DHL Netherlands Ergonomics analysis

Ergonomics and productivity analysis by Xdin for Vaculex

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Vaculex
WORKING WITH EASE

Vaculex has requested this ergonomics analysis (NIOSH) on behalf of DHL Netherlands. The analysis was produced by Mari Eriksson, Human Simulation Engineer at Xdin AB. The analysis was performed independently of Vaculex AB and DHL.

Conclusion - Manual Lifting

"The working environment has to be attended to immediately"

Conclusion - Using Vaculex TP

*"By implementing Vaculex TP, DHL Netherlands will reduce the risk for injury by **81 %**"*

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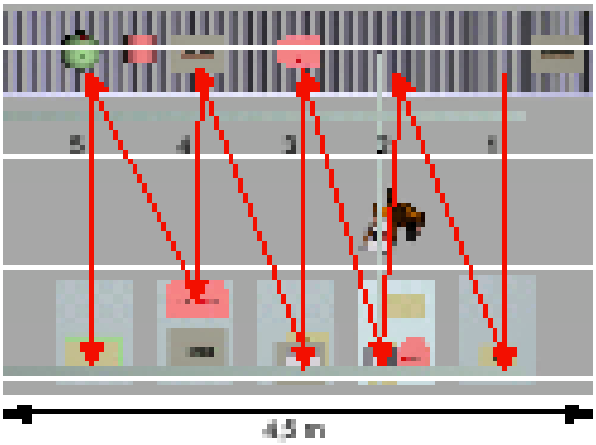
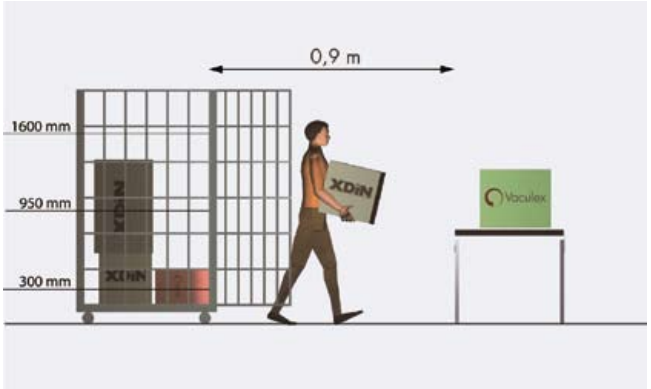
Analysis Conditions

NIOSH Manual





The operator is a 187 cm tall male in fit condition

Input Data

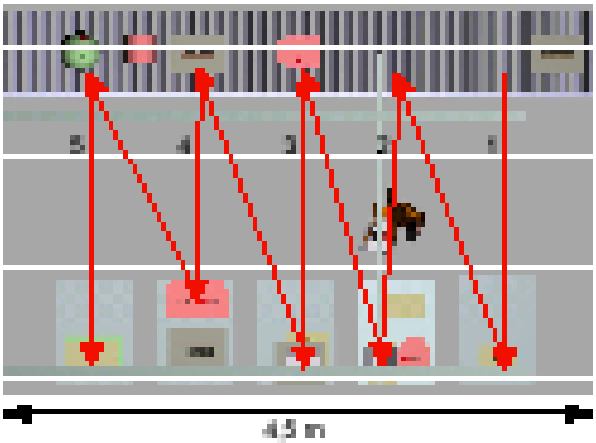
Even distribution, i.e. 33% on all heights

Low level	300 mm above floor
Mid level	950 mm above floor
High level	1600 mm above floor

FREQUENCY 500 lifts/hour

10% less than 3 kg
75% between 3 -12 kg
15% equal to 35 kg

NIOSH Vaculex



The operator is a 187 cm tall male in fit condition

Input Data

Even distribution, i.e. 33% on all heights

Low level	300 mm above floor
Mid level	950 mm above floor
High level	1600 mm above floor

