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Ergonomic Work Bench Systems for Industrial & Commercial Use

How to increase your operating efficiency by setting up manual workstations.



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1. Abstract

This document explains the scope of ergonomics based on recent research: why businesses can benefit from having ergonomic workstations, what requirements apply to workstation design, and what conditions a provider of work bench systems should meet.

There are two main reasons a business might be considering purchasing a work bench system:

- There are plans to set up a new production environment, for instance because a new product is being launched. A suitable work bench system must be chosen to accommodate these plans and meet technical and economic requirements.
- There are plans to improve an existing production environment. In this case, the business needs replacement equipment or additional components to supplement existing equipment.

These guidelines shed light on the term “ergonomics” and the economic benefits that ergonomics can bring. On that basis, this document then goes on to outline ergonomic and economic decision-making criteria that can help in selecting a work bench system.



2. Ergonomics – what for?

Effective and efficient organization of work takes ergonomic findings into account with regard to workstations. This is because an ergonomically designed workstation can save time, prevent symptoms of fatigue in employees, and minimize employees' health risks. Work-related physical strain is reduced, even if the employee uses the same workstation for years.

An ergonomic workstation always meets occupational safety and health requirements. The same is not true in reverse, however, because ergonomics goes beyond occupational safety and health regulations. But the goal of ergonomics involves more than merely preventing occupational accidents and job-related health problems; working conditions at an ergonomic workstation are arranged to ensure optimum employee performance.

The main ergonomics criteria at a glance

A number of requirements must be taken into account for ergonomic design:

- Adequate freedom of movement
- Ideal use of handling are to enable natural movements of the body and prevent those that cause strain
- Suitable working surface

- Individual working height for standing and seated positions
- Chair that enables dynamic sitting
- Appropriate provision and positioning of tools and materials
- Lighting and visual conditions designed according to activities

During this process, it is important to note that every employee has his or her own individual skills and deficits that should be taken into account in designing the work bench.

Comfort and well-being as factors in ergonomics

Research on work and the workplace takes not only medical findings, but also **psychological findings**, into account. This means that one very important factor in ergonomics is a **sense of physical comfort**, which is based on assessment of a work object and on the user's subjective evaluation of it.

With regard to a **work bench**, that sense of comfort is based first and foremost on the unit's functionality (how easy the work bench is to use) and secondly on its design (how it looks, for example whether it looks "cheap" or high-quality).

A work bench's **functionality** ensures, first, that the work bench is suitable for its intended purpose. For example, it must be sturdy enough. In addition, the work bench may have features

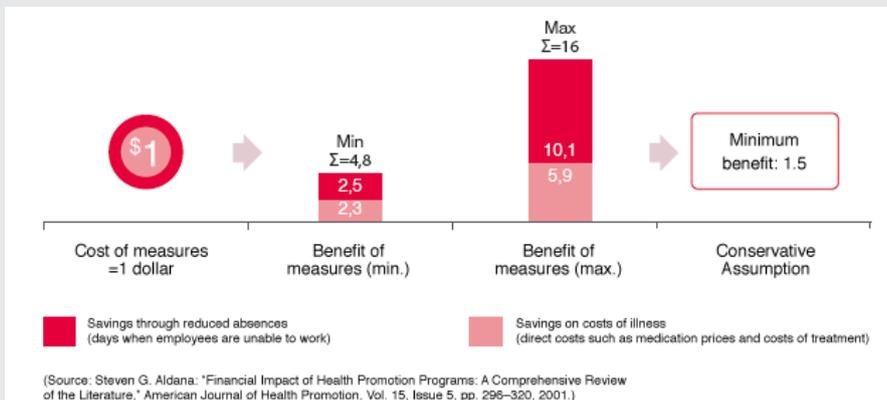
Ergonomics in workstation design implies optimized performance, thereby exceeding occupational safety and health requirements.



that make it easier for users to go about their work, such as an electrical height-adjustment system, well organized arrangement of information, or options for individual adjustment and adding equipment and accessories. These additional features also affect the work bench's functionality.

The **design** of the work bench also aims to set up the user's work in a comfortable and pleasant environment. This might mean, for instance, that employees like to sit at their work bench because they like the work bench itself, and that this expression of appreciation is also equated with positive commitment. ("At my work, the bosses aren't the only ones with high-end equipment at their workstations.")

In summary, ergonomics aims to achieve two goals: creating the best possible working conditions for people while also achieving maximum productivity, which can boost the company's profitability. This insight can be crucial in deciding to invest in a work bench system.



A best practice cost-benefit analysis of preventive occupational safety and health measures shows a minimum overall benefit to the economy of 1:5 for every dollar spent

3. Ergonomics – is it worthwhile?

Ergonomics can help enhance employee satisfaction and productivity, thereby boosting profitability.

