: Male 95%ile	Department: Workstation ID: Date: 14 Mar, 2021 Height: 190 cm	Job Classification: Shift: Worker ID: Gender: Male
		Age: 35

### Joint Moment Strength Data

% of Population Not Capable			Calculated Moment (Nm)
R Elbow	Flexor/Extensor Supinator/Pronator	0.1	0.3 EX 0.0
L Elbow	Flexor/Extensor Supinator/Pronator	0.1	0.3 EX 0.0
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	0.1	2.7 FL 0.0 0.0
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	0.1	2.7 FL 0.0 0.0
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	0.1	17.3 EX 0.0 0.0
		25%	

### Male Strength Data

		Mean Population Moment (Nm)	S.D. (Nm)	Angle (°)	Reference
R Elbow	Flexor/Extensor Supinator/Pronator	41 DNA	11	90	Askew et al. (1987)
L Elbow	Flexor/Extensor Supinator/Pronator	41 DNA	11	90	Askew et al. (1987)
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	69 DNA DNA	14	45	Koski & McGill (1994)
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	69 DNA DNA	14	45	Koski & McGill (1994)
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	480 DNA DNA	93	0	Troup & Chapman (1969)

(DNA = Data Not Available)

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Male 95%ile	Height: 190 cm	Gender: Male
	Weight: 100 kg	Age: 35

## 2D Action Details (Masking Process : Part from Trolley : Getting Part (95%M))

Table of Segment Positions

SEGMENT	ABS ANGLE* (°) xy plane    yz plane	CGx (m)	CGy (m)	CGz (m)	LENGTH (m)
Right Foot	-41.0	0.022	0.058	0.000	0.176
Right Leg	-104.0	0.017	0.363	0.000	0.449
Right Thigh	-82.0	0.028	0.811	0.000	0.462
Left Foot	-41.0	0.022	0.058	0.000	0.176
Left Leg	-104.0	0.017	0.363	0.000	0.449
Left Thigh	-82.0	0.028	0.811	0.000	0.462
Right Hand	-23.0	0.471	1.113	0.000	0.082
Right Forearm	-23.0	0.291	1.189	0.000	0.270
Right Arm	-64.0	0.108	1.391	0.000	0.308
Left Hand	-23.0	0.471	1.113	0.000	0.082
Left Forearm	-23.0	0.291	1.189	0.000	0.270
Left Arm	-64.0	0.108	1.391	0.000	0.308
Head	86.0	0.065	1.730	0.000	0.166
Pelvis	76.0	0.007	1.038	0.000	0.082
Torso	86.0	0.037	1.327	0.000	0.478

\* NOTE: THE ABS ANGLES ARE ALL ABSOLUTE VALUES WITH 0° BEING HORIZONTAL TO THE RIGHT.

Table of Reaction Forces and Moments acting on each Segment

SEGMENT	REACTION FORCES						WEIGHT (N)	MOMENTS						
	Proximal End			Distal End				Proximal End			Distal End			
	RFx (N)	RFy (N)	RFz (N)	RFx (N)	RFy (N)	RFz (N)		RMx (Nm)	RMy (Nm)	RMz (Nm)	RMx (Nm)	RMy (Nm)	RMz (Nm)	
Right Foot	0.0	-465.5	0.0	0.0	0.0	0.0	13.7	0.0	0.0	-62.7	0.0	0.0	0.0	
Right Leg	0.0	-419.4	0.0	0.0	465.5	0.0	46.1	0.0	0.0	-14.3	0.0	0.0	62.7	
Right Thigh	0.0	-321.3	0.0	0.0	419.4	0.0	98.1	0.0	0.0	-38.5	0.0	0.0	14.3	
Left Foot	0.0	-465.5	0.0	0.0	0.0	0.0	13.7	0.0	0.0	-62.7	0.0	0.0	0.0	
Left Leg	0.0	-419.4	0.0	0.0	465.5	0.0	46.1	0.0	0.0	-14.3	0.0	0.0	62.7	
Left Thigh	0.0	-321.3	0.0	0.0	419.4	0.0	98.1	0.0	0.0	-38.5	0.0	0.0	14.3	
Right Hand	0.0	-5.4	0.0	0.0	0.0	0.0	5.9	0.0	0.0	-0.6	0.0	0.0	0.0	
Right Forearm	0.0	10.3	0.0	0.0	5.4	0.0	15.7	0.0	0.0	-0.3	0.0	0.0	0.6	
Right Arm	0.0	37.8	0.0	0.0	-10.3	0.0	27.5	0.0	0.0	2.7	0.0	0.0	0.3	
Left Hand	0.0	-5.4	0.0	0.0	0.0	0.0	5.9	0.0	0.0	-0.6	0.0	0.0	0.0	
Left Forearm	0.0	10.3	0.0	0.0	5.4	0.0	15.7	0.0	0.0	-0.3	0.0	0.0	0.6	
Left Arm	0.0	37.8	0.0	0.0	-10.3	0.0	27.5	0.0	0.0	2.7	0.0	0.0	0.3	
Head	0.0	79.5	0.0	0.0	0.0	0.0	79.5	0.0	0.0	0.9	0.0	0.0	0.0	
Pelvis	0.0	642.6	0.0	0.0	-503.3	0.0	139.3	0.0	0.0	28.3	0.0	0.0	-17.3	
Torso	0.0	503.3	0.0	0.0	-155.0	0.0	348.3	0.0	0.0	17.3	0.0	0.0	-6.4	

