WORKSTATION LIGHTING

for industrial and technical environments:

5 STEPS TO SUCCESS

TRESTON

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”Lighting has a widely recognised impact on productivity as well as on human well-being and work satisfaction.”

SMARTLY CHOSEN LIGHTING BOOSTS PRODUCTIVITY AND CREATES WELL-BEING

Lighting has a widely recognised impact on productivity. In addition, properly chosen, individually controllable, lighting has a proven effect on human wellbeing and work satisfaction[1] – both of which are known as positive factors in terms of the quality and continuity management of industrial processes.

Intelligent lighting offers new opportunities

Modern lighting is increasingly intelligent, offering new opportunities for controlling the intensity, tone, direction and illumination levels – not only for home interiors and public spaces, but also for the needs of working life and industrial environments.

By utilising the very latest technologies, functional work lighting can nowadays be provided extremely efficiently in terms of costs, energy and environmental impacts. Cutting-edge solutions aim to satisfy individual preferences, which may vary depending on the tasks, age, mood or physical circumstances of employees.

Insights from research

According to research by Henri Juslén [1] at the Helsinki University of Technology (now Aalto University), increasing task illuminance above the minimum level was shown in field tests in real industrial environments to increase productivity by 0 and 7.7 percent depending on starting conditions, tasks and subjects. In any working space, it is not only the intensity of light that matters but also the colour of light. Evidence suggests that the direction of light, colour temperature and illuminance levels can have an impact on a person’s mood.

Recently discovered light sensitive receptors in the eye not only control our sleep-wake rhythms by recognising light’s colour temperature but are also linked to mental alertness.

Cooler light is experienced as being brighter and energises people during the working day, as warmer tones with lower intensity help us relax in the evening. At the same time, the preferred light levels and colour tones may differ significantly from person to person.[2]

Ensure the benefits of optimal lighting

Do you want to ensure the benefits of ideal lighting in your workplace and make optimal choices that match the unique needs of your workplace? Here is a list of **5 easy steps to successfully** implement a successful lighting solution in your workplace.

SELECTING
THE RIGHT LIGHTING SOLUTION

STEP 1: Terms and standards

- Familiarise yourself with the key terms and standards, such as intensity, tone and colour rendering. Knowing exactly what you want will ensure an optimal result.

STEP 2: Space and type of work

- Lighting should always be designed for a specific space, its unique physical conditions and for people adopting the space.

STEP 3: Individual preferences

- Preferred illuminances of industrial workers varies, but that most people tend to select levels that are higher than the minimum recommendations.
- Attention should be paid to optical ergonomics, including the design of work lighting for different age groups.

STEP 4: The most suitable lighting solution

- For optimal lighting solutions it is important to meet the individual needs and preferences of employees, which usually vary.
- An energy-efficient lighting system is a combination of general lighting and task lights. Increasing the task illuminance can be achieved without increasing energy consumption.
- Make sure that the selected solution works and serves its purpose even if the requirements of your production change.
- An adjustable lighting fixture suits a variety of tasks.
- To ensure value for your investment, choose well-known, reliable and certified products.

STEP 5: Implementation and training

- When the new lighting system is up and running, train all users to understand the functionalities and how to use them for their benefit.
- A pleasant eyesight experience requires illumination also for the background and shelves around the workstation.

”An industrial environment with manual workstations requires both sufficient generic lighting, as well as properly directed and adjustable task lighting. ”

LIGHTING IN A NUTSHELL

Properly chosen lighting has a proven effect on human wellbeing and work satisfaction, having an impact on quality, continuity of production and the customer experience.

In addition to the intensity of light, the colour of light also matters. Cooler light energises, while warmer tones with a lower intensity of light help us relax.

Lighting is a vital part of the work environment in terms of both productivity and human wellbeing.

Functional lighting at work can be provided efficiently in terms of costs, as well as energy and environmental impacts.