The research literature available on work and the workplace shows that certain methods can be used to demonstrate that it is financially advantageous for a company to improve employees' working conditions with ergonomics in mind. There are three "rules of thumb" that apply in this regard:

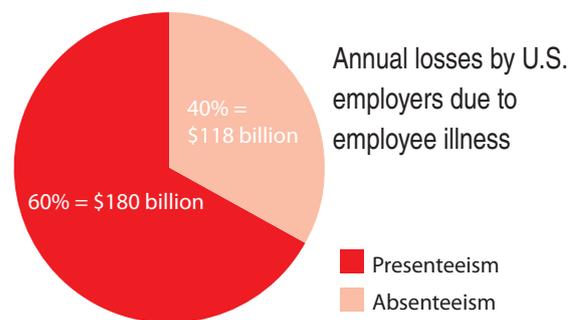
No. 1 rule of thumb

Ergonomics has many positive effects:

- Improved work performance
- Greater sense of well-being in the workstation
- Fewer absences
- Less presenteeism

"Presenteeism" is the tendency for employees to go to work even when they are ill and should stay home. This generates costs, for example due to lower work quality, accidents, deteriorating health, or mental exhaustion (burnout).

A 2011 study estimates that the financial losses due to presenteeism are considerably higher than those due to absenteeism.

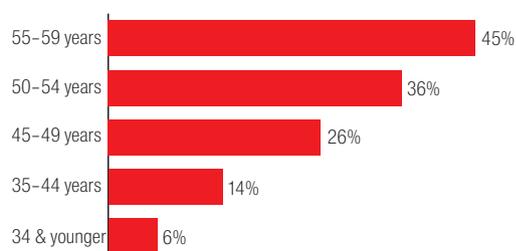


(Source: Tammy Prater, Kim Smith: "Underlying Factors Contributing to Presenteeism and Absenteeism," Journal of Business Economics Research, Vol. 9, Issue 6, pp. 1-14, 2011.)

No. 2 rule of thumb

The performance capacity of an employee who works in manual production generally decreases as that employee's age increases. This is part of the natural process of aging. Ergonomically designed workstations can help compensate for or delay some age-related deficits, at least in part.

Percentage of employees of production companies with limited performance



(Source: Gert Zülch and Patricia Stock (eds.): "Auswirkungen der demographischen Entwicklung in Montagesystemen" (Effects of Demographic Trends in Assembly Systems), Karlsruhe Institute of Technology, Institute of Work and Workplace Studies and Business Organization, p. 12, 2009.)



No. 3 rule of thumb

If a company is considering multiple work bench systems, the one that offers the best ergonomics should be given preference if the provider of that work bench system meets the criteria mentioned in these guidelines (see “Requirements for manufacturers”).

Conclusion: Ergonomics is worthwhile! Taking these rules of thumb into account directly affects the company’s cost-effectiveness since employee performance can be optimized and illness-related absences can be minimized. The next section explains what factors need to be considered in detail in order to create an ideal work environment.



An electrical height-adjustment system makes it possible to shift between seated and standing work positions.

4. Requirements for a work bench system

A work bench system for business use needs to meet the company's requirements and employees' needs. The manufacturer should be able to provide ergonomic workstations even where there are specific requirements such as full ESD (electrostatic

discharge) protection. This section discusses concrete criteria for workstation design according to ergonomic conditions, grouped into seven categories to apply to most businesses.