Table of Joint Coordinates

MARKER	X	Y	Z
Right Foot	0.088	0.000	0.000
Right Ankle	-0.044	0.115	0.000
Right Knee	0.064	0.551	0.000
Right Hip	0.000	1.009	0.000
Right Hand	0.508	1.097	0.000
Right Wrist	0.433	1.129	0.000
Right Elbow	0.184	1.234	0.000
Right Shoulder	0.049	1.511	0.000
Left Foot	0.088	0.000	0.000
Left Ankle	-0.044	0.115	0.000
Left Knee	0.064	0.551	0.000
Left Hip	0.000	1.009	0.000
Left Hand	0.508	1.097	0.000
Left Wrist	0.433	1.129	0.000
Left Elbow	0.184	1.234	0.000
Left Shoulder	0.049	1.511	0.000
L4-L5	0.020	1.089	0.000
Head	0.065	1.730	0.000
C7	0.053	1.565	0.000

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Male 95%ile	Height: 190 cm	Gender: Male
	Weight: 100 kg	Age: 35

## 2D Action Summary (Masking Process : Part from Trolley : Getting Part (5%F))

Trunk Angle: 0.0°

### Left Hand

Force: 11.3 N  
Angle in xy-plane: 90°

### Right Hand

Force: 11.3 N  
Angle in xy-plane: 90°

R.D. Forward: 61.8 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 143.9 cm

R.D. Forward: 61.8 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 143.9 cm

### L4-L5 Moment

Extensor: 11.5 Nm

### L4-L5 Compression

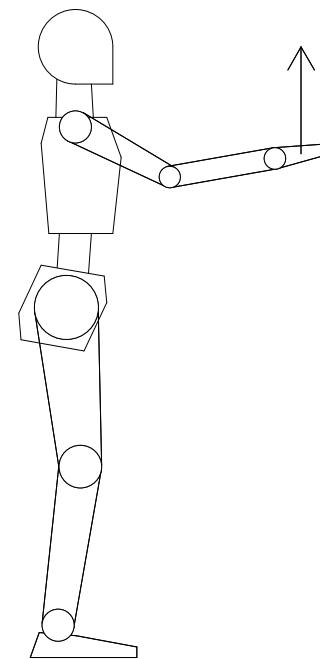
Total: 695 N

### Reaction Shear

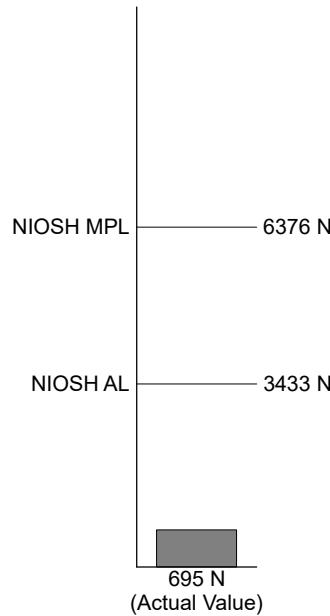
Posterior: 0 N

### Joint Shear

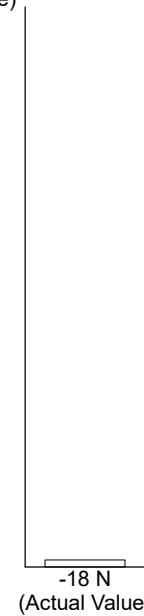
Posterior: -18 N



### Spine Compression Limits



### Spine Joint Shear Limit (none available)



Site: Job Name: Analyst: Anthropometrics: Male 95%ile	Department: Workstation ID: Date: 14 Mar, 2021 Height: 190 cm	Job Classification: Shift: Worker ID: Gender: Male
		Age: 35

### Joint Moment Strength Data

% of Population Not Capable			Calculated Moment (Nm)
R Elbow	Flexor/Extensor Supinator/Pronator	0.1	0.3 EX 0.0
L Elbow	Flexor/Extensor Supinator/Pronator	0.1	0.3 EX 0.0
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	0.1	5.7 FL 0.0 0.0
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	0.1	5.7 FL 0.0 0.0
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	0.1	11.5 EX 0.0 0.0
		25%	

### Male Strength Data

		Mean Population Moment (Nm)	S.D. (Nm)	Angle (°)	Reference
R Elbow	Flexor/Extensor Supinator/Pronator	41 DNA	11	90	Askew et al. (1987)
L Elbow	Flexor/Extensor Supinator/Pronator	41 DNA	11	90	Askew et al. (1987)
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	69 DNA DNA	14	45	Koski & McGill (1994)
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	69 DNA DNA	14	45	Koski & McGill (1994)
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	480 DNA DNA	93	0	Troup & Chapman (1969)

(DNA = Data Not Available)

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Male 95%ile	Height: 190 cm	Gender: Male
	Weight: 100 kg	Age: 35

## 2D Action Details (Masking Process : Part from Trolley : Getting Part (5%F))

Table of Segment Positions

SEGMENT	ABS ANGLE* (°) xy plane    yz plane	CGx (m)	CGy (m)	CGz (m)	LENGTH (m)
Right Foot	-40.0	0.045	0.057	0.000	0.176
Right Leg	-98.0	0.013	0.365	0.000	0.449
Right Thigh	-85.0	0.017	0.819	0.000	0.462
Left Foot	-40.0	0.045	0.057	0.000	0.176
Left Leg	-98.0	0.013	0.365	0.000	0.449
Left Thigh	-85.0	0.017	0.819	0.000	0.462
Right Hand	10.0	0.593	1.432	0.000	0.082
Right Forearm	10.0	0.400	1.398	0.000	0.270
Right Arm	-28.0	0.133	1.460	0.000	0.308
Left Hand	10.0	0.593	1.432	0.000	0.082
Left Forearm	10.0	0.400	1.398	0.000	0.270
Left Arm	-28.0	0.133	1.460	0.000	0.308
Head	90.0	0.014	1.742	0.000	0.166
Pelvis	80.0	0.005	1.048	0.000	0.082
Torso	90.0	0.014	1.338	0.000	0.478

\* NOTE: THE ABS ANGLES ARE ALL ABSOLUTE VALUES WITH 0° BEING HORIZONTAL TO THE RIGHT.