FREQUENCY 500 lifts/hour

With Vaculex the load is 3 kg

Analysis result NIOSH Manual

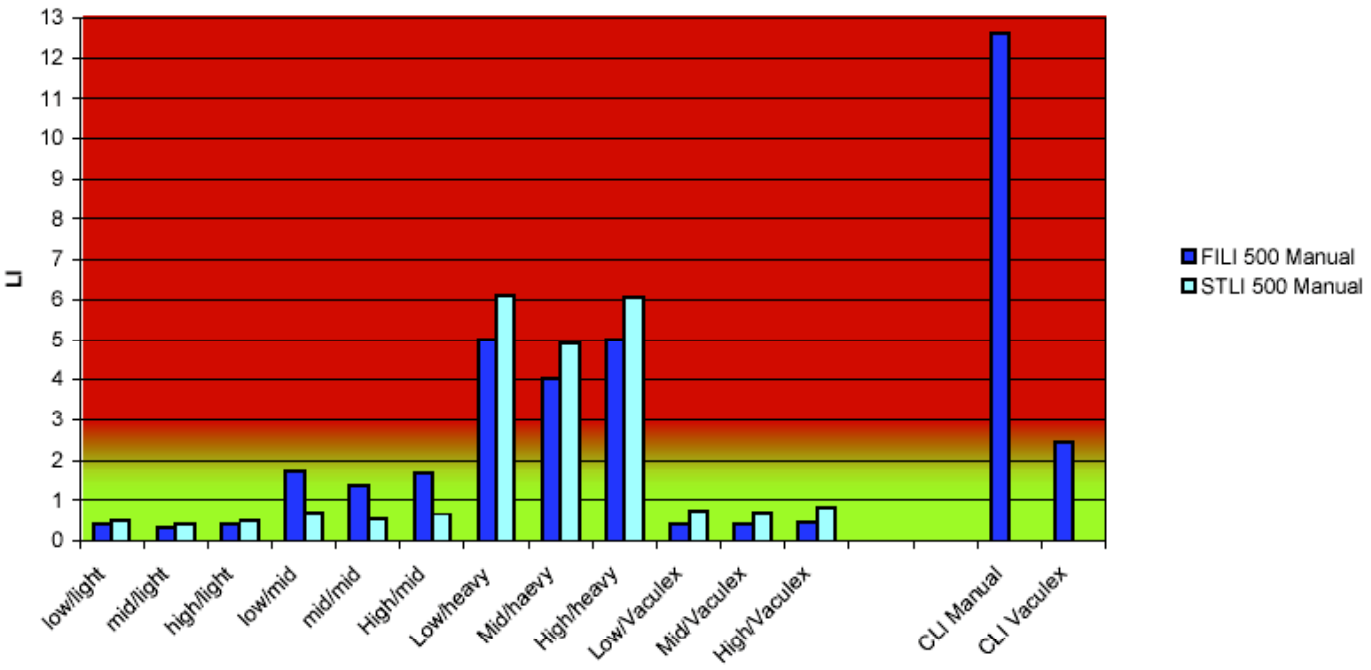
Task#	Deskription	Avg. Load	Max. Load	Origin H	Origin V	Dest H	Dest V	Vert Dist	Origin A	Dest A	Freq	Duration	Coupling	LC	HM	VM	DM	AM	CM	FM	FIRWL	STRWL	FILI	STLI
100	low/light	3	3	54.484	8.352	57.772	81.471	73.119	3.605	4.160	0.25	4.5	fair	23	0.46	0.80	0.88	0.99	0.95	0.84	6.98	5.89	0.43	0.51
110	mid/light	3	3	75.501	90.765	57.772	81.471	9.294	2.811	4.160	0.25	4.5	fair	23	0.40	0.95	1.00	0.99	1.00	0.84	8.64	7.28	0.35	0.41
120	high/light	3	3	87.906	127.193	57.772	81.471	45.722	2.433	4.160	0.25	4.5	fair	23	0.40	0.84	0.92	0.99	1.00	0.84	7.02	5.92	0.43	0.51
200	low/mid	3	12	54.484	8.352	57.772	81.471	73.119	3.605	4.160	2.06	4.5	fair	23	0.46	0.80	0.88	0.99	0.95	0.64	6.98	4.50	1.72	0.67
210	mid/mid	3	12	75.501	90.769	57.772	81.471	9.298	2.811	4.160	2.06	4.5	fair	23	0.40	0.95	1.00	0.99	1.00	0.64	8.64	5.56	1.39	0.54
220	High/mid	3	12	87.906	127.193	57.772	81.471	45.722	2.433	4.160	2.06	4.5	fair	23	0.40	0.84	0.92	0.99	1.00	0.64	7.02	4.52	1.71	0.66
300	Low/heavy	35	35	54.484	8.352	57.772	81.471	73.119	3.605	4.160	0.41	4.5	fair	23	0.46	0.80	0.88	0.99	0.95	0.82	6.98	5.74	5.01	6.10
310	Mid/haevy	35	35	75.501	90.769	57.772	81.471	9.298	2.811	4.160	0.41	4.5	fair	23	0.40	0.95	1.00	0.99	1.00	0.82	8.64	7.10	4.05	4.93
320	High/heavy	35	35	87.906	127.193	57.772	81.471	45.722	2.433	4.160	0.41	4.5	fair	23	0.40	0.84	0.92	0.99	1.00	0.82	7.02	5.77	4.99	6.07

