

## Analysis and improvement of the working environment of a workshop

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### Abstract

As a place where people live for a long time, the working environment is not only related to the physical and mental health of the staff, but also has a profound impact on product quality and work efficiency, and even threatens the safety of the staff. With the development of the times and the advancement of technology, the concept of "people-oriented" has become more and more popular, and the analysis and improvement of the working environment is particularly important. This article takes Nanjun Automobile Group Co., Ltd. as the research object, through field observation, investigation and analysis, sampling test, and data recording. Focus on the main influencing factors of the working environment such as lighting, noise and temperature in the car workshop. By calculating the illuminance values of the natural light source and the artificial light source, and then comparing with the illuminance uniformity index and the minimum illumination index of the American Lighting Engineering Society, the improvement method is determined, thereby improving the distribution of the actual workshop lighting, and calculating the composition of the workshop. The noise level of the area, with reference to the Occupational Safety and Health (OSHA) standard, makes a reasonable analysis of the area with excessive noise intensity, and proposes improvement suggestions; measures the ambient temperature of each position in the workshop, according to the labor intensity and the nature of the work. Make reasonable homework and rest time. Finally, the fuzzy comprehensive evaluation method and the analytic hierarchy process are used to evaluate and analyze the working environment of the workshop and draw the final improvement opinions, and finally improve the production efficiency and improve the working environment.

### Keywords

Working environment, fuzzy evaluation; improvement, analytic hierarchy process.

### 1. Introduction

The working environment is the place where people live for a long time. It is related to people's physiological and mental health and work efficiency as well as personal safety. Correct and reasonable analysis and improvement can not only reduce the negative feelings such as fatigue and depression during work. It also helps to improve the staff's psychological security and well-being. At the same time, it helps to improve the efficiency of employees. In a good working environment, the staff can exert the greatest enthusiasm and potential for high efficiency and high quality. The work creates a series of huge benefits for the enterprise and enhances the core competitiveness of the enterprise, improving the unity and cohesiveness of the employees. The improvement of the working environment is mainly reflected in the following aspects:

- (1) Improve the frequency of safety accidents, introduce advanced scientific work environment management systems, and establish a people-oriented concept.
- (2) Reduce the incidence of occupational diseases and achieve sustainable development of enterprises and employees.
- (3) Improve the sense of belonging of employees of the company and make it scientific and laborious, easy and efficient. At the same time, its personal safety has been strongly guaranteed, the

psychological has been greatly comforted, free from the suffering of the disease, reducing the worries of the future, not only the protection of the staff themselves, but also the guarantee of their family happiness.

From an organizational perspective, companies with sound operational development will provide a relatively satisfactory working environment for staff. The stable work of employees can be achieved through safe and secure working conditions. The democratic and harmonious working environment is beneficial to the positive innovation of employees. Through the “crowd relationship theory”, Mayo tells the good colleagues in the work and the relationship between the superior and the subordinate is conducive to the improvement of labor productivity. In order to better retain the competent and loyal employees to do their best to serve, and let employees actively and consciously carry out creative work, it is necessary to provide employees with a comfortable, safe, stable and harmonious working atmosphere, which makes the human capital investment high income. Sex is fully manifested.

From the perspective of employees, employees have a sense of belonging in a satisfactory working environment. On the basis of ensuring safety, they have a comfortable working atmosphere and a good working environment. Employees will actively participate in the challenges at work and fully resist external pressure. Employees will also have a strong sense of pride and responsibility. Personal goals are consistent with collective goals. Employees will cherish their work and create more spiritual and material wealth for business and society.

In the future, with the continuous development of industry, the operating environment will be valued by more and more enterprises, creating a safe and easy environment, not only preventing accidents, but also greatly improving people's work efficiency and affecting work. The physical and mental health, work performance and product quality of the people are developing in a good way, which will surely become the trend of the times.

## **2. Analysis and improvement of working environment in stamping workshop**

### **2.1 Lighting analysis and design**

On sunny days, the illuminance value of the stamping shop can meet the requirements of overall uniformity, and the illuminance value of the area where each process is located can meet the minimum theoretical illuminance value. On cloudy days, only the illuminance value of the area where the process of cutting and blanking can meet the minimum theoretical illuminance value, other processes have obvious shortcomings of insufficient illumination, and the overall uniformity of the illuminance value of the press shop is poor, which cannot meet the daily routine. Work demands. In order to make the above situation fully and reasonably improved, the following measures can be taken:

- (1) Increase the injection of natural light sources. If the area of the sunroof and side windows is properly increased, more natural light sources can enter the workshop and increase the illumination value of the workshop.
- (2) Appropriately increase the local artificial lighting to improve the illuminance value of the area where the part lacking illumination. According to the above analysis, it is known that only the illuminance value of the area where the shearing and blanking process is performed can meet the requirements on a cloudy day, and only local illumination needs to be added in other processes.
- (3) Adding artificial light sources to improve the overall lighting level can be divided into two ways:
  - ① Replace the model of the existing artificial light source LED lamp and switch to a larger luminous flux lamp to increase the light intensity.
  - ② Appropriately increase the number of lamps of the same type while keeping the existing lamp models unchanged.

