Waldmann

ENGINEER OF LIGHT.

INCREASING PRODUCTIVITY WITH LIGHT

TWIN-C LIGHTING SOLUTIONS INDUSTRY

ECONOMIC EFFICIENCY THROUGH TWIN-C

Lighting can have various effects on different environments. Used in the correct manner, lighting can be economical while assuring the proper amount on its subjects. This brochure details how you can benefit from quality lighting solutions with Waldmann the TWIN-C concept.

TWIN-C

TWIN-C is the combination of intelligent lighting concepts with compatible components – to provide proper lighting in any environment. The benefits for organizations are compelling:

1 PRODUCTIVITY:

The correct lighting solution can increase a company's productivity up to 40%. TWIN-C lighting concepts make the most of any manufacturing environment by assuring the best illumination of production workstations.

2 SAFETY:

Imagine up to 66% fewer accidents in the workplace. Accurate lighting promotes safety by allowing employees and operators to clearly recognize objects and movement. The TWIN-C lighting concepts teaches how you can prevent errors, accidents and downtime.

3 GOOD HEALTH:

Considerably lower absenteeism! Light promotes a sense of well-being if it is customized for that specific environment. Waldmann demonstrates how TWIN-C lighting concepts can make work environments more ergonomical, promote a sense of well-being among employees and lower absenteeism.

4 ENERGY SAVINGS:

The TWIN-C concept can provide a high percentage in savings. In addition, adjusting the light levels across an entire factory can stop wasted energy. Waldmann demonstrates that, all things considered, the TWIN-C lighting concept can save energy and lower costs, while providing safer light levels.

Waldmann. The pleasant feeling of having a reliable partner.

In the industrial sector, proper lighting in the right location is a crucial factor for greater productivity and employee motivation. Waldmann develops and designs lighting solutions for increased corporate earnings, for the safety and health of the employees in production and for energy savings, while taking environmental aspects into account. As "Engineers of Light", Waldmann has stood for the highest level of German craftsmanship and engineering skill for decades. Waldmann offers "Light made to measure", oriented to the objective and environment. Industrial customers benefit from the exclusive nature of the solution and the broad application know-how, which is the result of the wealth of experience from hundreds of spot solutions and is accompanied by tremendous synergistic effects. As a medium-sized company directed by shareholders, Waldmann has become one of the world's leading lighting manufacturers. The Waldmann brand is synonymous with quality and reliability "Made in Germany". Waldmann products comply with all established standards. Our quality assurance process with the in-house test lab is exemplary, Waldmann's proverbial excellent service stands out through dedicated contact persons and a worldwide support and market presence. Waldmann, a reliable solution – from engineers for engineers.

CE DVE CCC UL LISTED

YES. IT‘S TRUE.
40% MORE PRODUCTIVITY FROM PROPER LIGHT.

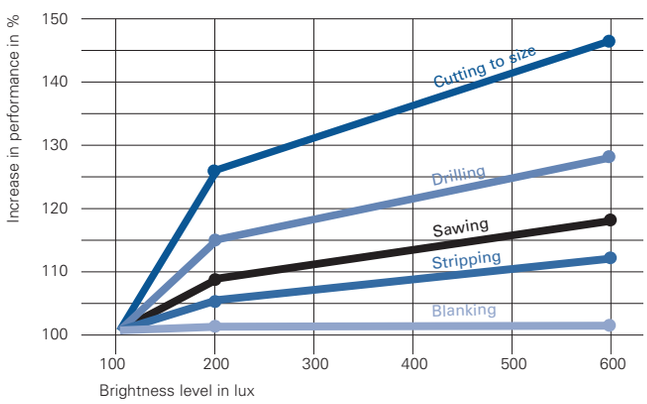
Proper lighting is crucial for productivity because it directly impacts employees everyday. The basis for the TWIN-C solution is improved performance by means of an intelligent lighting concept that recognizes both the needs of the employees and the potential of the that specific workplace.

EMPLOYEES ONLY OPERATE AT THE „SPEED OF LIGHT“ THAT IS PROVIDED.

Scientifically-based testing for industrial workplaces has proven that proper light increases performance, lowers scrap rates and reduces operator fatigue. These test results illustrate that an investment in the improvement of light is worthwhile for both the company and its employees.

Proper light improves performance.

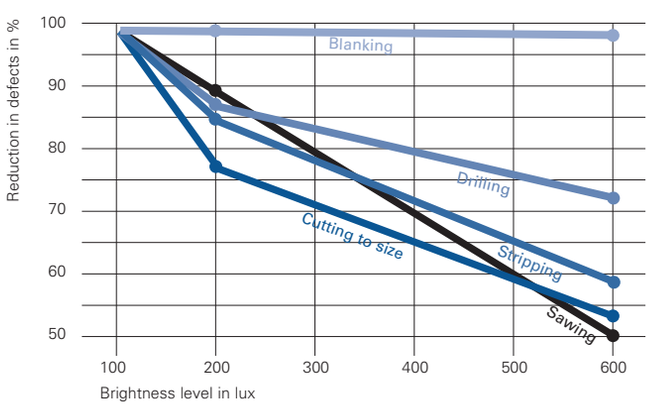
- The eye requires proper lighting to optimally process all information – this has a positive effect on job performance.
- The more difficult the visual task, the higher the performance increases when correct lighting exists.
- Productivity increases are possible without difficulty
- The values listed here are averages; individual requirements may be higher (i.e. people who wear glasses and older people).



Improved performance due to higher brightness levels.*

Proper light lowers both defect and scrap rates.

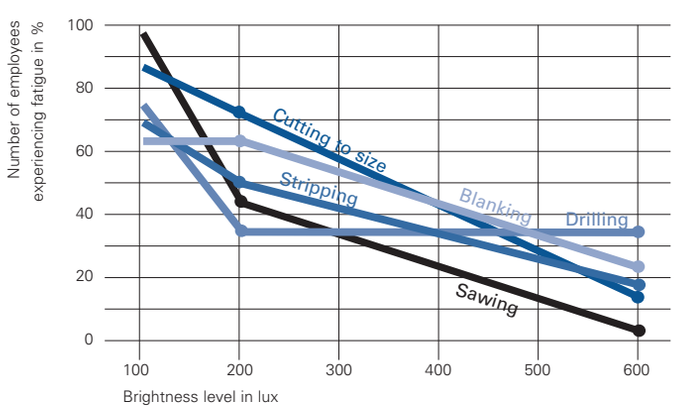
- If an operator can see more detail, fewer errors will be made.
- The defect rate can be reduced by up to 50% - a number that is difficult to achieve by other measures.
- Fewer defects minimize scrap. This is a crucial contribution to higher productivity.



Less scrap due to higher brightness levels.*

Obtain less fatigue through proper light.

- Light directly affects the melatonin (sleep hormone) level in people.
- Higher brightness levels minimize the effects of fatigue.
- Fatigue decreases as the brightness level increases in all work areas and creates a positive impact on the quality of work in production.
- Proper lighting is especially important during night shifts as to prevent a drop in employee performance.