Table of Reaction Forces and Moments acting on each Segment

SEGMENT	REACTION FORCES						WEIGHT (N)	MOMENTS						
	Proximal End			Distal End				Proximal End			Distal End			
	RFx (N)	RFy (N)	RFz (N)	RFx (N)	RFy (N)	RFz (N)		RMx (Nm)	RMy (Nm)	RMz (Nm)	RMx (Nm)	RMy (Nm)	RMz (Nm)	
Right Foot	0.0	-465.5	0.0	0.0	0.0	0.0	13.7	0.0	0.0	-63.6	0.0	0.0	0.0	
Right Leg	0.0	-419.4	0.0	0.0	465.5	0.0	46.1	0.0	0.0	-35.8	0.0	0.0	63.6	
Right Thigh	0.0	-321.3	0.0	0.0	419.4	0.0	98.1	0.0	0.0	-51.0	0.0	0.0	35.8	
Left Foot	0.0	-465.5	0.0	0.0	0.0	0.0	13.7	0.0	0.0	-63.6	0.0	0.0	0.0	
Left Leg	0.0	-419.4	0.0	0.0	465.5	0.0	46.1	0.0	0.0	-35.8	0.0	0.0	63.6	
Left Thigh	0.0	-321.3	0.0	0.0	419.4	0.0	98.1	0.0	0.0	-51.0	0.0	0.0	35.8	
Right Hand	0.0	-5.4	0.0	0.0	0.0	0.0	5.9	0.0	0.0	-0.7	0.0	0.0	0.0	
Right Forearm	0.0	10.3	0.0	0.0	5.4	0.0	15.7	0.0	0.0	-0.3	0.0	0.0	0.7	
Right Arm	0.0	37.8	0.0	0.0	-10.3	0.0	27.5	0.0	0.0	5.7	0.0	0.0	0.3	
Left Hand	0.0	-5.4	0.0	0.0	0.0	0.0	5.9	0.0	0.0	-0.7	0.0	0.0	0.0	
Left Forearm	0.0	10.3	0.0	0.0	5.4	0.0	15.7	0.0	0.0	-0.3	0.0	0.0	0.7	
Left Arm	0.0	37.8	0.0	0.0	-10.3	0.0	27.5	0.0	0.0	5.7	0.0	0.0	0.3	
Head	0.0	79.5	0.0	0.0	0.0	0.0	79.5	0.0	0.0	0.0	0.0	0.0	0.0	
Pelvis	0.0	642.6	0.0	0.0	-503.3	0.0	139.3	0.0	0.0	19.4	0.0	0.0	-11.5	
Torso	0.0	503.3	0.0	0.0	-155.0	0.0	348.3	0.0	0.0	11.5	0.0	0.0	-11.5	

Table of Joint Coordinates

MARKER	X	Y	Z
Right Foot	0.112	0.000	0.000
Right Ankle	-0.022	0.113	0.000
Right Knee	0.040	0.558	0.000
Right Hip	0.000	1.018	0.000
Right Hand	0.633	1.439	0.000
Right Wrist	0.552	1.425	0.000
Right Elbow	0.286	1.378	0.000
Right Shoulder	0.014	1.523	0.000
Left Foot	0.112	0.000	0.000
Left Ankle	-0.022	0.113	0.000
Left Knee	0.040	0.558	0.000
Left Hip	0.000	1.018	0.000
Left Hand	0.633	1.439	0.000
Left Wrist	0.552	1.425	0.000
Left Elbow	0.286	1.378	0.000
Left Shoulder	0.014	1.523	0.000
L4-L5	0.014	1.099	0.000
Head	0.014	1.742	0.000
C7	0.014	1.577	0.000

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Male 95%ile	Height: 190 cm	Gender: Male
	Weight: 100 kg	Age: 35

## 2D Action Summary (Masking Process : Finishing : Pushing Trolley)

Trunk Angle: 5.0°

### Left Hand

Force: 13.0 N  
Angle in xy-plane: 0°

### Right Hand

Force: 13.0 N  
Angle in xy-plane: 0°

R.D. Forward: 60.2 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 127.3 cm

R.D. Forward: 60.2 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 127.3 cm