1

KNOW THE TERMS AND STANDARDS

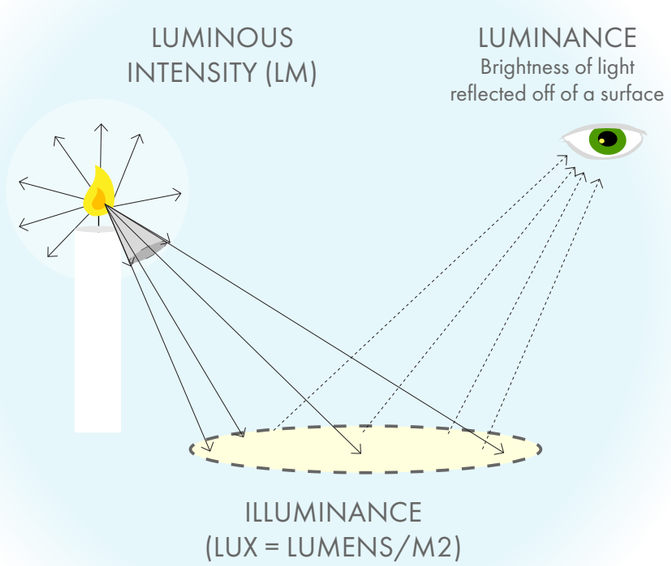
Familiarise yourself with the key terms and standards, such as intensity, tone and colour rendering. Knowing exactly what you want will ensure an optimal result.

Light source

Nowadays LED is widely used light source for any type of indoor workplace including industrial and technical environments. The biggest advantages of led are energy efficiency, long lifetime and low maintenance cost.

Carefree LED lights are often claimed to last 50 000 hours or more, which means around 24 years if light is used 8 hours a day, 5 days a week. And the lifetime can be even longer if LED is used dimmed. However, it is good to check also the L and B figures the manufacturer promises for LEDs as it tells how much light will be produced when lifetime of LEDs is going to its end.

For example, if lifetime is marked "50 000 hours, L90B10" it means that when 50 000 hours is reached is reached LEDs still provide 90% or more of the original lumen output value, only 10% of LEDs provide less than 90%. Basically, LED doesn't stop working immediately after 50 000 hours but the amount of light starts to fade slightly already before that.



Intensity

All lighting should be adjustable to different types of work. Make sure to provide always a sufficient amount of light for every type or phase of work. Accurate work, quality checks and assembly tasks when prolonged usually need a lot of light. Even when intensive lighting is necessary, it should be correctly directed and sufficiently spread so as not to dazzle or strain the eyesight.

Lighting professionals refer to the European standard for the lighting of indoor workplaces, EN 12464-1 [3], which gives average values for workplace lighting and the direct environment. However, exceeding these value can be recommended. The unit of lighting intensity is lux (lx) while lumen (lm) is the unit of luminous flux.

When a flux of 1000 lumens is concentrated into an area of one square metre, the area lights up with an illuminance of 1000 lux. The same amount of lumens spread out over ten square metres produces a dimmer illuminance of 100 lux.

The lighting intensity scale of indoor workplaces ranges from 300 lux to 1500 lux or even 2000-3000 lux depending on the task. It is important to measure out the actual intensity of light that is delivered all the way to the area where it is needed.

ILLUMINANCE, LX	ACTIVITY/SPACE
200 /300/500	**Simple visual tasks** e.g. rough mechanical work, basic assembly and office work.
300 /500/750	**Visual tasks that need moderate accuracy** e.g. motor reparation and other mechanical workshop work.
500/750/1000	**Visual tasks that need accuracy** e.g. Assembling small parts/ components, pretty accurate workbench and machine work, inspection and supervision rooms.
750/1000/1500	**Visual tasks that need special accuracy** e.g. quality check for colours.
1000/1500/2000	**Visual tasks that need extreme accuracy** e.g. Very detailed machine and workbench work, fine mechanics assembly, production of detailed measurement instruments.
1500 /2000/3000	Prolonged and excating visual tasks e.g. Tool and cutter production, goldsmith work, hand engraving, microelectronics.
2000 /3000/5000	Exceptionally difficult visual tasks e.g. Clocksmith, production of mesurement instruments.