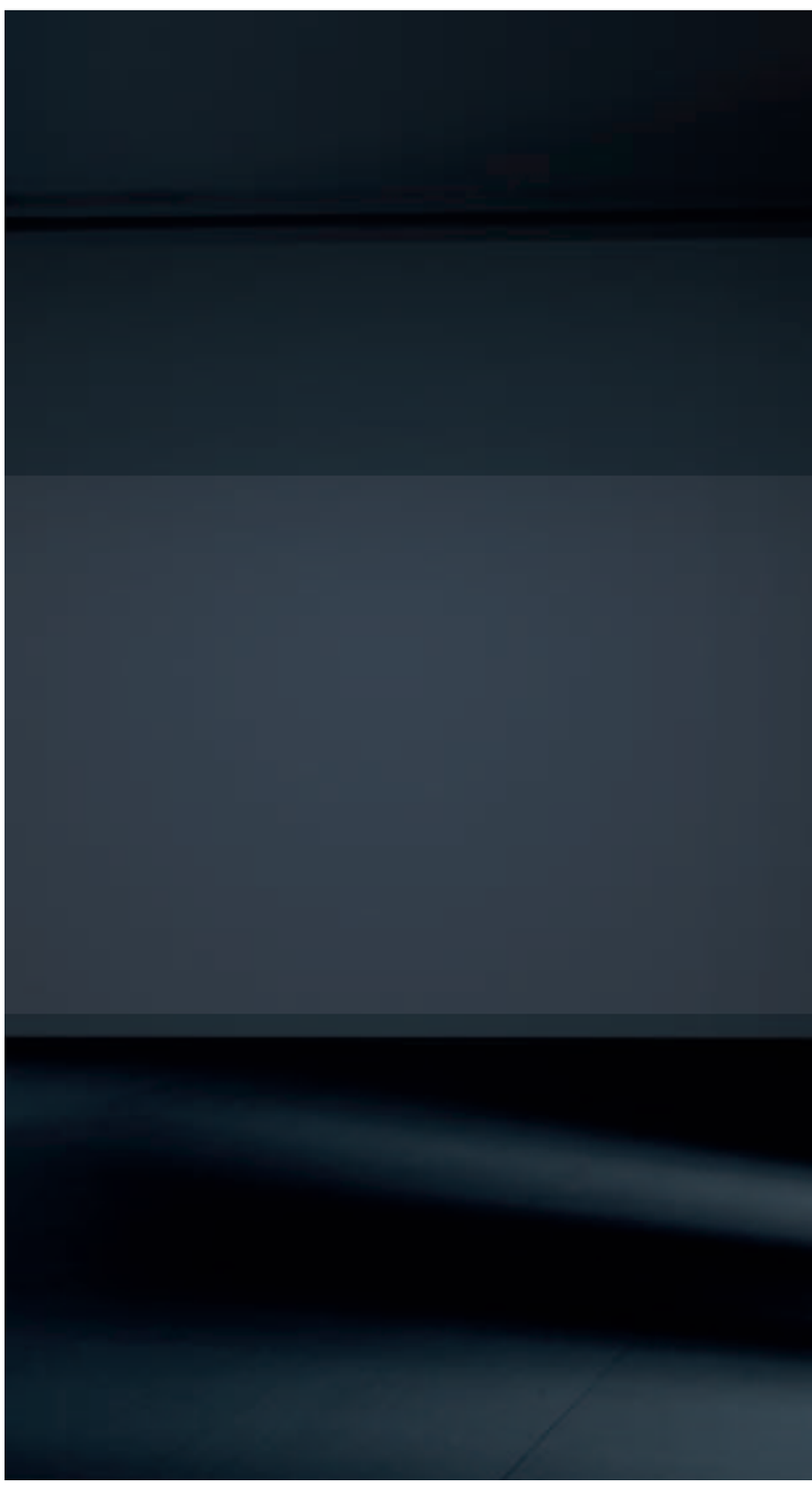


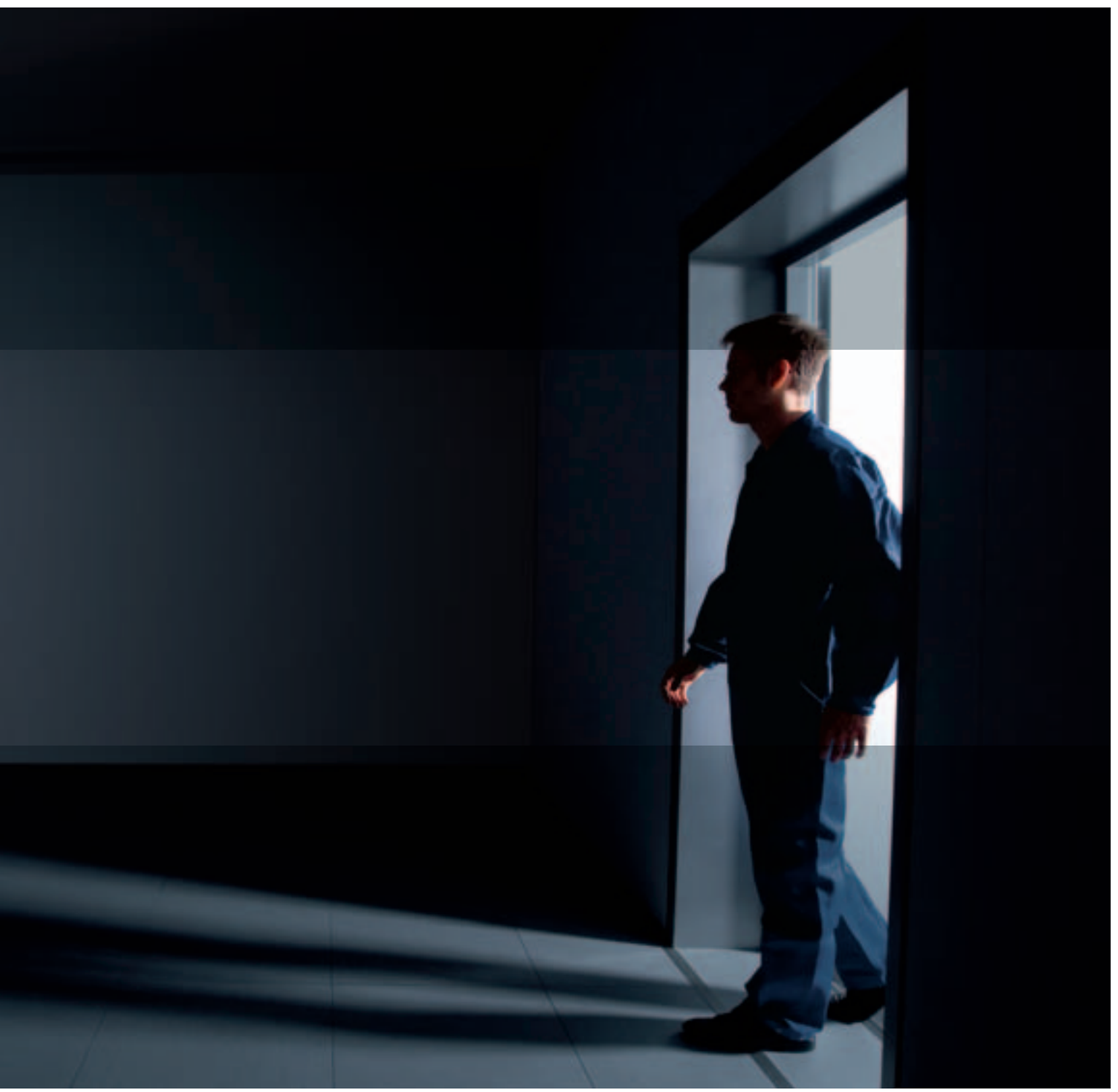
The brightness level increases – fatigue decreases.*

*Source: “Nutzen einer besseren Beleuchtung“ (Benefits of improved lighting). Final report at the University of Ilmenau. Long-term experiments in typical industrial workplaces with different subjects.