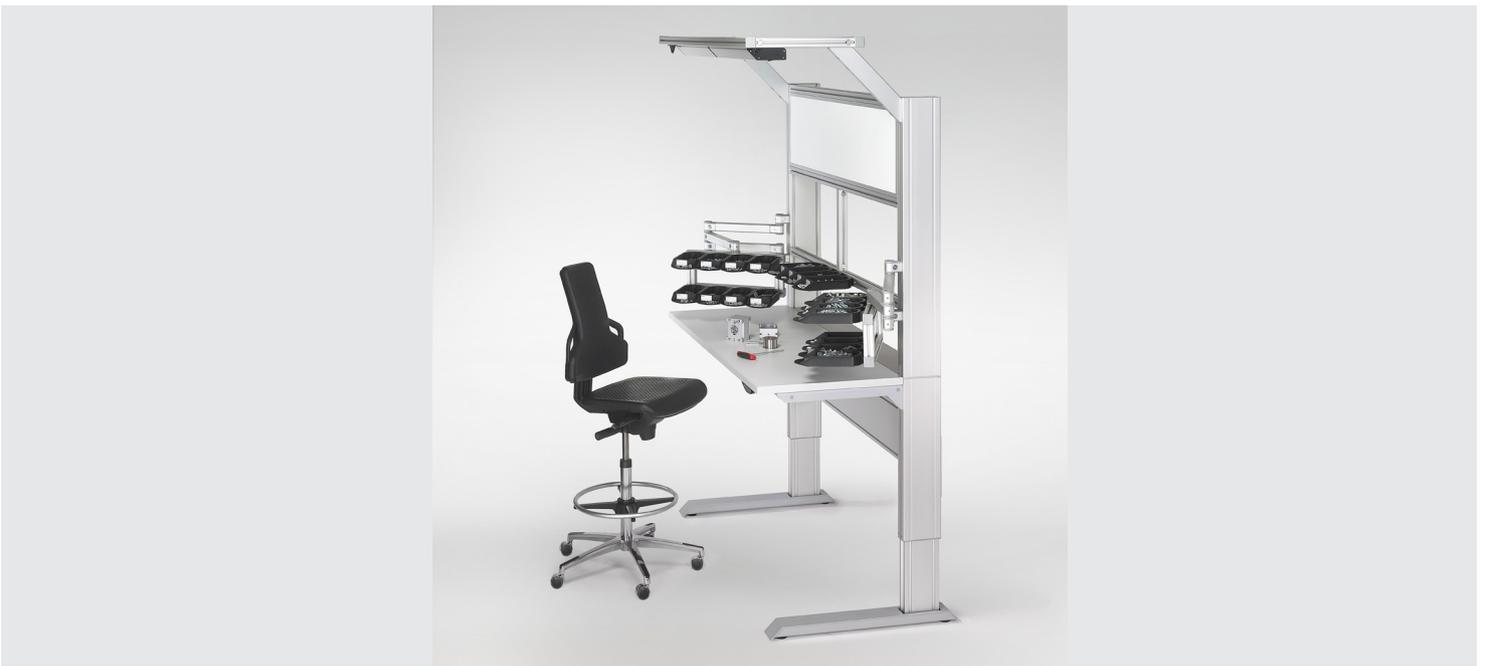
4.1 Work bench

The requirements that apply to a work bench are first and foremost of a technical nature: The work bench has to be suitable for its purpose. It should also meet the following ergonomic requirements:

1. The work bench system should offer **fastening options for securing all working materials**. It should be possible to expand it by adding suitable uprights and overhands. Fixtures for tools or parts containers should be arranged efficiently on the work bench. They should also be sturdy enough for the purpose, but also easy to remove if fast reconfiguration is necessary.

The upright and overhang offer options for attaching components to the work bench for purposes such as providing electricity and data, materials, tools, or lighting.

» For more information, please see the "Provision" section.



2. The work bench should be **electrically height-adjustable**. With an electric height adjustment system, the working position can be adjusted precisely to accommodate the specific employee's physical proportions. Ideally, employees should be able to switch as desired between standing and seated work positions. This helps counter lopsided **strain profiles** and **those with adverse health consequences**. If having a height-adjustable workstation is not favored because of the production environment (for instance because multiple workstations are interlinked together), an appropriate height-adjustable footrest is required in addition to easy-to-use seat height adjustment.
 - » For more information, please see the "Chair" and "Intralogistics" sections,
3. The work bench should be available in various sizes. The **optimum width and depth** of the work bench, which depends on the work task and the physical space available, should be feasible with the standard dimensions offered by the manufacturer. If the standard dimensions do not fit in a certain case, the manufacturer must be willing to supply the individual dimensions requested by the customer.
4. The work bench surface must be **adequately sturdy** and resistant to mechanical strain as well as resistant to any fluids used in the process. It should also be non-reflective and able to absorb noise.
5. The work bench should offer adequate **legroom**. As a result, parts such as clamping elements in the leg area are not considered favorable.



Good chairs are padded, easy to clean, adjustable, and can accommodate add-on armrests and footrests.

4.2 Chair

A chair's quality is a major factor in the well-being of the employee using it. A high-quality chair protects the back, since it is optimally adjusted to the employee and promotes dynamic sitting.

1. The **seat** and **backrest** should be **padded**. A chair that lacks padding is uncomfortable when used for long periods and can impede circulation.
2. The cushions should be **easy to clean**. Alongside aesthetic reasons, there are also hygienic reasons for this. The cushions should also have a long lifespan and be resistant to materials such as lubricants, penetrating or corrosive particles, and cleaning agents.
3. The seat should be inclined forward slightly to encourage a pelvic tilt, and thus **upright, proper posture when seated**.
4. The chair should have a **tilt- and height-adjustable backrest** with adjustable resistance. The employee should be able to make all adjustments from a seated position.
5. The chair should **rotate** and have **casters**. Chairs for normal sitting heights should be equipped with **casters with brakes**. For a higher sitting position, **foot gliders** should be used to prevent accidents when getting on the chair.
6. The chair can be equipped with **height- and width-adjustable armrests**. Armrests reduce strain on the shoulder and lower arm muscles while also improving hand positioning. The lower arm cannot be braced on the edge of the work bench during all assembly activities. The chair should also offer sufficient room to move in the shoulder area.
7. It should be possible to add a **footrest** to the chair. Especially with higher seating positions, a footrest supports healthy posture. If approved for the purpose, it can also be used to help employees get on the chair.
8. It should be possible to make all **adjustments** from a **seated position**. This ensures that optimum settings can be made directly.