Source: Finnish Institute of Occupational Health. Occupational physiotherapy, 2001. p. 196 (in Finnish).

" Make sure to provide always a sufficient amount of light for every type or phase of work."

KNOW THE TERMS AND STANDARDS

Familiarise yourself with the key terms and standards, such as intensity, tone and colour rendering. Knowing exactly what you want will ensure an optimal result.

Colour rendering

The general colour rendering index (CRI or CIE Ra index) is the international standard of a light source's colour characteristics compared to an ideal or natural light source on a scale of 0–100. The CRI is determined by comparing eight different colours in the reference light and the light under consideration.

High CRI ≥80 *Low CRI <80*

A high CRI is especially important in colour-critical processes. An Ra-index of at least 80 is seen as natural. The Ra-index of typical LED lights is more than 80. When the Ra-index is less than 70, different colours do not stand out well and red is poorly distinguished.

"A high CRI is especially important in colour-critical processes."

6500 K

4000 K

2700 K

Tone

Adjusting the colour temperature of white light offers interesting possibilities for indoor workplaces. Just as natural light regulates your daily rhythm and effects your mood and emotions, daylight-adjusted lighting can increase people's activity and wellbeing.

On a cloudy day, bright light can provide a boost, while in the evening, warm white light relaxes you and makes you feel comfortable. Most people seem to prefer working conditions that resemble daylight. Cold white light affects human alertness and productivity.

For example, a field study by Henri Juslén showed that white light after lunchtime reduced fatigue.[3]

The unit of colour temperature is kelvin (K). Colour temperatures over 5000 K are described as cold or bluish. Daylight equals 5500 K, and a colour temperature of 4000 K represents neutral white light. Lower colour temperatures (2700–3000 K) are seen as warm and yellowish colours, reminding us of incandescent light bulbs. The best lights are steplessly adjustable from relaxing warm tones up to energising daylight.

"Most people seem to prefer working conditions that resemble daylight. White light after lunchtime reduces fatigue."

2

KNOW YOUR SPACE AND THE TYPE OF WORK

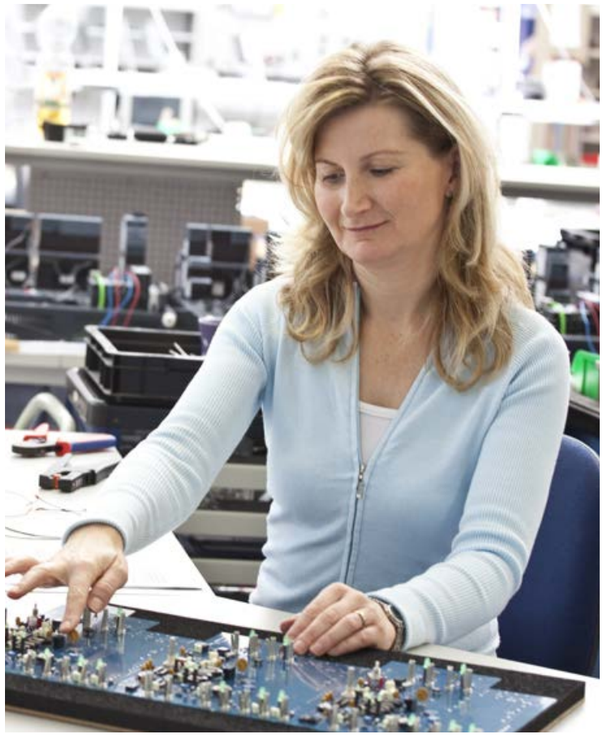
The shape and height of the room, the materials and colours of the floor, walls and ceiling, the constantly changing daylight affect lighting design