66% OF ALL WORK-RELATED ACCIDENTS OCCUR IN POOR LIGHTING.

Analyses have shown that insufficient lighting is a crucial factor in work-related accidents. Unlike expensive safety measure changes, lighting concepts from Waldmann offer considerably more efficient solutions without the expense.



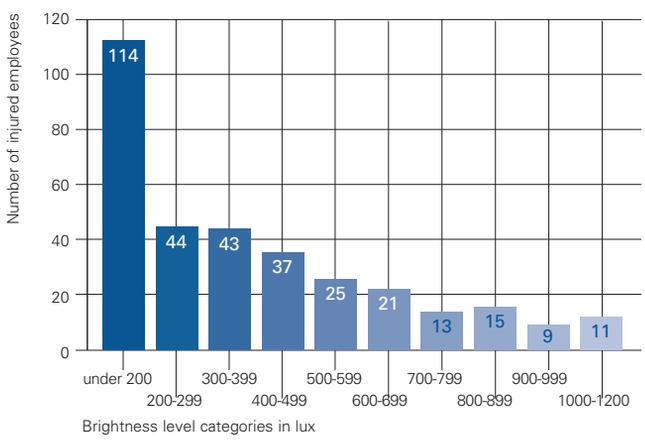


STATISTICS PROVE IT: AS THE LUX INCREASES, ACCIDENTS DECREASE.

Trade associations commissioned studies in 350 industrial workplaces to determine the correlation between the frequency of accidents and low lighting levels. The results support the theory that an investment in optimized lighting solutions makes sense.

More light means fewer work-related accidents.

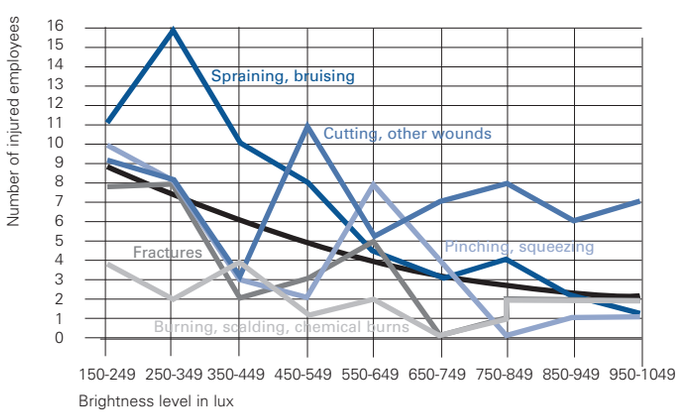
- 66% of all reported accidents occur in workplaces with a brightness level of less than 500 lx.
- A lighting solution with optimized lux values can clearly lower the number of accidents.



Fewer work-related accidents with better lighting.*

Sufficient light reduces the number and the extent of injuries.

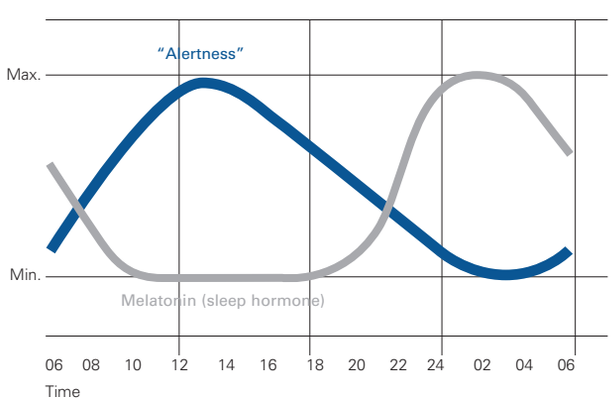
- Insufficient illumination results in the highest number of mistakes and errors.
- The most severe injuries occur at low lux values.
- As the lighting level increases, the number of injuries decreases, particularly severe injuries.
- Quality characteristics such as recognizing colors and avoiding glaring or stroboscopic effects play a role.
- Overall, the risk of injury decreases as the brightness level increases.



Frequency and severity of accidents as a function of the brightness level.*

The proper lighting solution provides more alert, focused employees.

- Light stimulates employees, creates alertness and suppresses the production of melatonin (sleep hormone).
- The production of "feel-good hormones" such as serotonin increases with proper light.



Light affects the production of melatonin, makes people alert.

*Source: University of Ilmenau, Metal Trade Association.


INGER

DON‘T STAY IN THE DARK WHEN IT COMES TO EMPLOYEE HEALTH.

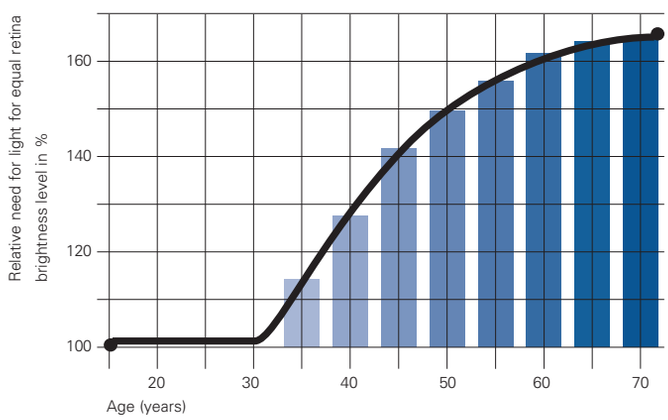
The TWIN-C lighting concept helps minimize age-related deficiency symptoms as well as distractions such as headaches due to glare. The idea that illumination directly impacts employee health in the office environment has been widely accepted. Now, manufacturing and production facilities are following this trend and improving their illumination levels as well. The truth is that the health of the employee directly affects the quality of their work, no matter the environment.

CREATE MORE ALERT EMPLOYEES.

Lighting has the most positive effect on employees when it is adjusted to the custom needs of each employee. Over time, the specific needs of employees will change according to their age and which shift they work.

Proper light can counteract symptoms of old age.