### L4-L5 Moment

Extensor: 43.7 Nm

### L4-L5 Compression

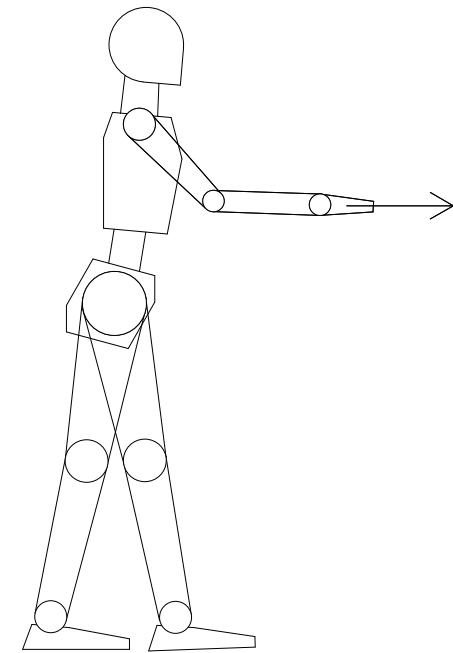
Total: 1250 N

### Reaction Shear

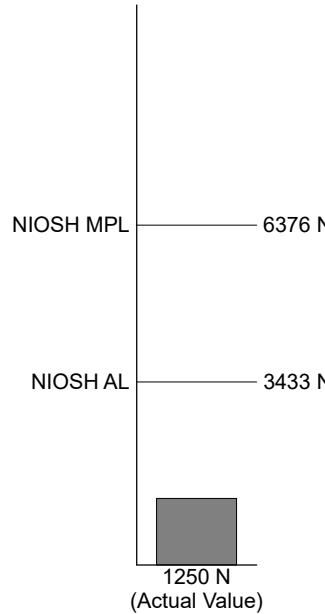
Anterior: 72 N

### Joint Shear

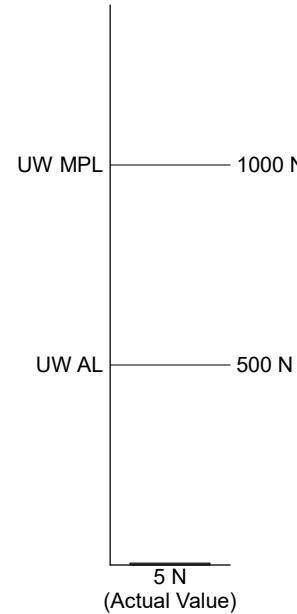
Anterior: 5 N



### Spine Compression Limits



### Spine Joint Shear Limits



Site: Job Name: Analyst: Anthropometrics: Male 95%ile	Department: Workstation ID: Date: 14 Mar, 2021 Height: 190 cm	Job Classification: Shift: Worker ID: Gender: Male
		Age: 35

### Joint Moment Strength Data

% of Population Not Capable			Calculated Moment (Nm)
R Elbow	Flexor/Extensor Supinator/Pronator	0.1	3.5 FL 0.0
L Elbow	Flexor/Extensor Supinator/Pronator	0.1	3.5 FL 0.0
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	0.1	7.8 FL 0.0 0.0
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	0.1	7.8 FL 0.0 0.0
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	0.1	43.7 EX 0.0 0.0
			25%

### Male Strength Data

		Mean Population Moment (Nm)	S.D. (Nm)	Angle (°)	Reference
R Elbow	Flexor/Extensor Supinator/Pronator	71 DNA	15	90	Askew et al. (1987)
L Elbow	Flexor/Extensor Supinator/Pronator	71 DNA	15	90	Askew et al. (1987)
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	69 DNA DNA	14	45	Koski & McGill (1994)
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	69 DNA DNA	14	45	Koski & McGill (1994)
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	480 DNA DNA	93	0	Troup & Chapman (1969)

(DNA = Data Not Available)

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Male 95%ile	Height: 190 cm	Gender: Male
	Weight: 100 kg	Age: 35

## 2D Action Details (Masking Process : Finishing : Pushing Trolley)

Table of Segment Positions

SEGMENT	ABS ANGLE* (°) xy plane    yz plane	CGx (m)	CGy (m)	CGz (m)	LENGTH (m)
Right Foot	-38.0	0.243	0.057	0.000	0.176
Right Leg	-79.0	0.125	0.361	0.000	0.449
Right Thigh	-79.0	0.038	0.810	0.000	0.462
Left Foot	-40.0	-0.114	0.057	0.000	0.176
Left Leg	-103.0	-0.124	0.361	0.000	0.449
Left Thigh	-100.0	-0.035	0.809	0.000	0.462
Right Hand	-2.0	0.583	1.275	0.000	0.082
Right Forearm	-2.0	0.388	1.282	0.000	0.270
Right Arm	-46.0	0.152	1.411	0.000	0.308
Left Hand	-2.0	0.583	1.275	0.000	0.082
Left Forearm	-2.0	0.388	1.282	0.000	0.270
Left Arm	-46.0	0.152	1.411	0.000	0.308
Head	85.0	0.077	1.726	0.000	0.166
Pelvis	75.0	0.008	1.035	0.000	0.082
Torso	85.0	0.042	1.323	0.000	0.478

\* NOTE: THE ABS ANGLES ARE ALL ABSOLUTE VALUES WITH 0° BEING HORIZONTAL TO THE RIGHT.

Table of Reaction Forces and Moments acting on each Segment

SEGMENT	REACTION FORCES						WEIGHT (N)	MOMENTS						
	Proximal End			Distal End				Proximal End			Distal End			
	RFx (N)	RFy (N)	RFz (N)	RFx (N)	RFy (N)	RFz (N)		RMx (Nm)	RMy (Nm)	RMz (Nm)	RMx (Nm)	RMy (Nm)	RMz (Nm)	
Right Foot	10.9	-396.7	0.0	0.0	0.0	0.0	13.7	0.0	0.0	-54.8	0.0	0.0	0.0	
Right Leg	10.9	-350.6	0.0	-10.9	396.7	0.0	46.1	0.0	0.0	-82.3	0.0	0.0	54.8	
Right Thigh	10.9	-252.5	0.0	-10.9	350.6	0.0	98.1	0.0	0.0	-104.5	0.0	0.0	82.3	
Left Foot	15.1	-556.8	0.0	0.0	0.0	0.0	13.7	0.0	0.0	-74.2	0.0	0.0	0.0	
Left Leg	15.1	-510.7	0.0	-15.1	556.8	0.0	46.1	0.0	0.0	-13.4	0.0	0.0	74.2	
Left Thigh	15.1	-412.6	0.0	-15.1	510.7	0.0	98.1	0.0	0.0	31.1	0.0	0.0	13.4	
Right Hand	-13.0	5.9	0.0	0.0	0.0	0.0	5.9	0.0	0.0	0.2	0.0	0.0	0.0	
Right Forearm	-13.0	21.6	0.0	13.0	-5.9	0.0	15.7	0.0	0.0	3.5	0.0	0.0	-0.2	
Right Arm	-13.0	49.1	0.0	13.0	-21.6	0.0	27.5	0.0	0.0	7.8	0.0	0.0	-3.5	
Left Hand	-13.0	5.9	0.0	0.0	0.0	0.0	5.9	0.0	0.0	0.2	0.0	0.0	0.0	
Left Forearm	-13.0	21.6	0.0	13.0	-5.9	0.0	15.7	0.0	0.0	3.5	0.0	0.0	-0.2	
Left Arm	-13.0	49.1	0.0	13.0	-21.6	0.0	27.5	0.0	0.0	7.8	0.0	0.0	-3.5	
Head	0.0	79.5	0.0	0.0	0.0	0.0	79.5	0.0	0.0	1.1	0.0	0.0	0.0	
Pelvis	-26.0	665.1	0.0	26.0	-525.8	0.0	139.3	0.0	0.0	58.0	0.0	0.0	-43.7	
Torso	-26.0	525.8	0.0	26.0	-177.6	0.0	348.3	0.0	0.0	43.7	0.0	0.0	-16.7	