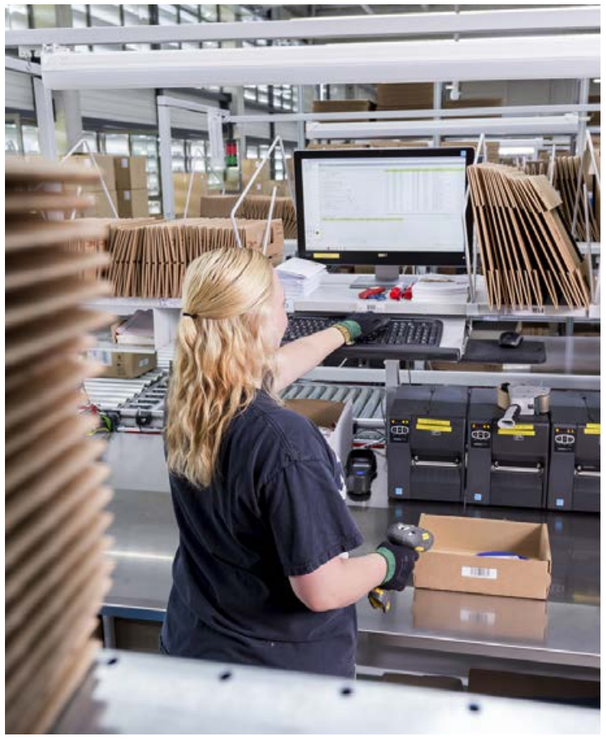
Lighting should always be designed for a specific space, its unique physical conditions and for people adopting the space. The shape and height of the room, the materials and colours of the floor, walls and ceiling, the constantly changing daylight coming through the windows, and the shadows cast by constructions or machinery must all be taken into account. They all play an active role when creating an optimal lighting solution in terms of safety, consistent quality and productivity.

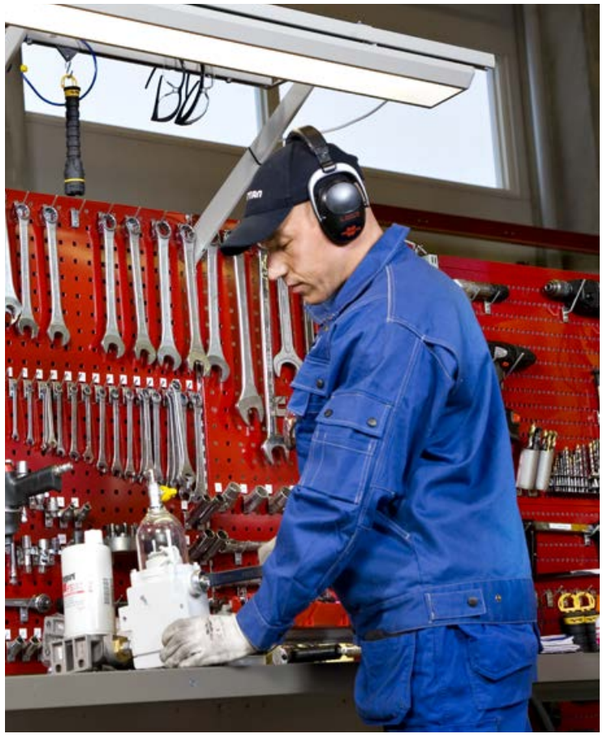
"An industrial environment with manual workstations requires both sufficient generic lighting, as well as properly directed and adjustable task lighting."

An industrial environment with manual workstations requires both sufficient generic lighting, as well as properly directed and adjustable task lighting. The general lighting of the space should deliver sufficient illumination for walking through a factory hall. The goal is to find a good balance between visual efficiency and energy efficiency. These days there is a clear trend towards utilising natural light as much as possible.

For example, some 200 lux is usually sufficient in a corridor or a coffee corner, whereas the recommended intensity of general lighting for rough mechanical work is 300 lux and for motor repairs 500 lux according to the European standard for the lighting of indoor workplaces. Extremely detailed mechanical assembly, microelectronics and other exacting visual tasks require higher levels of illumination of up to 2000 or even 3000 lux.