### **2.2 Noise environment analysis and improvement**

For the existing problems in the noise environment of the press shop, the following improvements can be made:

- (1) Re-layout the existing process positions to minimize the interaction of noise between machines in each process.
- (2) There are two sources of noise in the workshop: one is the noise generated when the workshop machine works, and the other is the noise generated by the collision between the various processes during the processing. However, according to the actual situation, it is known that the noise generated by the operation of the workshop machine is unavoidable. Therefore, measures such as adding a buffer zone to the flow of the product between the various processes can be considered to reduce the noise.
- (3) The noise generated by each process in the workshop is different, so there is an uneven distribution of the overall noise in the workshop. For the process with a large amount of noise generation, it can be used in the area where the noise adsorption and insulation materials are implemented. Closed to avoid impact on other areas.
- (4) According to the people-oriented concept, the improvement of the noise environment can be understood as an improvement to the staff. The specific implementation is as follows:
  - ① Workers can wear hearing protection products, such as earplugs, ear protection equipment, etc., because the staff does not need to communicate when working, which not only protects the hearing, but also allows the staff to concentrate and improve work efficiency.
  - ② Develop a reasonable work plan for the staff to reduce their exposure time in a noisy environment.

### 2.3 Temperature analysis and control

The current temperature environment of the workshop is not suitable for long-term work by the staff. In particular, the temperature generated during certain process operations is very harmful to the workers, such as stamping and coiling. Therefore, a series of reasonable measures must be taken to improve the temperature environment. According to the actual situation of the workshop, the following measures can be made:

- (1) Effectively prevent and control the heat source.
  - 1) If there is no need to worry about the cost, you can consider replacing the equipment and using more advanced equipment to reduce the heat generated during the operation of the equipment.
  - 2) Reasonably and appropriately isolate the process, separating the equipment in the process of generating a large amount of heat from other equipments that generate less heat, and reducing the heat transfer between the process and the process.
  - 3) Develop reasonable working hours for the staff of the high temperature process to reduce the impact of high temperature on the workers.
  - 4) Let the staff wear insulated work tools.
- (2) Perform effective heat dissipation.
  - 1) Accelerate the flow of air inside the workshop, and increase the number of heat dissipation equipment in the workshop, such as fans and air conditioners.
  - 2) For the process of generating more heat, such as the stamping process, it can be arranged at the shop window or the doorway to accelerate the heat dissipation.
  - 3) Reduce the humidity in the workshop. When the ambient humidity is high, the body's heat dissipation by evaporation of sweat will be significantly reduced, and the external heat will be transmitted to the human body through the wet clothes with good thermal conductivity, which will cause the body to dissipate heat.
  - 4) For the workshop staff, it is possible to consider distributing clothing with good heat permeability and strong sweat absorption to speed up heat dissipation. ,
- (3) Scientific protection of human measures
  - 1) Regular drinking water. Regular drinking water here includes healthy drinking water and scientific drinking water. The so-called healthy drinking water means drinking as little as possible of alcohol,

coffee and carbon dioxide. The drinking habit should be based on boiled water. Scientific drinking water means that the staff should use drinking water less than once. In addition, it can also Supplement the body with appropriate amounts of vitamins, protein and calcium.

2) Scientifically and reasonably work and rest. The higher the temperature, the lower the work efficiency of the staff, the worse the work quality, and the increased fatigue strength, and the recovery time will be longer and longer. In order to pursue short-term efficiency and benefits, the stamping workshop requires that the staff members need to work for 8 hours or more regardless of the season. The labor intensity of the stamping workshop is III or IV, as shown in Table 1. It can be seen that the working time of the stamping workshop at different temperatures under the level of labor intensity, and then look up Table 2 to know the rest time of the workers in the stamping workshop at different temperatures, and finally in Table 3 Advice on the work and rest time of the press shop at different temperatures.