4.3 Power and data supply

Ensuring that the workstation is reliably connected to various electrical and other supply lines is an essential factor when it comes to a smooth workflow. Along with general connections to the local electrical grid via power strips, data cables, communication lines, compressed air lines also need to be installed. A generously dimensioned cable duct offers a secure, tidy place for electrical components and extra cables.

It should be possible to ensure that the workstation and its components are connected with a neat and tidy look. These features should also be implemented with a general eye to occupational safety and health.

1. An **easy-to-install** power supply with various connections that can be placed in varying positions is required. It must also be possible to add USB, network, and phone connections
2. The workstation should be able to be equipped with a **compressed air supply that can be placed in various positions**.
3. The work bench system should offer the option of **securing all cables and other lines** in place so that they do not get in the way, but are still easily accessible in case additional lines are needed.
4. For **height-adjustable** electric work benches, **flexible cable routing** must be ensured. This minimizes the risk of accidents and equipment failures.
5. It is often advisable to secure every workstation separately with a **residual current device**. This enhances user safety and offers protection from wider-ranging equipment failures in the event of a fault.



4.4 Lighting

In addition to visual acuity, lighting also affects employees' sense of well-being, performance capacity, and concentration (number of assembly errors and workplace accidents). The work bench system must therefore be able to accommodate optimum lighting.

What is needed, therefore, is a broad spectrum of different lamp types (such as spotlights, magnifying lamps) and equipment that can be used to position and direct these lamps.

1. Lighting intensity should be **adjusted individually** to the process and the employee. It is also a good idea to consider energy use when mapping out the overall lighting concept.
2. Having a lot of shadow on the working surface is disruptive and affects concentration. **Largely low-shadow illumination** should be preferred. This is achieved by using as few different lamps as possible, ideally with diffuse lighting.
3. **Parabolic reflector grids** or **microprisms** can be used with optimum directionality to reduce direct glare. Indirect glare due to reflective surfaces in the work environment, including the workpiece itself, should also be taken into account.
4. Flickering is often apparent and perceived as disruptive, especially in the case of simple lighting using fluorescent tubes. Lights with **electronic lamp control units** can help with this.
5. In most cases, a neutral white **color temperature (3300K–5300K)** is considered the best setting. The

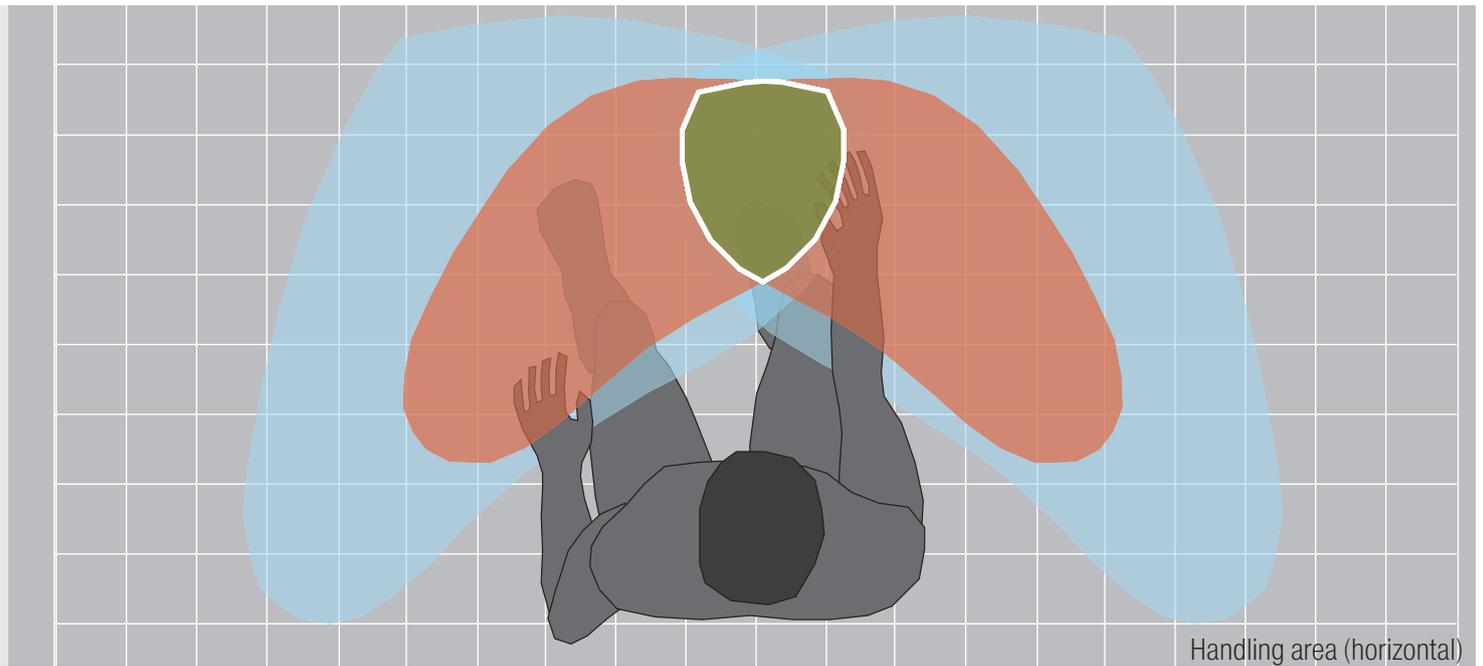
requirements this involves with regard to the process should be taken into account in all cases.