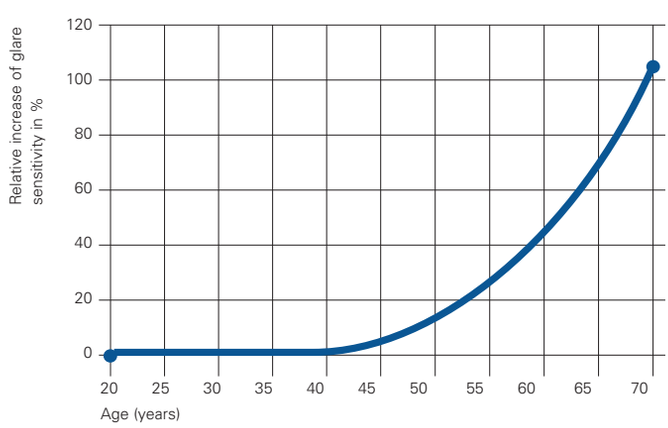
- Statistics show that the need for light increases with age. The eyes loses permeability and the average pupil width decreases. This creates the need for more light in any environment.
- A 60-year old employee requires double the light as his 20-year old colleague to see clearly.
- Even employees over the age of 35 have a greater need for light than 20-year old.
- The number of older employees in companies will increase in the coming years. As a result, the "lighting" topic will gain increasing importance – a lighting concept should address this issue.



The need for light increases with age.*
*Source: Prof. Ch. Schierz, H. Krueger

A properly lit facility should be void of glare and reflection.

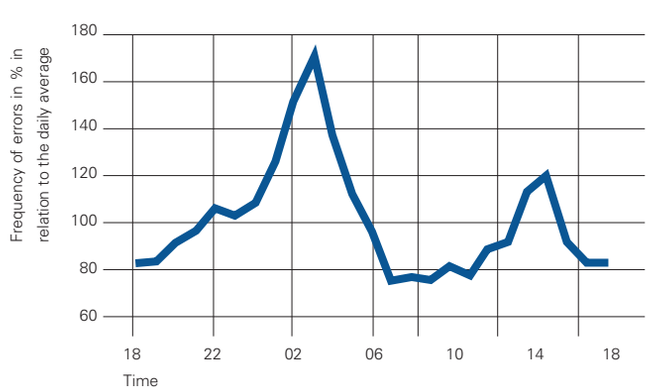
- Glare can distract employees from tasks and can affect their performance.
- Sensitivity to glare increases with age. The older the employee, the more accurate and safe their task lighting must be.
- Incorrectly positioned light sources can create a harsh, direct glare.
- Eliminating glare from glossy surfaces will help increase production and accuracy.



Glare is harmful – sensitivity increases with age.
*Source: Ch. Schierz

Increase productivity by providing individually adjustable luminaires.

- Each workplace and employee needs lighting solutions that are custom. Luminaires should be adjustable to meet these individual needs.
- An employee working the night shift requires more light than his colleague on the morning shift; at certain times of the day/night, the defect rate is significantly higher. This can be minimized with the correct lighting solution.
- Lighting solutions from Waldmann enable ideal individual adjustment. This can provide employees with improved concentration or allow a lighting design around the needs of employees.



Typical daily defect curve – light may "counteract".
*Source: Bjerner and Swenson

PROPER BALANCE OF LIGHT CREATES A MORE ENERGY EFFICIENT ENVIRONMENT.

TWIN-C lighting concepts ensure that light is used precisely where it is needed – thus eliminating wasted energy.

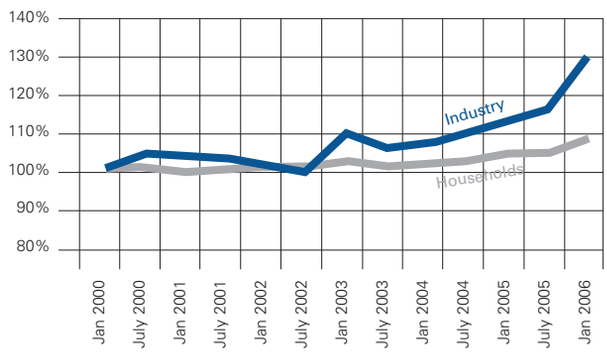

3
2
1

EXPERIENCE ENERGY SAVINGS THAT CLEARLY AFFECT THE BOTTOM LINE.

Waldmann knows intelligent TWIN-C lighting concepts enable energy savings in any production environment - illumination should be provided especially where an employee is working.

Power consumption through lighting is a cost factor.

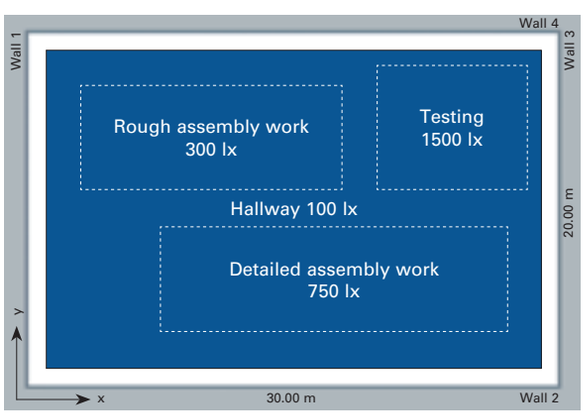
- Electricity and natural gas prices have risen drastically in the last few years (Electricity alone has gone up an average of 30% since 2005; data source Commonweath Edison 2005).
- Energy consumption awareness helps present a positive image to it's target markets therefore making it a competitive advantage for organizations of all sizes.
- As green-initiative awareness continually grows, companies are looking to as many cost-cutting resources as possible Proper lighting solutions can be both a tremendous electricity saving strategy and assist in the increase of productivity.



In Europe, the energy prices rose considerably - and will continue to rise.*
*Source: Eurostat, Brennstoffspiegel.

Pin pointing areas that need light.

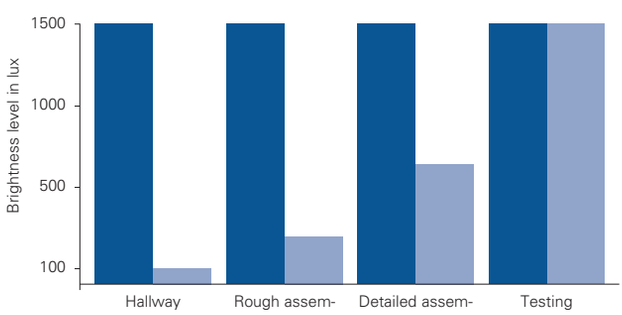
- Until now,organizations based the illumination of a production facility on the dimension of the building. This way, the entire space would be illuminated equally. With this lighting model, the actual requirements of the individual spatial zones are not taken into consideration. The result is wasted energy and improper illumination.
- The concern is that frequently, energy is consumed where it is not required – and light is lacking where it is needed: At the individual workplace.



Floor plan of a production building in the electrical industry with different zones, which according to EN 12464-1 (see page 36), require different brightness levels.

Illuminating only those areas where work is performed.