Table 1 High temperature operation rating table

|      | WBGT Index / Celsius |       |       |       |       |       |       |       |       |     |
|------|----------------------|-------|-------|-------|-------|-------|-------|-------|-------|-----|
|      | 25-26                | 27-28 | 29-30 | 31-32 | 33-34 | 35-36 | 37-38 | 39-40 | 41-42 | ≥43 |
| ≤120 | I                    | I     | I     | I     | II    | II    | II    | III   | III   | III |
| ≥121 | I                    | I     | II    | II    | III   | III   | IV    | IV    | —     | —   |
| ≥241 | II                   | II    | III   | III   | IV    | IV    | —     | —     | —     | —   |
| ≥361 | III                  | III   | IV    | IV    | —     | —     | —     | —     | —     | —   |

Note: Level I in the table indicates light labor; Level II indicates labor; Level III indicates heavy labor; Level IV indicates extremely heavy labor.

Table 2 High temperature operation allows continuous contact with heat time limit table (unit: min)

|        | Light labor | Moderate labor | Heavy labor |
|--------|-------------|----------------|-------------|
| 30-32  | 80          | 70             | 60          |
| >32    | 70          | 60             | 50          |
| >34    | 60          | 50             | 40          |
| >36    | 50          | 40             | 30          |
| >38    | 40          | 30             | 20          |
| >40    | 30          | 20             | 15          |
| >42-44 | 20          | 10             | 10          |

Table 3 Relationship between labor break system, labor intensity and WBGT value (unit: Celsius)

| Type of work         | Light work | Medium work | Heavy work |
|----------------------|------------|-------------|------------|
| Continuous operation | 30         | 26.7        | 25.0       |
| 75% labor, 25% rest  | 30.6       | 28.0        | 25.9       |
| 50% labor, 50% rest  | 31.4       | 29.4        | 27.9       |
| 25% labor, 75% rest  | 32.2       | 31.1        | 30.0       |

Table 4 Suggested values for labor and rest time in the press shop at different temperatures (unit: min)

| Workplace temperature / Celsius | Continuous labor time | Break time |
|---------------------------------|-----------------------|------------|
| 30-32                           | 60                    | 180        |
| >32                             | 50                    | 150        |
| >34                             | 40                    | 120        |
| >36                             | 30                    | 90         |
| >38                             | 20                    | 60         |
| >40                             | 15                    | 45         |
| >42-44                          | 10                    | 30         |

### 3. Conclusion

This paper mainly analyzes and improves the working environment of the stamping workshop of Nanjun Automobile Company based on human factors engineering, aiming to provide employees with a harmonious, comfortable, quiet and relaxed working atmosphere, as well as the work efficiency and quality of the workshop. The promotion provides a solution. Through the research and exploration of the lighting, noise and temperature environment of the workshop working environment, the following conclusions can be drawn.

#### (1) Lighting environment.

1) On a sunny day, the overall illumination of the workshop cannot meet the uniformity requirements, but the illumination of the area where the various processes in the workshop are located meets the minimum illumination requirements of the American Lighting Engineering Association.

2) On a cloudy day, the illumination of the entire workshop or the area where the various processes in the workshop are located cannot meet the requirements. As we all know, the quality of the lighting environment is related to the health of workers and the quality and efficiency of work, especially the requirements of fine process control. Therefore, workshop managers should focus on lighting as a key improvement.

#### (2) Noise environment.

1) The noise level of the stamping workshop is generally high and does not meet the specified industrial noise emission standards. Noise has little effect on staff's work efficiency and health in the short term, but long-term in this noisy environment will have a very large impact on the hearing health of staff. In severe cases, it may even cause temporary hearing defects or even deafness. .

2) The noise in the area where most of the press shop is located exceeds the noise standard, such as stamping and sheet metal operations. The noise will distract the staff, be mentally exhausted, and cause great damage to the physical and mental health of the employees. Combined with the actual situation of the workshop, employees can be properly protected from hearing, such as wearing hearing protection equipment, which is not only low cost, but also efficient and convenient.

#### (3) Temperature environment.

The temperature environment in the press shop is determined by the nature of the work in the shop and the local weather temperature at the shop. According to the actual investigation, it is very common to find high temperature in the workshop. Temperature is a crucial factor affecting the work in the human environment. Excessively high and too low temperatures will bring physical and psychological impact to people, thus affecting The efficiency and quality of people's work, and even the occurrence of accidents. In order to prevent the impact of high temperature on employees, you can increase the heat dissipation equipment in the workshop, such as fans. It can also allow employees to wear appropriate thermal insulation tools or scientifically supplement nutrients and water. When the temperature is too high, the working time can be shortened.

For the workshop work environment, there are still many improvements in the details, and the staff and managers need to work together.

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