General assembly activities call for a light intensity of about 46.5 fc (500 lux). If the components are very small, the assembly is complicated, or high levels of joining precision need to be achieved, the requisite lighting intensity can be as much as 100 to 139.4 fc (1000 to 1500 lux).

Required light intensity according to industry standard DIN EN 12464:

Activity	Light intensity in foot-candles (fc)	Light intensity in lux
Rough assembly work	18.6	200
Moderately detailed assembly work	27.9	300
Detailed machining and assembly work	46.5	500
Highly detailed assembly work	69.7	750
Precision mechanics and micromechanics	100-139.4	1000 - 1500

When considering lighting, a person's individual visual acuity should also be taken into account. This may vary between individual employees. The physical circumstances within the space are another factor.



Handling area (horizontal)

4.5 Provision

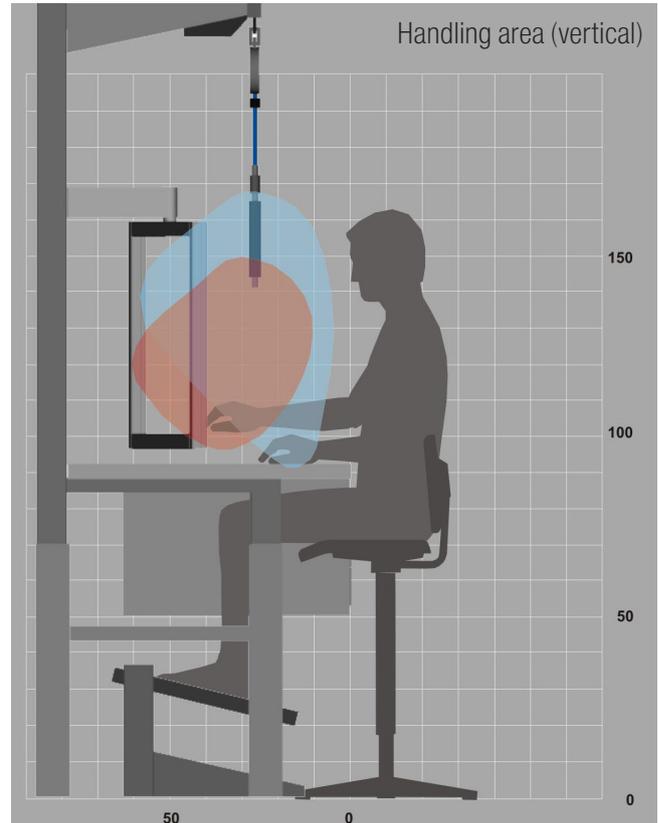
We distinguish between provision of information, tools, and materials. All three factors need to be coordinated and aligned to the employee's physical proportions and the process. In principle, the ideal place to provide material is within the single-handed zone (orange area). The ideal way to accommodate the employee's handling area is by using pivot arms with two (or, even better, three) joints. This allows for the shortest amounts of time in reaching items while also reducing strain on the employee. In principle, the same also applies to provision and positioning of tools.



In this arrangement, every tool has a dedicated spot, selected according to ergonomic criteria and equipped with a holder that is ideally suited to removing tools and putting them back.



Optimizing the horizontal and vertical angles in parts containers further facilitates the employee's work.