Table of Joint Coordinates

MARKER	X	Y	Z
Right Foot	0.313	0.003	0.000
Right Ankle	0.174	0.111	0.000
Right Knee	0.088	0.552	0.000
Right Hip	0.000	1.006	0.000
Right Hand	0.624	1.273	0.000
Right Wrist	0.542	1.276	0.000
Right Elbow	0.272	1.286	0.000
Right Shoulder	0.058	1.507	0.000
Left Foot	-0.047	0.000	0.000
Left Ankle	-0.181	0.113	0.000
Left Knee	-0.080	0.551	0.000
Left Hip	0.000	1.006	0.000
Left Hand	0.624	1.273	0.000
Left Wrist	0.542	1.276	0.000
Left Elbow	0.272	1.286	0.000
Left Shoulder	0.058	1.507	0.000
L4-L5	0.021	1.085	0.000
Head	0.077	1.726	0.000
C7	0.063	1.561	0.000

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Male 95%ile	Height: 190 cm	Gender: Male
	Weight: 100 kg	Age: 35

## 2D Action Summary (Masking Process : Finishing : Open Oven Door)

Trunk Angle: -13.0°

### Left Hand

Force: 200.1 N  
Angle in xy-plane: 180°

### Right Hand

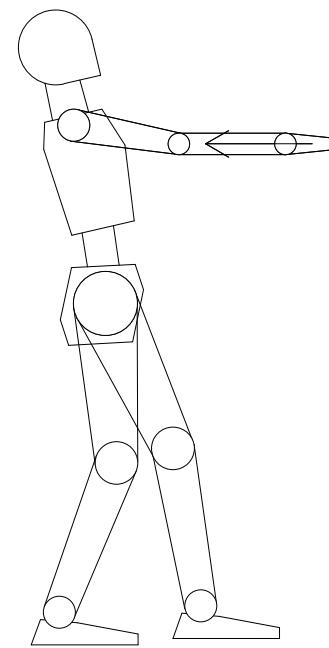
Force: 200.1 N  
Angle in xy-plane: 180°

R.D. Forward: 56.0 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 143.5 cm

R.D. Forward: 56.0 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 143.5 cm

### L4-L5 Moment

Flexor: -177.9 Nm



### L4-L5 Compression

Total: 4376 N

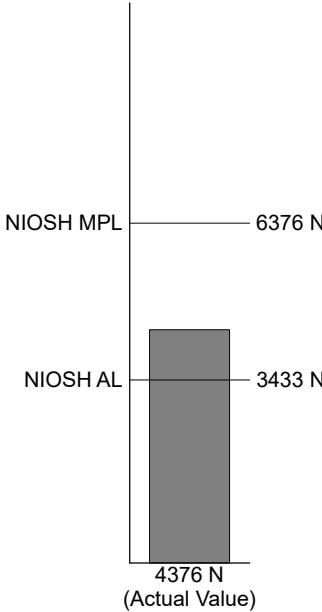
### Reaction Shear

Posterior: -508 N

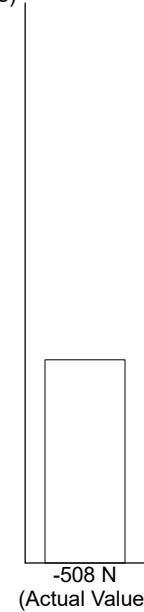
### Joint Shear

Posterior: -508 N

### Spine Compression Limits



### Spine Joint Shear Limit (none available)



Site: Job Name: Analyst: Anthropometrics: Male 95%ile	Department: Workstation ID: Date: 14 Mar, 2021 Height: 190 cm	Job Classification: Shift: Worker ID: Gender: Male
		Age: 35

### Joint Moment Strength Data

% of Population Not Capable			Calculated Moment (Nm)
R Elbow	Flexor/Extensor Supinator/Pronator	0.1	3.7 FL 0.0
L Elbow	Flexor/Extensor Supinator/Pronator	0.1	3.7 FL 0.0
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	0.1	24.5 FL 0.0 0.0
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	0.1	24.5 FL 0.0 0.0
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	0.3	177.9 FL 0.0 0.0
		25%	

### Male Strength Data

		Mean Population Moment (Nm)	S.D. (Nm)	Angle (°)	Reference
R Elbow	Flexor/Extensor Supinator/Pronator	71 DNA	15	90	Askew et al. (1987)
L Elbow	Flexor/Extensor Supinator/Pronator	71 DNA	15	90	Askew et al. (1987)
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	69 DNA DNA	14	45	Koski & McGill (1994)
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	69 DNA DNA	14	45	Koski & McGill (1994)
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	369 DNA DNA	69	0	Troup & Chapman (1969)