"The goal is to find a good balance between visual efficiency and energy efficiency."

3

FIND OUT THE INDIVIDUAL PREFERENCES OF YOUR EMPLOYEES

Recent field studies conducted in actual industrial environments show that the preferred illuminances of industrial workers varies, but that most people tend to select levels that are higher than the minimum recommendations

Scientific evidence backs up the impact of lighting on human emotions, wellbeing and ultimately workplace productivity. Although the cause-and-effect relationships are not unambiguous, improving workplace lighting has been shown to reduce production errors and even absenteeism.

"Improving workplace lighting has been shown to reduce production errors and even absenteeism."

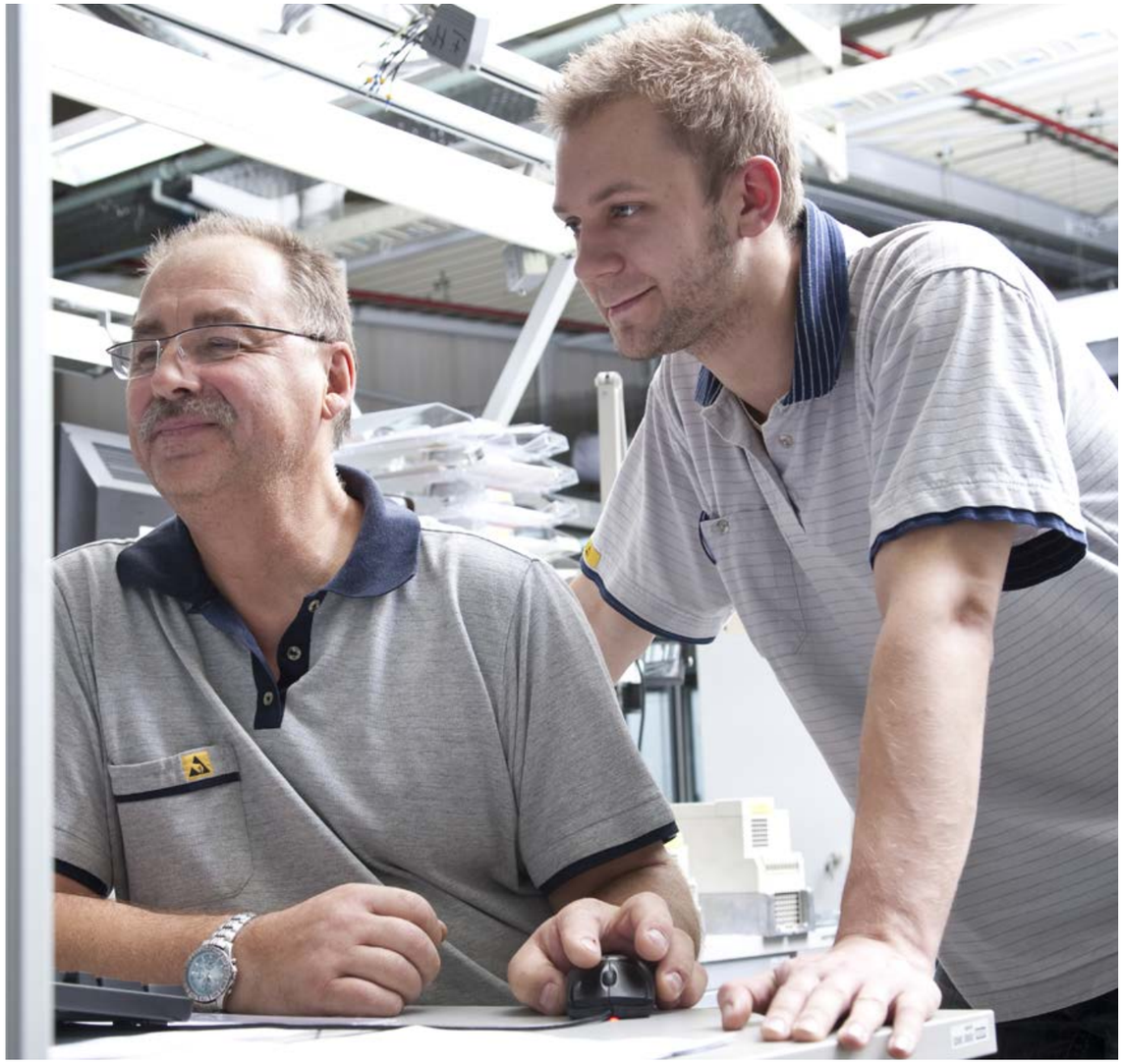
Recent field studies conducted in actual industrial environments show that the preferred illuminances of industrial workers varies, but that most people tend to select levels that are higher than the minimum recommendations. In addition, workers prefer to be able to adjust their task lighting by themselves.