Analysis result NIOSH Vaculex

Task#	Description	Avg. Load	Max. Load	Origin H	Origin V	Dest H	Dest V	Vert Dist	Origin A	Dest A	Freq	Duration	coupling	LC	HM	VM	DM	AM	CM	FM	FIRWL	STRWL	FILI	STLI
520	low vaculex	3	3	97.159	43.963	54.855	102.777	58.814	2.622	41.489	2.75	4.5	good	23	0.40	0.90	0.90	0.99	1.00	0.57	7.33	4.22	0.41	0.71
620	Mid vaculex	3	3	62.918	130.574	54.855	102.777	27.797	0.945	41.489	2.75	4.5	good	23	0.40	0.83	0.98	1.00	1.00	0.57	7.47	4.30	0.40	0.70
720	High vaculex	3	3	65.920	149.487	54.855	102.777	46.71	1.183	41.489	2.75	4.5	good	23	0.40	0.78	0.92	1.00	1.00	0.57	6.48	3.73	0.46	0.80

Analysis result

Summary



CLI Manual 12.614

CLI Vaculex 2.438

Composite Lifting Index

What is CLI?

Multiple Lift Jobs

NIOSH recognised that the overall risk of injury for a lifting job is dependent upon the combined effects of the job, rather than the individual effects of the tasks.

A method was developed called the *Composite Lifting Index* (CLI). It is the sum of the largest single task LI and the incremental increases in the CLI as each subsequent task is added. The incremental increase in the CLI for a specific task is defined as the difference between the LI for that task at the cumulative frequency and the LI for that task at its actual frequency.

The decision to use the single or multitask approach should be based on:

1. The need for detailed information about all facets of the multitask lifting job.

2. The need for accuracy and completeness of data in performing the analysis.

3. The analyst's level of understanding of the assessment procedures.

The Composite Lifting Index

Calculation of the CLI requires five major steps:

Step 1
Compute the Frequency-Independent Recommended Weight Limits (FIRWLs). Compute the FIRWL value for each task by using the respective task variables and setting the frequency multiplier to a value of 1.0. The FIRWL for each task reflects the compressive force and muscle strength demands for a single repetition of that task. If significant control is required at the destination for any individual task, the FIRWL must be computed at both the origin and the destination of the lift.

Step 2
Compute the Single-Task Recommended Weight Limit (STRWL). Compute the STRWL for each task by multiplying its FIRWL by its appropriate frequency multiplier. The STRWL for a task reflects the overall demands of that task, assuming it was the only task being performed. Note, this value does not reflect the overall demands of the task when the other tasks are considered. Nevertheless, this value is helpful in determining the extent to which an individual task may present excessive physical stress.

Step 3
Compute the Frequency-Independent Lifting Index (FILI). The FILI is computed for each task by dividing the maximum load weight for that task by the FIRWL. The FILI can identify individual tasks with potential strength problems. If any of the FILI values exceed 1.0, then ergonomic changes may be needed to decrease the strength demands.