Handling area (vertical)



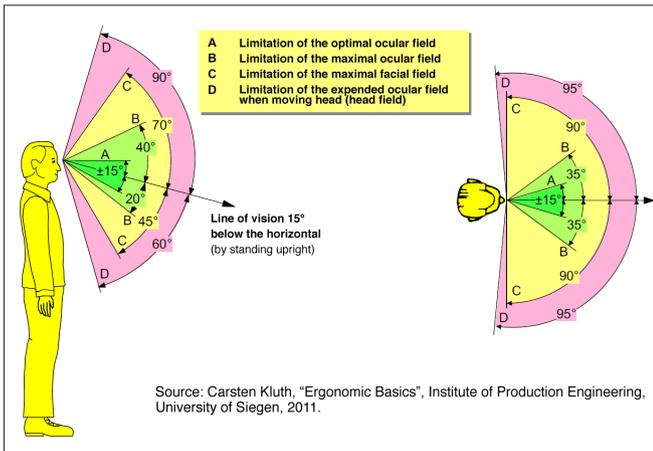
Inserting further outward-facing parts containers enables a natural sequence of movements when taking materials out of the containers. A slight tilt toward the user makes the parts more visible and facilitates faster access to the materials inside.

visible and facilitates faster access to the materials inside.



In general, equipment aimed at providing materials, especially items in heavy use, is placed to be below the level of the user's heart. This reduces strain on the cardiovascular system. In vertical arrangements, additional care must be taken to ensure that there is still enough room to perform the processes, and that heavier and more frequently used items are placed below lighter and less frequently used ones.

Less frequent movements can be performed within the expanded one-hand zone (blue). Carts, ideally also height-adjustable, are an effective option in this case.



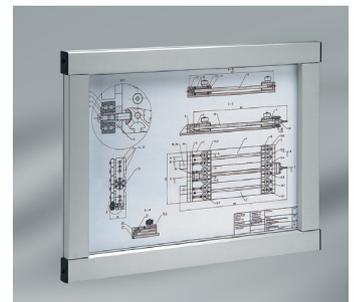
The actual activity that determines the process should ideally take place in the two-hand zone (green). This area is also where the field of vision and visual acuity are at their greatest. For provision of information, the field of vision that corresponds to the handling area should be taken into account. This means that from the viewer's standpoint, information should be arranged from the inside out in descending order of importance. This