(DNA = Data Not Available)

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Male 95%ile	Height: 190 cm	Gender: Male
	Weight: 100 kg	Age: 35

## 2D Action Details (Masking Process : Finishing : Open Oven Door)

Table of Segment Positions

SEGMENT	ABS ANGLE* (°) xy plane    yz plane	CGx (m)	CGy (m)	CGz (m)	LENGTH (m)
Right Foot	-40.0	-0.061	0.057	0.000	0.176
Right Leg	-111.0	-0.037	0.351	0.000	0.449
Right Thigh	-86.0	0.014	0.794	0.000	0.462
Left Foot	-40.0	0.341	0.076	0.000	0.176
Left Leg	-80.0	0.229	0.383	0.000	0.449
Left Thigh	-65.0	0.085	0.812	0.000	0.462
Right Hand	0.0	0.515	1.435	0.000	0.082
Right Forearm	0.0	0.320	1.435	0.000	0.270
Right Arm	-10.0	0.033	1.465	0.000	0.308
Left Hand	0.0	0.515	1.435	0.000	0.082
Left Forearm	0.0	0.320	1.435	0.000	0.270
Left Arm	-10.0	0.033	1.465	0.000	0.308
Head	103.0	-0.149	1.702	0.000	0.166
Pelvis	93.0	-0.002	1.023	0.000	0.082
Torso	103.0	-0.058	1.308	0.000	0.478

\* NOTE: THE ABS ANGLES ARE ALL ABSOLUTE VALUES WITH 0° BEING HORIZONTAL TO THE RIGHT.

Table of Reaction Forces and Moments acting on each Segment

SEGMENT	REACTION FORCES						WEIGHT (N)	MOMENTS						
	Proximal End			Distal End				Proximal End			Distal End			
	RFx (N)	RFy (N)	RFz (N)	RFx (N)	RFy (N)	RFz (N)		RMx (Nm)	RMy (Nm)	RMz (Nm)	RMx (Nm)	RMy (Nm)	RMz (Nm)	
Right Foot	-214.5	-512.0	0.0	0.0	0.0	0.0	13.7	0.0	0.0	-94.2	0.0	0.0	0.0	
Right Leg	-214.5	-465.9	0.0	214.5	512.0	0.0	46.1	0.0	0.0	-104.9	0.0	0.0	94.2	
Right Thigh	-214.5	-367.8	0.0	214.5	465.9	0.0	98.1	0.0	0.0	-217.5	0.0	0.0	104.9	
Left Foot	-185.7	-441.5	0.0	0.0	0.0	0.0	13.7	0.0	0.0	-81.4	0.0	0.0	0.0	
Left Leg	-185.7	-395.4	0.0	185.7	441.5	0.0	46.1	0.0	0.0	-196.5	0.0	0.0	81.4	
Left Thigh	-185.7	-297.3	0.0	185.7	395.4	0.0	98.1	0.0	0.0	-343.2	0.0	0.0	196.5	
Right Hand	200.1	5.9	0.0	0.0	0.0	0.0	5.9	0.0	0.0	0.2	0.0	0.0	0.0	
Right Forearm	200.1	21.6	0.0	-200.1	-5.9	0.0	15.7	0.0	0.0	3.7	0.0	0.0	-0.2	
Right Arm	200.1	49.1	0.0	-200.1	-21.6	0.0	27.5	0.0	0.0	24.5	0.0	0.0	-3.7	
Left Hand	200.1	5.9	0.0	0.0	0.0	0.0	5.9	0.0	0.0	0.2	0.0	0.0	0.0	
Left Forearm	200.1	21.6	0.0	-200.1	-5.9	0.0	15.7	0.0	0.0	3.7	0.0	0.0	-0.2	
Left Arm	200.1	49.1	0.0	-200.1	-21.6	0.0	27.5	0.0	0.0	24.5	0.0	0.0	-3.7	
Head	0.0	79.5	0.0	0.0	0.0	0.0	79.5	0.0	0.0	-3.0	0.0	0.0	0.0	
Pelvis	400.2	665.1	0.0	-400.2	-525.8	0.0	139.3	0.0	0.0	-213.2	0.0	0.0	177.9	
Torso	400.2	525.8	0.0	-400.2	-177.6	0.0	348.3	0.0	0.0	-177.9	0.0	0.0	-46.1	

Table of Joint Coordinates

MARKER	X	Y	Z
Right Foot	0.006	0.000	0.000
Right Ankle	-0.129	0.113	0.000
Right Knee	0.032	0.533	0.000
Right Hip	0.000	0.994	0.000
Right Hand	0.556	1.435	0.000
Right Wrist	0.473	1.435	0.000
Right Elbow	0.204	1.435	0.000
Right Shoulder	-0.100	1.488	0.000
Left Foot	0.408	0.019	0.000
Left Ankle	0.273	0.132	0.000
Left Knee	0.195	0.575	0.000
Left Hip	0.000	0.994	0.000
Left Hand	0.556	1.435	0.000
Left Wrist	0.473	1.435	0.000
Left Elbow	0.204	1.435	0.000
Left Shoulder	-0.100	1.488	0.000
L4-L5	-0.004	1.076	0.000
Head	-0.149	1.702	0.000
C7	-0.112	1.541	0.000

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Male 95%ile	Height: 190 cm	Gender: Male
	Weight: 100 kg	Age: 35

## 2D Action Summary (Masking Process : Finishing : Close Oven Door 3)

Trunk Angle: 21.0°

### Left Hand

Force: 200.1 N  
Angle in xy-plane: 4°

### Right Hand

Force: 200.1 N  
Angle in xy-plane: 4°

R.D. Forward: 79.6 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 129.4 cm