Composite Lifting Index

Step 4

Compute the Single-Task Lifting Index (STLI). The STLI is computed for each task by dividing the average load weight for that task by the respective STRWL. In general, a task's STLI value should exceed its FILI value. The STLI can identify individual tasks with potentially excessive physical demands.
The STLI values do not indicate the relative stress of the individual tasks in the context of the whole job, but the STLI value can be used to prioritize the individual tasks according to the magnitude of their physical stress. Thus, if any of the STLI values exceed 1.0, then ergonomic changes may be needed to decrease the overall physical demands of the task.

It may be possible to have a job in which all of the individual tasks have a STLI less than 1.0 and still be physically demanding because of the combined demands of the tasks. In cases in which the FILI exceeds the STLI for any task, the maximum weights may represent a significant problem and careful evaluation is necessary.

Step 5

Compute the Composite Lifting Index. The tasks are renumbered in order of decreasing physical stress, beginning with the task with the greatest STLI down to the task with the smallest STLI. The CLI is equal to the highest STLI value plus the summation of increased LI values for the remaining tasks.

The purpose of the CLI is to reveal the physical stressor impact of combined effects of different tasks that make up a job.

Interpretation of the CLI

Jobs with a CLI greater than 1 pose an increased risk for lifting-related low back pain for some fraction of the workforce. High risk tasks within jobs that are hazardous can be identified (task with highest STLI). Individual multipliers can identify task characteristics that contribute most to the task's risk (lowest multiplier value).

As the magnitude of the CLI increases, the level of the risk for a given worker is increased, and a greater percentage of the workforce is likely to be at risk for developing lifting-related low back pain. The shape of the risk function is not known. It is impossible to predict the magnitude of the risk for a given individual or the exact percent of the work population who would be at an elevated risk for low back pain.

From the NIOSH perspective, it is likely that lifting tasks with a CLI > 1.0 pose an increased risk for lifting-related low back pain for some fraction of the workforce. NIOSH considers that the goal shold be to design all lifting jobs to achieve a CLI of 1.0 or less. Some experts believe that worker selection criteria may be used to identify workers who can perform potentially stressful lifting tasks (lifting tasks that would exceed a CLI of 1.0) without significantly increasing their risk of work-related injury.

These experts agree that nearly all workers will be at an increased risk of a work-related injury when the CLI exceeds 3.0. Also, informal or natural selection of workers may occur in many jobs that require repetitive lifting tasks. According to some experts, this may result in a unique workforce that may be able to work above a CLI of 1.0, at least in theory, without substantially increasing their risk of low back injuries above the baseline rate of injury.

Conclusion

Conclusion - NIOSH Manual

A Composite Lift Index (CLI) of 12.614 means that more than 95% of the population will get musculoskeletal disorders within a short period of time.

The working environment has to be attended to immediately. There are approximately 4 different measures to take. The measure that is most effective is placed on top of the list and the measure that is least effective on the bottom.

1. **Reduce the weight of the object (parcel)**
2. **Reduce the lifting frequency considerably**
3. **Adjust working heights so that lifting always starts and ends just above waist height and avoid twisting movements.**
4. **Reduce the number of working hours**

Measure one (1) and three (3) are normally changes that are possible to make without negatively affecting the company's commitments . If measure 1 and 3 is taken, the delivery quality will increase. The reason is that when a person is working close to her capacity she is prone to make more mistakes.

Conclusion - NIOSH Vaculex

Even if the weights are reduced and every specific lift is approved, the frequency produces a lift index of total 2.438.

This can be taken care of in different ways. The measure that is most effective is placed on top of the list and the measure that is least effective on the bottom.

1. **Reduce the lifting frequency considerably**
2. **Adjust working heights so that lifting always starts and ends just above waist height**
3. **Reduce the number of working hours**

Summary

By implementing Vaculex TP, DHL Netherlands will reduce the risk for injury by 81%.
The second measure to take, if possible, is to reorganise the work place so that working heights are adjusted so that lifting always starts and ends just above waist height.