These conclusions are still valid, as each individual has his/her own preferences depending on factors such as age, gender, individual eyesight, overall health and even temperament or mood.

Occupational health experts point out that older people in general need more light than younger ones. Regardless of individual preferences, due to physical changes in the eye related to the aging process, people at the age of 40 or more need in general more light than their younger colleagues to avoid eyesight fatigue and headaches, as well as to work efficiently.

Powerful lighting reduces the need for the eye to focus and makes it easier to see up close and keep working until the task is done.

Older people may also experience glare more easily, which can be avoided by enabling the user to adjust the direction of the lighting. The colour of light matters, too. Older people often prefer yellowish light that does not scatter in the eye. Furthermore, the light should always be of high quality, as blinking will strain the eyes at any age.



"Regardless of individual preferences, people at the age of 40 or more need in general more lightthan their younger colleagues."

4

SELECT THE MOST SUITABLE LIGHTING SOLUTION

Creating lighting conditions that enhance job satisfaction and productivity is an investment that will pay for itself over the years to come in the form of improved working capacity and motivation and a reduction in errors and absenteeism.

Once you are aware of the general guidelines and standards for lighting, as well as for the need of individual adjustability, it's time to select the most suitable lighting solutions for your premises. Creating lighting conditions that enhance job satisfaction and productivity is an investment that will pay for itself over the years to come in the form of improved working capacity and motivation and a reduction in errors and absenteeism.

Bright tasklighting combined with general lighting

An energy-efficient lighting system is a combination of general lighting and task lights. For example, according to Henri Juslén's research, improved and adjustable workstation lighting can lead to an increase in productivity due to many factors, including visual performance, visual comfort, visual ambience, interpersonal relationships, biological clock or circadian rhythms, stimulation, job satisfaction, problem solving, the halo effect and/or the change process.

In addition, increasing the task illuminance can be achieved without increasing energy consumption, which can even be reduced. The relative costs of adjustability and high-quality light will be compensated by energy savings from adopting LED technology and from maintaining moderate general lighting. Dimmability lengthens the age of the LED module when used appropriately.

"The costs of one day's sick leave compares quite closely to the difference between the unit prices of high quality lighting fixtures and the most affordable options on the market."

Tasks ligth is vital part of the industrial workstation

The lighting fixture is a vital part of the workstation as a whole. High-quality task lighting fixtures deliver high-quality light and offer adjustability to meet individual needs and work processes. For example, the cost of one day's sick leave compares quite closely to the difference between the unit prices of high quality lighting fixtures and the most affordable options on the market.

Most often, the best outcome can be achieved by letting employees control their task lighting as they wish. The ultimate goal is to offer employees the optimal light and optical ergonomics to enable them to perform their tasks to the best of their abilities.

When both sufficiently effective and correctly directed, task lights help ensure the required intensity of light and contrast – regardless of the preferences and needs of the individual worker or the accuracy level of the task. However, to provide a pleasant eyesight experience, illumination is also required for the background and shelves around the workstation.