- According to the TWIN-C lighting philosophy,only the required amount of luminous power is used.
- The overall illumination is reduced to the necessary level, thus consuming less energy.
- This minimal energy usage does not leave the employees with less light.
  On the contrary: They have better individual lighting which offers them considerably more lux.



Spatial concept
Adjusting the brightness level in the entire room to the most difficult visual task, in this example, testing at 1500 lx = high energy demand.

Lighting designed for visual task, with a direct connection to the workplace
Targeted adjustment of the brightness level to the normative requirements of the visual task of the respective area = low energy demand.

TWIN-C ALLOWS COMPANIES TO OPERATE MORE EFFICIENTLY.

TWIN-C

The right light combination.

An increasing number of industrial businesses start to understand that lighting can be an extremely important productivity factor. This requires the correct philosophy consisting of "concepts" and "components": TWIN-C. Waldmann creates solutions that first address the custom requirements of the workplace and then provides ideal lighting conditions through the intelligent use of coordinated components.

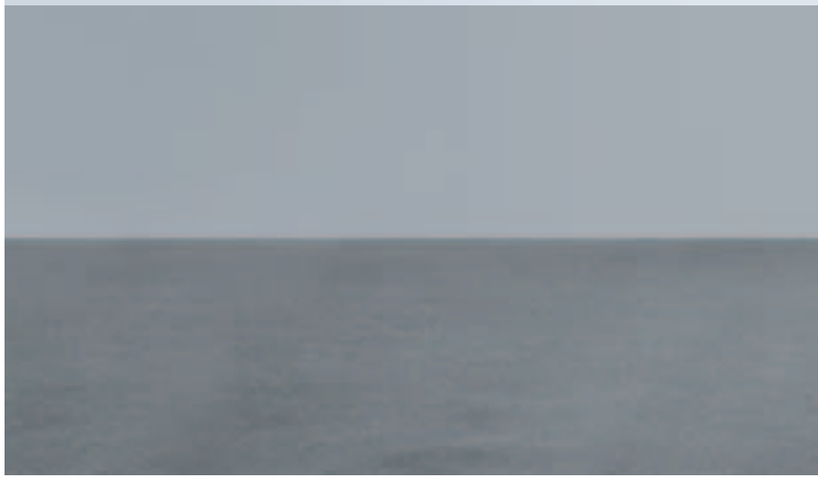
1. Concepts (example):

- Productivity: Lighting solutions for faster picking and placing, more reliable quality testing, more precise measuring and adjusting work.
- Safety: Proper brightness levels in the area where work is performed can lower the number of potential accidents.
- Health: The operator is provided with optimized lighting conditions, which support the employee's health and performance.
- Energy: In order to save energy, light is properly disbursed where work is performed.

2. Components (example):

Workplace:
- System lighting
- Universal luminaires
- Magnifying luminaires
- Hand-held luminaires
- Inspection luminaires

Machine:
- Protective-tube luminaires
- Halogen luminaires
- Recessed and surface-mounted luminaires
- LED luminaires



4 STEPS TO THE IDEAL LIGHTING SOLUTION.

Lighting solutions from Waldmann take organizations from a broad lighting concept to a tailored concept designed for visual tasks. When completed, this process demonstrates how employees can work more productively with proper lighting.

1 ANALYSIS

Waldmann Lighting Consultants survey the facility's illumination requirements on-site. The data is then analyzed for productivity, safety, health and energy savings.

2 CONCEPT

Based on the respective activities, this on-site "lighting analysis" and any necessary standards and practices, Waldmann then develops a custom lighting concept.

3 COMPONENTS

Once the lighting concept is established, the process enters the next phase: the selection and determination of the correct "components". Waldmann's full-line of facility lighting luminaires are defined.

4 SOLUTION

The result of this process is: The correct amount of light in the right location which helps achieve cost-effective production and increased morale among employees.

ANY INDUSTRIAL WORKPLACE CAN BECOME MORE PRODUCTIVE AS A RESULT OF LIGHT.

EN 12464-1 defines how to optimize industrial workplaces with lighting technology. Waldmann takes this process one step further and focuses not only on complying with this standard from a technology point of view, but also on the economical benefit for the customer.

EN 12464-1

Since March 2003, the industrial lighting standards have changed. EN 12464-1 defines the new requirements that are placed on the illumination of inside workplaces: Since then, the lighting system is defined based on the type of visual task. This means that, using the example of a grinding workstation, the workplace is divided into two tasks: 1. Grinding and adjusting the machine parameters, and 2. reading the drawing and measuring the workpiece. For these activities, individual luminaires are required. In addition, EN 12464-1 has defined brightness levels for nearly all industrial workplaces (see table pages 36-39).

TWIN-C Industrial workplace solutions:

At industrial workplaces, a variety of activities are often performed simultaneously:

- Reading technical instructions.
- Measuring materials.
- Recording data on monitors.
- Inspecting surfaces, and many more.

Each activity is a different "visual task", which often requires a different level of brightness. Waldmann individually adjusts the correct lighting solution to each workplace and employee.

Then: Antiquated Broad Illumination Concepts

- Light was adjusted to the space, not the task.
- Standard illumination of the entire space with generally high brightness levels.
- Brightness levels that were overall high, but individually low in areas where work is performed.
- High energy consumption.

Now: TWIN C Lighting Solution

- Lighting is adjusted to the people and the task.
- Customized lighting concepts for different work zones.
- Brightness levels that are overall low, but individually high in areas where work is performed.

Examples of industrial workplaces

- Assembly workplaces
- Production lines
- Quality control
- Packaging/order picking
- Aisles
- Machine operator workplaces
- Painting workstations

EXAMPLE 1: TWIN-C LIGHTING SOLUTION FOR ASSEMBLY WORKSTATIONS.

Only using ceiling lighting for manual inspections and detailed assembly work is not a good solution and wastes energy. Waldmann has the correct lighting solution for all your custom workstation needs.

Before TWIN-C

- General lighting permanently installed on the ceiling.
- The employees' individual lighting requirements have not been addressed.
- The flexible configuration of the assembly line has not been considered.
- High energy consumption because the lighting level must be very high in order to reach the employee (EN 12464-1 assembly work with average details= 500 lx).

After TWIN-C

- Reduced general lighting on the ceiling with the addition of workstation individual lighting.
- **Increased Productivity:** Higher performance, considerably fewer production and assembly errors.
- **Better Safety:** Reduced risk of accidents due to optimized visibility.
- **Improved Health:** Individually adjustable, satisfied and motivated employees.
- **Energy Savings:** Due to reduced general lighting.

Waldmann system lighting

- Lighting designed for visual tasks.
- General lighting can be reduced. The luminaire is portable for high flexibility.
- A sense of well-being is created with integrated glare protection.
- Allows for energy savings.

Waldmann universal luminaires

- Maximum adaptability to individual lighting needs.
- Ideal for shared workstations.
- Creates a sense of well-being.
- No heat generation in the luminaire head area.
- Retrofitting available.

EXAMPLE 2: TWIN-C LIGHTING SOLUTION FOR ELECTRONIC WORKSTATIONS.