R.D. Forward: 79.6 cm  
R.D. Lateral: 0.0 cm  
R.D. Hand-Floor: 129.4 cm

### L4-L5 Moment

Extensor: 193.8 Nm

### L4-L5 Compression

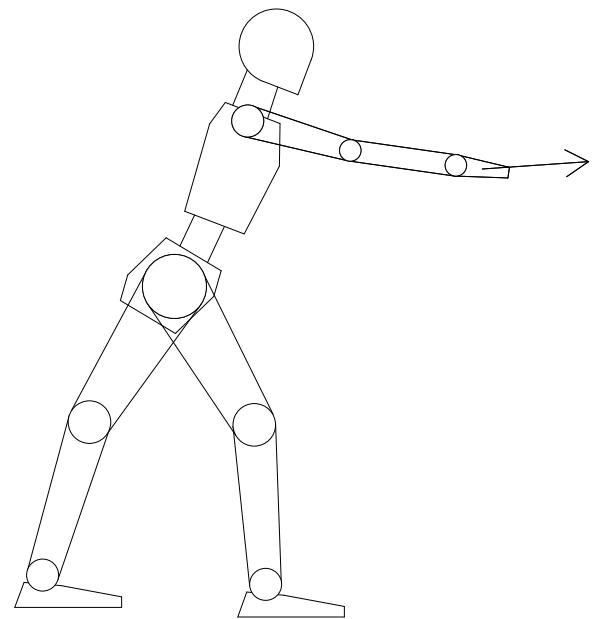
Total: 3552 N

### Reaction Shear

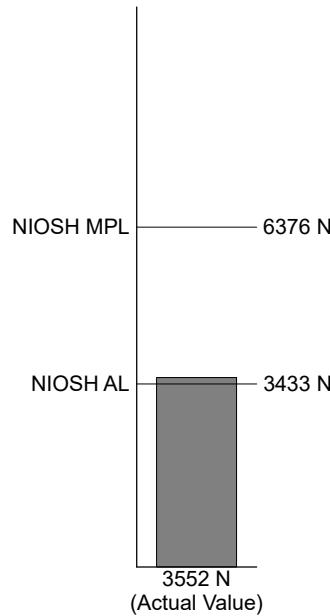
Anterior: 551 N

### Joint Shear

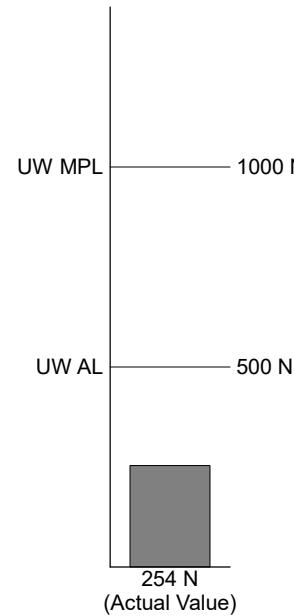
Anterior: 254 N



### Spine Compression Limits



### Spine Joint Shear Limits



Site: Job Name: Analyst: Anthropometrics: Male 95%ile	Department: Workstation ID: Date: 14 Mar, 2021 Height: 190 cm	Job Classification: Shift: Worker ID: Gender: Male
		Age: 35

### Joint Moment Strength Data

% of Population Not Capable			Calculated Moment (Nm)
R Elbow	Flexor/Extensor Supinator/Pronator	0.3	11.0 EX 0.0
L Elbow	Flexor/Extensor Supinator/Pronator	0.3	11.0 EX 0.0
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor		22.2 EX 0.0 0.0
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor		22.2 EX 0.0 0.0
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	0.1	193.8 EX 0.0 0.0
		25%	

### Male Strength Data

		Mean Population Moment (Nm)	S.D. (Nm)	Angle (°)	Reference
R Elbow	Flexor/Extensor Supinator/Pronator	41 DNA	11	90	Askew et al. (1987)
L Elbow	Flexor/Extensor Supinator/Pronator	41 DNA	11	90	Askew et al. (1987)
R Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	DNA DNA DNA			
L Shoulder	Flexor/Extensor Internal/External Rotator Abductor/Adductor	DNA DNA DNA			
Lumbar	Flexor/Extensor Right/Left Twist Right/Left Lateral Bend	480 DNA DNA	93	0	Troup & Chapman (1969)

(DNA = Data Not Available)

Site:	Department:	Job Classification:
Job Name:	Workstation ID:	Shift:
Analyst:	Date: 14 Mar, 2021	Worker ID:
Anthropometrics: Male 95%ile	Height: 190 cm	Gender: Male
	Weight: 100 kg	Age: 35

## 2D Action Details (Masking Process : Finishing : Close Oven Door 3)

Table of Segment Positions

SEGMENT	ABS ANGLE* (°) xy plane    yz plane	CGx (m)	CGy (m)	CGz (m)	LENGTH (m)
Right Foot	-40.0	0.330	0.057	0.000	0.176
Right Leg	-86.0	0.245	0.367	0.000	0.449
Right Thigh	-60.0	0.100	0.788	0.000	0.462
Left Foot	-40.0	-0.309	0.083	0.000	0.176
Left Leg	-107.0	-0.302	0.384	0.000	0.449
Left Thigh	-122.0	-0.106	0.792	0.000	0.462
Right Hand	-8.0	0.798	1.299	0.000	0.082
Right Forearm	-8.0	0.605	1.326	0.000	0.270
Right Arm	-16.0	0.323	1.390	0.000	0.308
Left Hand	-8.0	0.798	1.299	0.000	0.082
Left Forearm	-8.0	0.605	1.326	0.000	0.270
Left Arm	-16.0	0.323	1.390	0.000	0.308
Head	69.0	0.273	1.632	0.000	0.166
Pelvis	59.0	0.015	0.987	0.000	0.082
Torso	69.0	0.128	1.255	0.000	0.478

\* NOTE: THE ABS ANGLES ARE ALL ABSOLUTE VALUES WITH 0° BEING HORIZONTAL TO THE RIGHT.