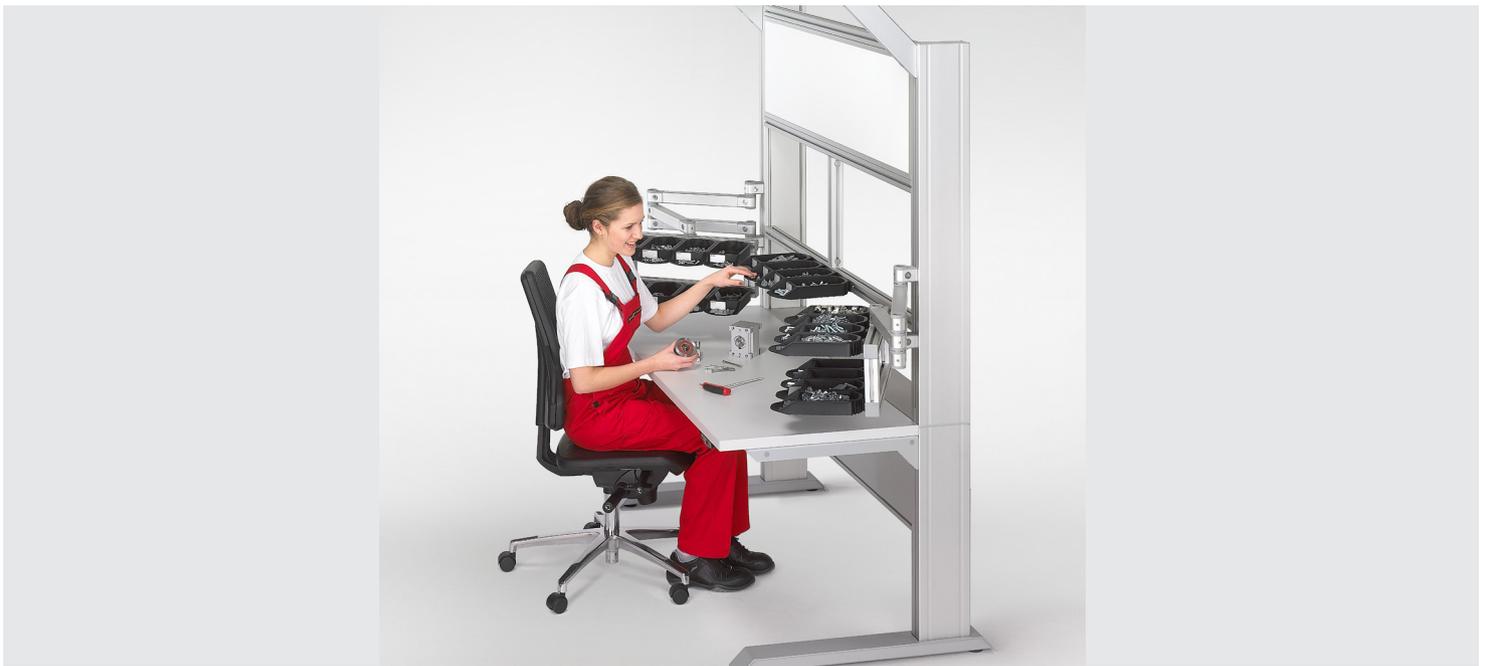


ensures that information that is needed regularly can be found without unnecessary turns of the head, which create strain.



For changing information, document holders or magnetic boards (where applicable, with magnetic notice holders) are an especially good option. For longer-term information, display panel holders or frames are preferred. It is often a good idea to color-code different types of information.





1. **Optimum alignment** of materials, tools, and information in terms of horizontal and vertical spacing and angles (ideally through two- or three-joint height-adjustable pivot arms).
2. Materials, tools, and information should be arranged **according to frequency of use** within the handling area or field of vision, as the case may be. In the case of materials, weight is another factor to take into account.
3. Wherever possible, place materials **below heart level**.
4. All materials, tools, and information should be **assigned to a specific place**.
5. **Labels and visual coding** make it easier to find parts and materials.
6. All alignments must be **easy to adjust** and should not shift unintentionally during operation.



4.6 Intralogistics

The work bench system should accommodate the logistical flows of materials and goods within the business optimally.

1. The work bench system should be suitable for **all organizational forms** of manual production, which also makes it possible to interlink workstations together.

Example:

A product is assembled individually. Because higher unit quantities are required, the company management decides to shift to assembly line production to increase cost-effectiveness. The work bench system should, first, have all of the necessary components for this move and, second, be able to be reconfigured so that the same workstation furnishings used for individual assembly can continue to be used. Reconfiguring should not be a makeshift or stopgap solu-

tion, meaning that the redesigned workstations should still be ergonomic in their design.

2. In addition to conventional fixtures used to interlink workstations together (such as **roller conveyors**), versatile and adjustable **transportation carts** should also be available for the work bench system.
3. A return feed for empty workpiece carriers should be part of the design as needed.
4. Transfer gates that can be adjusted to the workpiece carriers make it possible to lock materials securely for processing within the interlinked line of workstations.

4.7 Accessible workstation

In addition to ergonomic workstation design, the workstation will need to be adjusted especially careful with an eye to individual needs and deficits in the case of employees with disabilities. The following criteria make accessible workstation design possible:

1. The system should be **flexible** in terms of the design of the workstation.

2. It should offer the ability to retrofit, expand, and **readjust** the **workstations afterward**.
3. The **workstation height** must be **infinitely adjustable** without requiring a lot of strength or force. The work bench should also be able to be set to very low and very high heights.
4. C-shaped work benches offer **legroom** and unimpeded use of the workstation for wheelchair users.



4.8 Design

Design affects employees' comfort and sense of well-being. An appealing work environment also enhances employees' willingness to treat their workstations with care. A clearly structured visual design and arrangement that stresses functionality makes it easier to follow working processes and ensure a neat and tidy working environment. Attractive design also emphasizes the employer's quality standards, for both employees and visitors. This helps achieve the goal of positive commitment and a professional external image for the company.





5. Requirements for the manufacturer

A manufacturer of work bench systems should meet five requirements:

1. The manufacturer should provide a buyer with **professional, expert** advice, including on site as needed. For advice to be considered expert and professional, the contact person must have detailed knowledge of the products. The manufacturer should be able to train the customer's employees in how to use the work bench system.
2. The manufacturer should offer **all-in-one** solutions and plan them together with the customer. If needed, the manufacturer should offer on-site assembly and installation as a service.
3. The manufacturer should be able to **deliver on a tight timeline**. This is especially necessary if parts of an existing work bench system have been damaged and immediate replacements are needed.
4. The manufacturer should engage in ongoing further development of its products. Requirements that apply to a work bench system can become more stringent over time, and new insights into ergonomic workstation design may emerge. For that reason, the manufacturer must work continuously on **further developing and refining its work bench system**.
5. All components and systems offered by the manufacturer to design the workstation must be **modular** in structure, compatible with each other, and accommodate incorporation into existing production lines. This gives the customer additional options.

If you want to make sustainable long-term investments in work bench system productivity, you must have detailed information. This includes not only process-oriented and ergonomic aspects, but also consideration of the provider's overall capabilities and expertise.