Electronic workstations frequently involve small components with glossy surfaces. General ceiling lighting is not sufficient for this special visual task. Waldmann offers solutions that avoid glare and errors.

Before TWIN-C

- General lighting permanently installed on the ceiling.
- The employees' individual lighting requirements have not been addressed.
- The flexible configuration of the assembly line has not been considered.
- Reflections on glossy surfaces creates visual disturbances.
- Eyes become fatigued and errors may occur especially when using very small components.

After TWIN-C

- Reduced general lighting on the ceiling with the addition of workstation individual lighting.
- **Increased Productivity:** Higher performance, considerably fewer production and assembly errors.
- **Better Safety:** Reduced risk of accidents due to optimized visibility.
- **Improved Health:** Individually adjustable, satisfied and motivated employees.
- **Energy savings:** Only those areas where work is performed and light is required are illuminated.

Waldmann illumination luminaires

- For testing and assembly of medium to large parts.
- Increased safety in the production process by using daylight spectrum.
- Shadowl-free, wide-area lighting.
- Glare-free, accurate testing on all surfaces.

Magnifying luminaires

- For testing and assembly of small parts.
- Optimizes perception for quality and safety.
- Subject is illuminated with accuracy and energy-saving lighting.
- Ergonomically designed with fully pivoting, clear lens.
- Shadow-free for even illumination or may provide hard shadows for inspecting structured surfaces.

WALDMANN LUMINAIRES COMPLY WITH THE EN1837 STANDARD.

The EN 1837 standard defines all parameters for lights that are integrated in machines. Machine manufacturers are obligated to comply with this standard – and document their compliance. This is not a problem with a TWIN-C lighting solution from Waldmann.

Binding for all manufacturers: the EN 1837 standard.

Compliance with the EN 1837, which defines the requirements of machine-integrated luminaires, is binding for all machine manufacturers. The brightness level required must be considered as a function of the visual task. It must be sufficiently high and even to enable reliable and easy perception of the task. According to the standard, the average brightness level should be at least 500 lx. To avoid complaints or retrofitting, simply contact Waldmann.

An overview of the EN 1837 standard:

Brightness level:
The brightness level must be sufficiently high and even. Minimum: 500 lx

Avoiding glare:
According to the standard, any glare of people must be avoided. Be it in the form of direct or indirect glare of operators – or of people in adjacent zones.

No shadowing:
According to the standard, no interfering shadows may develop in the work area. Waldmann adjusts the lighting system to avoid shadowing.

No stroboscopic effects:
Stroboscopic effects must be completely avoided. These are caused by conventional ballasts. The consequences are extremely severe injuries. Waldmann eliminates these effects!

Satisfying a standard is one thing. Creating ideal lighting conditions for customers and operators is another. Speak with a Waldmann representative to ensure that your lighting solution is customized for your specific applications.

TWIN-C meets all requirements – including documentation.

To meet all criteria for lighting technology and ergonomics, a lighting concept and documentation must be prepared since every manufacturer is required to guarantee, verify and document that the lighting equipment on machines complies with the necessary standard. Today, the majority of customer orders relate to standards that are in force, with compliance being subject to increasing verification. The Waldmann lighting consultants support all machine manufacturers through personal consultations, by performing light measurements on-site and by creating all measurement reports required for documentation purposes.


NC 160

EXAMPLE 1: TWIN-C LIGHTING SOLUTION FOR OPEN MACHINE TOOLS.

Open-machine tooling environments are frequently equipped with general ceiling lighting for adjusting, measuring and testing activities. This type of lighting is particularly unsafe for the operators. TWIN-C offers the right solutions.

Before TWIN-C

- General lighting on the ceiling.
- No lighting on the machine itself.
- The employees' individual lighting requirements have not been addressed.
- The different lighting needs of the employees remain without consideration.
- Energy consumption is extremely high.

After TWIN-C

- Reduced general lighting on the ceiling with the addition of workstation individual lighting.
- **Increased Productivity:** Higher performance, considerably fewer production and assembly errors.
- **Better Safety:** Reduced risk of accidents due to optimized visibility.
- **Improved Health:** Individually adjustable.
- **Energy savings:** Only those areas where work is performed and light is required are illuminated.

Waldmann LED machine luminaires

- Ideal for error-free, safe adjustment and maintenance work.
- Direct and spot illumination of the machining area.
- Maximum efficiency: high energy savings, long service life.
- No stroboscopic effect.
- Non-sensitive LED technology (percussion, vibrations, frequent switching on and off).
- No heat radiation in the direction of the light beam.

Waldmann halogen machine luminaires

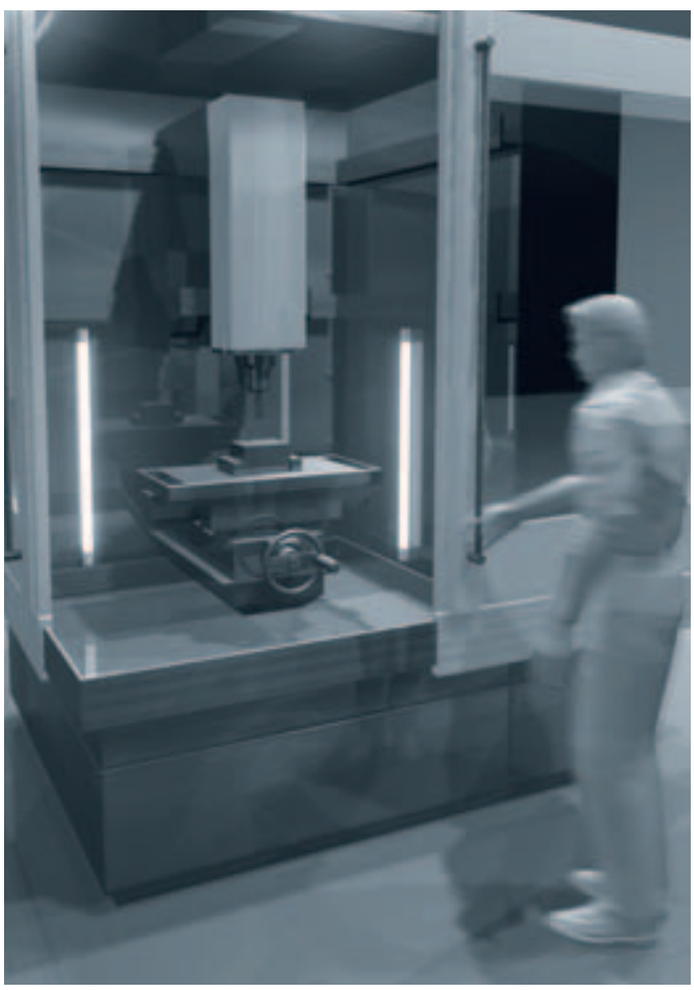
- Maximum brightness levels for detailed work, spot illumination and high luminous intensity.
- Stray light for inspecting surfaces.
- Flexible even over long distances.
- Easy and quick to adapt and adjust.
- No stroboscopic effect.
- Water-tight with different radiation angles.