Design and ease of installation

Functional and lean design is part of the overall quality of the product and contributes to the comfort of the working environment. Do not forget the importance of easy installation so that your well-lit workstation will soon be ready for productive use. To ensure value for your investment, you should choose well-known, reliable and certified products.

Adjustability provides possibilities

Before the final decision it's good to think about the future as well and ensure that the selected lighting solution works and serves its purpose even if the requirements of your production change. An adjustable lighting fixture with dimming and colour temperature control is suitable for a variety of tasks.

Now that you have considered all the facts and figures of your specific premises, employees and tasks, you should be able to make a well-balanced choice.

"The ultimate goal is to offer employees the optimal light and optical ergonomics to enable them to perform their tasks to the best of their abilities."

9 POINTS TO CONSIDER

When making the lighting decision, pay attention to:

1 LIGHT SOURCE AND LED QUALITY

- ✓ Energy efficient LED is widely used light source.
- ✓ LED lifetime is important, > 50 000 hours is nowadays widely used.
- ✓ Check also LB (e.g. L90B10) figures, usually the bigger the L and the smaller the B the better lighting is still available after 50 000 hours.

2 AMOUNT OF LIGHT

- ✓ Most often it is beneficial to select work station lighting that provides more light than recommended in the standards as it ensures there is enough light for each individual and different type of tasks.
- ✓ Luminous flux (lm) gives guidance but the illuminance (lux) figures show how much light actually hits the working surface.
- ✓ With adjustability options e.g. dimming bright light can be customised to different needs.

3 DIMMABILITY

- ✓ Is the minimum requirement for a workstation task light.
- ✓ Dimming helps users to adjust the lighting according to their personal needs.

4 COLOUR TONE ADJUSTABILITY

- ✓ Brings more options for individual to select the lighting conditions that best suit to his/her needs.
- ✓ Also important for example in quality control to ensure all the details are seen correctly.
- ✓ Studies indicate that adjustable colour tone has health benefits
- ✓ If not available 4000 K is most commonly used in industrial environments.

5 DISTRIBUTION OF LIGHT

- ✓ Ensure the workstation light distributes light evenly to the whole working surface and doesn't cause glare to workstation user or nearby colleagues.

6 ADJUSTABILITY

- ✓ Being able to adjust the direction of the light helps to find the right lighting conditions e.g. light directed 10° towards back of the workbench reduces the reflection.

7 CRI

- ✓ CRI ≥ 80 is the minimum for colour rendering and it is seen as natural.

8 CERTIFICATION

- ✓ Guaranteed quality comes with established brand,certification and third party testing.
- ✓ Selected lighting solution should have at least CE or other local certification.
- ✓ Third party testing reports such as EMC ensures product's quality.

9 LIGHTING OPTIONS

- ✓ Best option for workstation lighting is to provide light from 3 angles: above, and both sides.
- ✓ However, light above the workbench is a practical and good solution in many cases for industrial and technical work.
- ✓ Being able to provide side light gives more flexibility to desk lighting allowing a working surface with or without shadows depending on the needs of the ongoing task.

"Creating lighting conditions that enhance job satisfaction and productivity is an investment that will pay for itself over the years to come."