6. Conclusion

These guidelines have explained the positive effects of ergonomics on productivity. This gives all profit-oriented businesses an incentive to consider ergonomics.

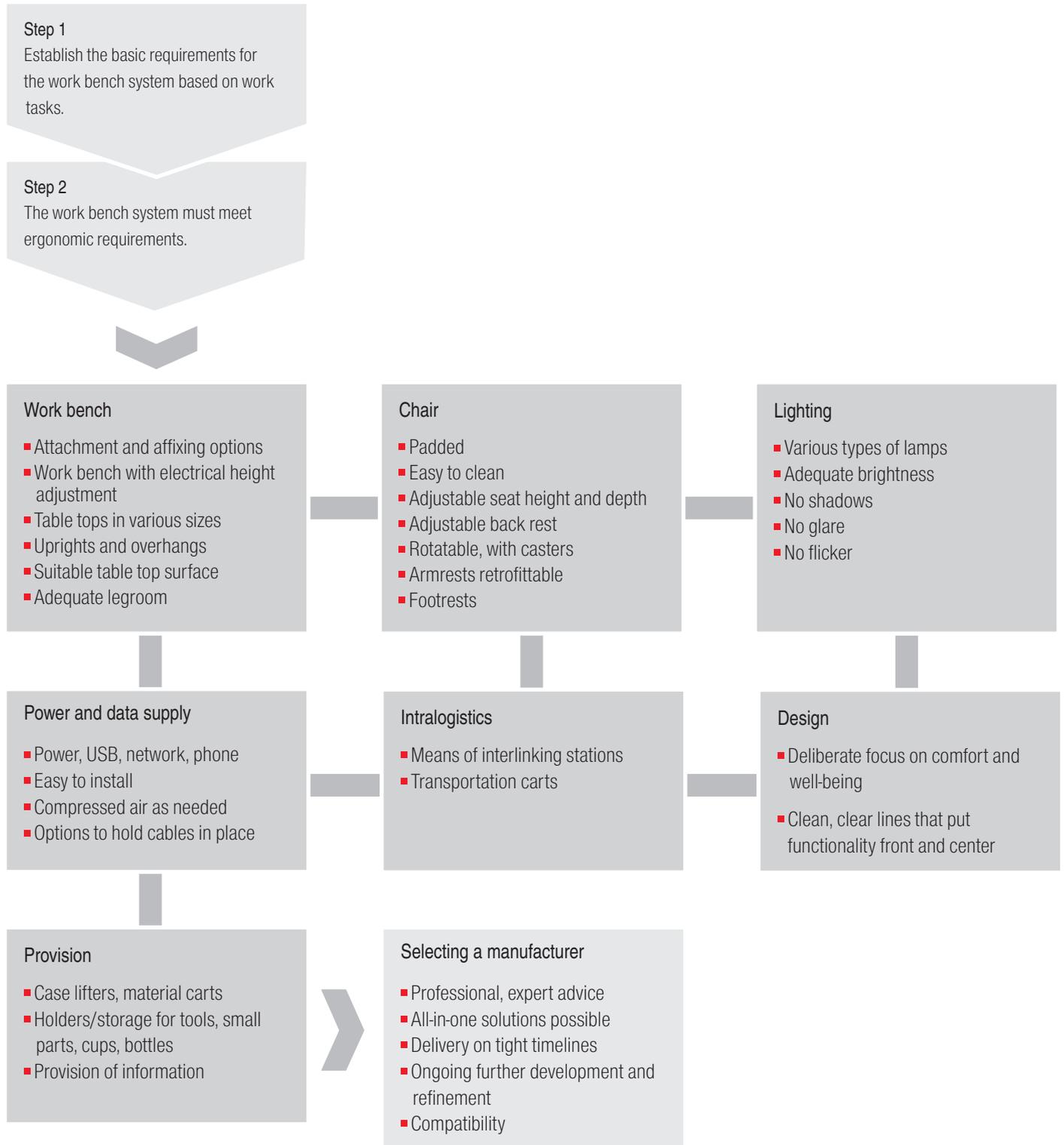
When setting up or reviewing a manual workstation, the ergonomic criteria outlined in these guidelines and the employee's individual requirements should be considered.

The fact that there are multiple aspects to bear in mind means that there are stringent requirements that apply to the work bench system, which has to support different organizational

forms, especially assembly line production. There are also specific technical requirements that apply (such as ESD protection). Above all, a work bench system manufacturer should be able to deliver on a tight timeline and provide capable, expert advice. It is important to have professional, expert points of contact who can support the customer on site as needed.

Comparing different manufacturers is a good first step toward finding the right work bench system to suit the individual needs of the business.

Deciding to buy a work bench system: an overview





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