Waldmann hand-held luminaires

- Flexible and compact, ideal for testing, repair and maintenance work.
- Well-suited for tight applications.
- Wide-area illumination with high luminous intensity, maximum luminous flux with minimized design.
- Maximum resistance to water, dust or percussions.

EXAMPLE 2: TWIN-C LIGHTING SOLUTION FOR ENCLOSED MACHINERY.

The lighting of enclosed machinery and especially of the machining area with the required 500 lx is not always guaranteed. In addition, these areas are frequently subject to glare and shadows. TWIN-C demonstrates how these machines can be properly and evenly illuminated.



Before TWIN-C

- First problem: Achieving uniform brightness levels of 500 lx (according to EN 1837) is difficult, especially where the work is performed.
- Second problem: Attaching the light in the area of the visual task.
- Partial glare effects and also shadowing.
- High energy demand to provide general lighting of the machine space.

After TWIN-C

- Correct installation of a compliant protective-tube or recessed lighting will provide basic illumination. In addition, another component should be used to properly illuminate the machine area.
- **Productivity:** No defects during adjustment or measurement procedures.
- **Safety:** In the machining area 500 lx for lower risk of accidents.
- **Health:** Sufficient illumination,glare-free and no stroboscopic effects.
- **Energy savings:** Due to the separate light in the machining area, the general lighting in the machine can be reduced.

Waldmann LED machine luminaires

- Ideal for error-free, safe adjustment and maintenance.
- Direct and spot illumination of the machining area.
- Maximum efficiency: high energy savings, long service life.
- No stroboscopic effect.
- Heat dissipates to the rear of the luminaire head.
- Eliminates both movement from vibrations and frequent switching on and off.

Waldmann protective-tube machine lighting

- Even, wide area lighting of the entire machining area.
- Increased safety in the production process, glare-free.
- Errors are easily recognized for faster corrections.
- Tested and proven resistance to extreme conditions: vibration, temperature, water pressure, corrosive coolants and lubricants.

Waldmann machine recessed and surface-mounted lighting

- Allows for more space of machining (luminaire is recessed in the machine wall).
- Even, wide area lighting of the entire machining area.
- Increased safety, glare-free. Production or measurement errors are easily recognized for faster corrections.
- Tested and proven resistance to extreme conditions: resistant to sharp-edged metal shavings, no area for shavings to accumulate.

PROPER LIGHTING FOR ANY REQUIREMENT.

Excerpt from DIN EN 12464-1 regarding the illumination of indoor workplaces.
The listed values are requirements.

Waldmann
ENGINEER OF LIGHT.

Traffic zones and general areas inside of buildings

Type of room, task or activity	$\bar{E}_m$	R_a
Traffic areas and hallways	100	40
Stairs, escalators, moving walkways	150	40
Loading ramps, loading areas	150	40

Warehouses and cold storage rooms

Type of room, task or activity	$\bar{E}_m$	R_a
Storage and warehouse rooms	100	60
Shipping and packing areas	300	60

(High-bay) Racking

Type of room, task or activity	$\bar{E}_m$	R_a
Tracks without passenger traffic	20	40
Tracks with passenger traffic	150	60
Control room	150	60

Industrial and craftsmen activities Ceramics, tiles, glass, glasswares

Type of room, task or activity	$\bar{E}_m$	R_a
Drying	50	20
Material processing, general machine work	300	80
Enameling, rolling, pressing, molding simple parts, glazing, glass marking	300	80
Grinding, engraving, buffing glass, molding small parts, production of glass instruments	750	80
Grinding of optical glasses, crystal, manual grinding and engraving, working on medium-sized parts	750	80
Detailed work, e.g. grinding ornamentation (ornamental grinding), manual painting	1000	90

Industrial and craftsmen activities Ceramics, tiles, glass, glasswares

Type of room, task or activity	$\bar{E}_m$	R_a
Production/processing of synthetic precious stones	1500	90

Chemical industry, plastics and rubber industry

Type of room, task or activity	$\bar{E}_m$	R_a
Processing systems with remote control	50	20
Processing systems with occasional manual intervention	150	40
Continuously occupied workplaces in processing systems	300	80
Precision measuring chambers, laboratories	500	80
Drug manufacture	500	80
Tire production	500	80
Color testing	1000	90
Cutting, reworking, control work	750	80

Electrical industry

Type of room, task or activity	$\bar{E}_m$	R_a
Cable and wire production	300	80
Winding		
▪ large coils	300	80
▪ medium-sized coils	500	80
▪ fine coils	750	80
Impregnating of coils	300	80
Electroplating	300	80
Assembly work		
▪ rough, e.g. large transformers	300	80
▪ medium-sized, e.g. control panels	500	80
▪ detailed, e.g. telephones	750	80
▪ very detailed, e.g. measuring instruments	1000	80
Electronic repair shops, testing, adjusting	1500	80

Waldmann
ENGINEER OF LIGHT.

Food, beverage and tobacco industry

Type of room, task or activity	$\bar{E}_m$	R_a
Workplaces and work zones in ▪ Breweries, on malting floors ▪ for cleaning, for bottling in barrels, for cleaning, for straining, for peeling ▪ for boiling in canning and chocolate factories ▪ Workplaces and work zones in sugar factories ▪ for drying and fermenting raw tobacco, fermenting cellars	200	80
Sorting and washing products, milling, blending, packaging	300	80
Workplaces and critical zones in slaughter houses, butcher shops, dairies, mills, on filter floors in sugar refineries	500	80
Cutting and sorting fruit and vegetables	300	80
Production of delicatessen products, kitchen work, production of cigars and cigarettes	500	80
Inspection of glasses and bottles, product inspection, garnishes, sorting, decorating	500	80
Laboratories	500	80
Color inspection	1000	90

Foundry and metal casting

Type of room, task or activity	$\bar{E}_m$	R_a
Walkable underground tunnels, cellars etc.	50	20
Platforms	100	40
Sand processing	200	80
Workplaces on the cupola melting furnace and the mixer	200	80
Casting houses	200	80

Foundry and metal casting

Type of room, task or activity	$\bar{E}_m$	R_a
Emptying stations	200	80
Machine molding	200	80
Hand and core molding	300	80
Diecasting	300	80
Prototyping	500	80

Jewelry production

Type of room, task or activity	$\bar{E}_m$	R_a
Processing of precious stones	1500	90
Production of jewelry	1000	90
Watch-making (manual)	1500	80
Watch production (automatic)	500	80

Leather and leather products

Type of room, task or activity	$\bar{E}_m$	R_a
Working on vats, barrels, mines	200	40
Scouring, splitting, sanding, fulling the skins	300	80
Saddler work, shoe-making: stitching, sewing, buffing, pressing, cutting to size, stamping	500	80
Sorting	500	90
Tanning (automatic)	500	80
Quality control	1000	80
Color testing	1000	90
Shoe-making	500	80
Glove production	500	80