Table of Reaction Forces and Moments acting on each Segment

SEGMENT	REACTION FORCES						WEIGHT (N)	MOMENTS						
	Proximal End			Distal End				Proximal End			Distal End			
	RFx (N)	RFy (N)	RFz (N)	RFx (N)	RFy (N)	RFz (N)		RMx (Nm)	RMy (Nm)	RMz (Nm)	RMx (Nm)	RMy (Nm)	RMz (Nm)	
Right Foot	320.0	-750.2	0.0	0.0	0.0	0.0	13.7	0.0	0.0	-65.8	0.0	0.0	0.0	
Right Leg	320.0	-704.0	0.0	-320.0	750.2	0.0	46.1	0.0	0.0	54.7	0.0	0.0	65.8	
Right Thigh	320.0	-605.9	0.0	-320.0	704.0	0.0	98.1	0.0	0.0	29.9	0.0	0.0	-54.7	
Left Foot	79.3	-175.5	0.0	0.0	0.0	0.0	13.7	0.0	0.0	-15.6	0.0	0.0	0.0	
Left Leg	79.3	-129.4	0.0	-79.3	175.5	0.0	46.1	0.0	0.0	38.9	0.0	0.0	15.6	
Left Thigh	79.3	-31.3	0.0	-79.3	129.4	0.0	98.1	0.0	0.0	91.2	0.0	0.0	-38.9	
Right Hand	-199.6	-8.1	0.0	0.0	0.0	0.0	5.9	0.0	0.0	-3.2	0.0	0.0	0.0	
Right Forearm	-199.6	7.6	0.0	199.6	8.1	0.0	15.7	0.0	0.0	-11.0	0.0	0.0	3.2	
Right Arm	-199.6	35.1	0.0	199.6	-7.6	0.0	27.5	0.0	0.0	-22.2	0.0	0.0	11.0	
Left Hand	-199.6	-8.1	0.0	0.0	0.0	0.0	5.9	0.0	0.0	-3.2	0.0	0.0	0.0	
Left Forearm	-199.6	7.6	0.0	199.6	8.1	0.0	15.7	0.0	0.0	-11.0	0.0	0.0	3.2	
Left Arm	-199.6	35.1	0.0	199.6	-7.6	0.0	27.5	0.0	0.0	-22.2	0.0	0.0	11.0	
Head	0.0	79.5	0.0	0.0	0.0	0.0	79.5	0.0	0.0	4.7	0.0	0.0	0.0	
Pelvis	-399.3	637.2	0.0	399.3	-497.9	0.0	139.3	0.0	0.0	245.1	0.0	0.0	-193.8	
Torso	-399.3	497.9	0.0	399.3	-149.6	0.0	348.3	0.0	0.0	193.8	0.0	0.0	39.6	

Table of Joint Coordinates

MARKER	X	Y	Z
Right Foot	0.397	0.000	0.000
Right Ankle	0.262	0.113	0.000
Right Knee	0.231	0.561	0.000
Right Hip	0.000	0.962	0.000
Right Hand	0.839	1.294	0.000
Right Wrist	0.757	1.305	0.000
Right Elbow	0.490	1.343	0.000
Right Shoulder	0.194	1.427	0.000
Left Foot	-0.242	0.027	0.000
Left Ankle	-0.376	0.140	0.000
Left Knee	-0.245	0.570	0.000
Left Hip	0.000	0.962	0.000
Left Hand	0.839	1.294	0.000
Left Wrist	0.757	1.305	0.000
Left Elbow	0.490	1.343	0.000
Left Shoulder	0.194	1.427	0.000
L4-L5	0.042	1.032	0.000
Head	0.273	1.632	0.000
C7	0.213	1.478	0.000

## **APPENDIX D**

### **IND712 Term Project Work breakdown Form**

Each team must submit 1 Work breakdown form with their projects

I hereby confirm that the work breakdown specified below is a fair representation of the work performed by each of the team members. I am aware that mis-representing the work of myself or another student constitutes an Academic Misconduct Violation under Ryerson's Policy 60: *Student Code of Academic Conduct*.

**Student name (print) & ID (last 4 digits)**

**Signature**

1. Ryan Rajakulam	xxxxx9076
2. Tahsin Rezaul	xxxxx5517
3. Muhammad Aras Naveed	xxxxx5142
4. Hosein Kobeissi	xxxxx7146

R.R

T.R.

M.A.N

H.K

**Use the table below to outline each team members primary and secondary responsibilities in the submitted project. (multiple students can take primary/lead responsibility for the same work if the work is shared evenly – please note this as ‘shared’). Form may go to 2 pages if needed.**

Student Name & ID (last 4 digits)	Specify Lead, secondary (2 <sup>nd</sup> ) or ‘shared’ responsibility Use as many lines as required to explain the contribution of each team member.	(blank)
1. Ryan Rajakulam  xxxx19076	Visited cyclone mfg./ Dad’s workplace - to inspect and gain info Psycho-social effects from current and new design Discussion	
2. Muhammad Aras Naveed  xxxxx5142	Editing Abstract Objective Ergonomics Conclusion	
3. Tahsin Rezaul  xxxxx5517	CAD/Jack/Watbak Rack/Shelf Design Surveys Nasa load index Updated/fixed Numerical Analysis (RULA assessment, forces, spinal and shoulder loading)	
4. Hosein Kobeissi	Furnace Design Cost Implementation Alternative 1, 2 & 3 Nasa load index original Force Analysis	