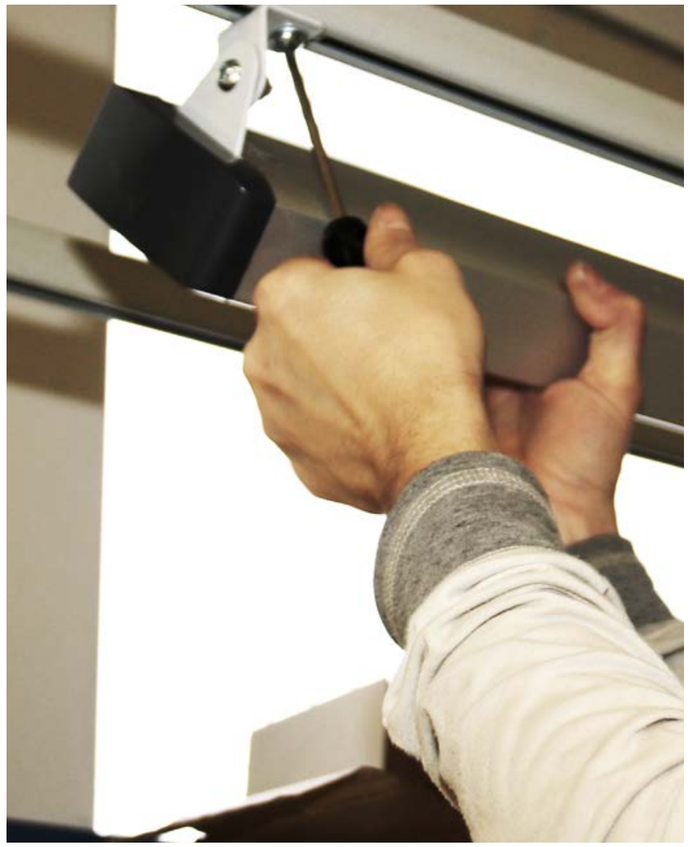
5

IMPLEMENT YOUR LIGHTING SOLUTION AND TRAIN YOUR EMPLOYEES

When the new lighting system is up and running, train all the users to understand the functionalities. Inform and discuss the purpose of the changes.

The planning phase of the investment is critical, but implementation is crucial to make the most of it. To gain the benefits you aim at, the new equipment needs to be properly installed. Once the new lighting system is up and running, pay attention to interactive communication.

Inform employees and discuss with them the purpose of the changes and make sure everyone knows how they can take out most of the new equipment. Ask managers or team leaders to get feedback and listen to what their team members have on their minds, and provide them with prompt response and information.



Training all users to understand the functionalities is also important. Ensure that clear guidance can be easily found at any time and encourage everyone to try out what works best for them.

Anything that can be adjusted should be adjusted according to the user's individual needs. In essence, this is how you crowdsource the optimal indoor lighting system for industrial and technical environments and provide a boost to your people and productivity.

"Anything that can be adjusted should be adjusted according to the user's individual needs."

Thank you for your time and interest towards this workstation lighting eBook.

If you want to take the next step,

please check Treston NaturLite LED -
A family of high-quality Treston LED lights, designed
for use as workstation lighting in technical and industrial spaces.

Watch the NaturLite LED video

"An industrial environment with manual workstations requires both sufficient generic lighting, as well as properly directed and adjustable task lighting."

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E-book about ESD gives guidelines on setting up an EPA and Ergonomics e-book focuses on ergonomics and how it affects productivity and well-being at work.

RESOURCES:

1. H Juslén: Lighting, Productivity and Preferred Illuminances – Field Studies in the Industrial Environment http:/lib.tkk.fi/Diss/2007/isbn9789512289622/
   Overview in PDF format (ISBN 978-951-22-8962-2) [8279 KB]
   Dissertation is also available in print (ISBN 978-951-22-8961-5)

2. Human Centric Lighting: https://www.lightingeurope.org/human-centric-lighting

3. European standard for the lighting of indoor workplaces EN 12464-1 (2011), https://standards.globalspec.com/std/1380223/cen-en-12464-1

4. H Juslén: As we know, cold, blue light keeps eye receptors alert by maintaining a level of blue light at certain times of the day when productivity may dip – such as after lunch. http://www.fm-world.co.uk/good-practice-legal/legal-articles/human-centric-lighting/

Mikael Vilpponen, lighting design expert

ISO/TR 22411:2008: Ergonomics data and guidelines for the application of ISO/IEC. Guide 71 to products and services to address the needs of older persons and persons with disabilities. https://www.iso.org/standard/40933.html

In Finnish: SFS-KÄSIKIRJA 48-1 Esteettömyys. Osa 1: Johdanto ja periaatteet tuotteiden, palveluiden ja ympäristöjen suunnitteluun. 2010.

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DEDICATED TO HUMAN WORKSPACE