Metal cutting and metal working

Type of room, task or activity	$\bar{E}_m$	R_a
Free-form cutting	200	60
Drop forging	300	60
Welding	300	60
Rough and average machine work: Tolerances ≥ 0.1 mm	300	60
Fine machine work, grinding: tolerances < 0.1 mm	500	60
Tracing, inspection	750	60
Wire and pipe drawing, cold forming	300	60
Machining heavy sheet metal: thickness ≥ 5 mm	200	60
Machining lightweight sheet metal: thickness < 5 mm	300	60
Production of tools and cutlery	750	60
Assembly work:		
▪ rough	200	80
▪ medium	300	80
▪ fine	500	80
▪ very fine	750	80
Electroplating	300	80
Surface machining and painting	750	80
Production of tools, gauges and devices, precision and micro mechanics	1000	80

Paper and paper products

Type of room, task or activity	$\bar{E}_m$	R_a
Working on beaters, edge runners, wood grinding machines	200	80
Paper production and processing, paper and cardboard machines, cardboard box production	300	80
General book-binding work, e.g. folding, sorting, gluing, cutting, stamping, sewing	500	80

Power plants

Type of room, task or activity	$\bar{E}_m$	R_a
Fuel supply facilities	50	20
Boiler houses	100	40
Machine shops	200	80
Secondary rooms, e.g. pump rooms, condenser rooms etc.; switching systems (in buildings)	200	60
Switch rooms	500	80
Outside switch rooms	20	20

Print shops

Type of room, task or activity	$\bar{E}_m$	R_a
Cutting, gold-plating, stamping, etching of printing plates, working on stones and plates, printing machines, matrix production	500	80
Paper sorting and block printing	500	80
Type-setting, retouching, lithography	1000	80
Color inspection during multi-color printing	1500	90
Steel and copper engraving	2000	80

Rolling mills, smelteries and steel mills

Type of room, task or activity	$\bar{E}_m$	R_a
Production facilities without manual intervention	50	20
Production facilities with occasional manual intervention	150	40
Production facilities with continuous manual intervention	200	80
Slab warehouse	50	20
Furnace	200	20
Rolling mill, swifts, shearing/separating stations	300	40
Control platform, control stands	300	80

Waldmann
ENGINEER OF LIGHT.

Rolling mills, smelteries and steel mills

Type of room, task or activity	$\bar{E}_m$	R_a
Testing, measuring and inspection stations	500	80
Walkable underground tunnel, conveyor roads, cellars etc.	50	20

Textile production and processing

Type of room, task or activity	$\bar{E}_m$	R_a
Workplaces and work zones on baths, bale openers	200	60
Carding, washing, ironing, working on the shredder, stretching, combing, finishing, lacing cords, prespinning, jute and hemp spinning	300	80
Spinning, twining, spooling, winding	500	80
Warping, waving, braiding, knitting	500	80
Sewing, fine-gauge knitting, taking up stitches	750	80
Drafting, designing	750	90
Underlaying, dying	500	80
Drying chamber	100	60
Automatic textile printing	500	80
Napping, looping, stripping	1000	80
Color inspection, textile inspection	1000	90
Invisible mending	1500	90
Hat manufacture	500	80

Automobile production

Type of room, task or activity	$\bar{E}_m$	R_a
Body production and assembly	500	80
Painting, spray booths, grinding booths	750	80
Painting: touch-ups, inspection	1000	90
Upholstery	1000	80
Final inspection	1000	80

Woodworking and wood processing

Type of room, task or activity	$\bar{E}_m$	R_a
Automatic processing, e.g. drying, laminated wood production	50	40
Steaming beds	150	40
Saw frame	300	60
Working on the planing bench, gluing, assembly	300	80
Grinding, painting, joiner's shop	750	80
Working on wood processing machines, e.g. turning, grooving, true running, rabbeting, cutting, sawing, milling	500	80
Selecting veneer wood	750	90
Marquetry, wood inlay work	750	90
Quality control	1000	90

Explanations:

$\bar{E}_m$: Average brightness level. The quotient of the luminous flux and the surface with which it meets corresponds to the brightness level. In general, it is determined on horizontal and vertical surfaces and listed in the unit of measure of lux.

R_a: Color rendering index, which was introduced for the objective identification of the color rendering properties of a light source. The highest possible R_a value is 100. This value decreases with decreasing color rendition quality.

HEADQUARTERS GERMANY
Herbert Waldmann GmbH & Co. KG
Postfach 50 62
D-78057 Villingen-Schwenningen
Phone +49 7720 601-100
Fax +49 7720 601-290
www.waldmann.com
info@waldmann.com

FRANCE
Waldmann Eclairage S.A.S.
Z.I. Rue de l'Embranchement
F-67116 REICHSTETT
Mailing address:
BP 23431 Reichstett
F-67455 MUNDOLSHEIM Cedex
Phone +33 (0) 388209588
Fax +33 (0) 388209568
www.waldmann.com
info-fr@waldmann.com

ITALY
Waldmann Illuminotecnica S.r.l.
Via della Pace, 18 A
IT-20098 San Giuliano Milanese (MI)
Telephone: +39 02 98 24 90 24
Fax: +39 02 98 24 63 78
www.waldmann.com
info-it@waldmann.com

THE NETHERLANDS
Waldmann Lichttechniek B.V.
Lingewei 19
NL-4004 LK Tiel
Telephone: +31 (0) 344 - 631019
Fax: +31 (0) 344 - 627856
www.waldmann.com
info-nl@waldmann.com

AUSTRIA
Waldmann Lichttechnik Ges.m.b.H.
Gewerbepark Wagram 7
AT-4061 Pasching/Linz
Telephone: +43 (0)722967400
Fax: +43 (0)722967444
www.waldmann.com
info-at@waldmann.com

SWITZERLAND
Waldmann Lichttechnik GmbH
Benkenstasse 57
CH-5024 Küttigen
Telephone: +41 (0)62 839 1212
Fax: +41 (0)62 839 1299
www.waldmann.com
info-ch@waldmann.com

UK
Waldmann Lighting Ltd.
Holme Well Road
Middleton
GB-Leeds LS 10 4TQ
West Yorkshire
Telephone: +44 1132775662
Fax: +44 1132775775
www.waldmann.com
enquiries@waldmannlighting.co.uk

USA
Waldmann Lighting Company
9 W. Century Drive
Wheeling, Illinois 60090, USA
Telephone: +1 847 520-1060
Fax: +1 847 520-1730
www.waldmannlighting.com
waldmann@waldmannlighting.com

CHINA
Waldmann Lighting (Shanghai) Pte. Ltd.
Part A, No. Five Normative Workshop
199 Changjian Road, Baoshan
CN-Shanghai, P.R.C. 200949
Telephone: +86 21 5169-1799
Fax: +86 21 3385-0032
www.waldmann.com
s.lo@waldmann.com.cn

SINGAPORE
Waldmann Lighting Singapore Pte. Ltd.
Blk 168, Jalan Bukit Merah,
#04-09B, Connection One, Tower 3,
Singapore 150168
Telephone: +65 62758300
Fax: +6vvvvvvvvv5 62758377
www.waldmann.com
sales@waldmann.com.sg