Working conditions for welders

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Abstract: - This research examines from the point of view of ergonomics, the possibilities of intervention on improvements in working conditions of industrial welders. We raised the main factors leading to difficulties and constraints in this activity, especially with regard to biomechanical conditions. In addition, the study presents a structured approach as the requirements of ergonomics French confronting the real problems of welders, which are not in work, performed by outside consultants who, in a sense, hide real conditions of work. It was through a case study, the majority of work in both the scientific literature on the work of external consulting expertise. The constraints of the welders are characterized as postural and behavioral risks, not showing that behind these, there are characteristics of requirements the solder that force the worker to adopt efforts biomechanical posture to which they are unable to behave properly as stated in the research.

Keywords: –ergonomics, risk analysis, safety and health to welders, working conditions

I. INTRODUCTION

For this research, it takes the analysis and discussion of the working situations of industrial welder and likely proposed ergonomic intervention in a mechanical assembly of industry, from internal demands and pre-existing work carried out by external consultants. The analysis begins in the field informing a support group (called in this work-force task) that assists the researcher in the analysis and understanding of activities, this group composed by the welders. Different techniques are used in research, such as direct observation, statistical observation record of biomechanical variables (physiological and Kinesiology), building on a collection of data related to information of the object under study.

The activity of the welding industry in question the need for research, in a first level of formulation, process of responding to that in industrial activities of welders, is understood as a process necessary for the conduct of their duties.

Thus, given these explanations, a second question for the research comes to establishing the company under study, what are the factors that related to rates of accidents and diseases from the activities of industrial welding and that the company is doing to manage these issues, beginning of course. The establishment of harmfulness that are submitted the subject in their work processes and what the previous work that may have contributed or not the assessment of the difficulties and constraints of the biomechanical welders. A company in the area of mechanical assembly, inside a steel factory in Pindamonhangaba, São Paulo, Brazil, selected as the unit of study.

II. THE COMPANY'S INITIAL RESEARCH

The demand

The company contacted and received the attention of the Medical Professional, who started the initial schedule for the discussion of the work. In this discussion, the proposal presented to the completion of an ergonomic analysis of work in order to care for a demand to given by the company, which coincided with the current needs of the same conduct in this work. The Medical Review of Labor shows that the company has invested in studies of occupational hygiene and ergonomics and has no satisfactory return of this work, because the rate of absenteeism by musculoskeletal disorders has been growing gradually in recent years. According to him, given the analysis of this function, more than half of the company assessed, as the existing manual process is now completely dependent on this activity.
It found that the vast majority of searches came from outpatient welders. Of these, the most frequent related to musculoskeletal disorders.

Even as demand, the company says that the future possibility of extending the work of ergonomics research in the other activities of the organization in a proactive vision, as the company moves to the process of certification to OHSAS18001:1999 [1] and need for job analysis proactive risk to meet this certification.

It is for this research to investigate the causes of, seeking the status of work to explain them. As the posture is a dependent variable (not free) the constraint can find in the postural demands of the task in your product and obtained, the equipment and tools, etc.

The stages of progress of research

The basic steps established by the methodology used in this research is proposed on the formation of a participatory group (task force) in order to collectively analyze the work, covering the prescribed task and analysis of activity in different stages of the real work and the analysis of work of advice oneergonomics developed by the company. Through this method, the contacts established by a group of welders used to systematize the observations to identify the specific requirements of the processes related to ergonomics. The group studied includes the experience of a group of 08 pre-selected by officials of the area supervisors, based on their experience of more than five years in office.

Accordingly, there were interviews with: group of welders, coordination of operations, safety engineering, chosen at time of field research on a random, as exercising their duties, with observations open the work of welders, followed by verbalizations about the activity, totaling over 450 hours of fieldwork settings and reports. We also collected information on official documents on the organization of work and on the population under study, but have not found (or supplied) detailed flow of production. The researcher a plan of systematic observation of the activity of work, which allowed reaching the final diagnosis and recommendations to overcome the problems identified later defined this.

The data for analyzing the characteristics of the population of workers were in general, scattered among several locations (sectors) in the company, and filled in various forms and coded according to their nature. Some, such as indicators of productivity, health problems and accidents at work were difficult to obtain.

The task of welding in the company

A striking feature of the activities of welders in the industrial enterprise is its wide range of tasks, which, in many cases in which maintenance activities conducted outside the warehouse, customers in industries, even in open sky, as in the case of the maintenance of cookers. In each project there is a significant number of activities, each project generates a unique final product, most times not exactly, an activity is similar to another in their working conditions and human variables. This entails various problems, hindering the establishment of a standard solution related to the organization development of measures for the protection and physical integrity of the employee.

The activity linked to human factors that need large amount of workers and the physical strength of the operator feeds the manipulation of pieces by the interface with the brazier and the assembler. The labor of the worker is up almost exclusively in the handling and use of tools (welding equipment, mallets, keys, etc.). The tasks delegated to employees, according to the company documentation, are: the manufacture of light and heavy pieces of steel, consisting of mapping, cutting, notch, bend, mangle, bridge, build, weld, test, wash, paint, inspect, packing and storage, and repair parts in the various sectors of the steel mill customers. Given individual protection equipment for the activities in the company, such as coat of scraper, safety footwear, gloves scraper, welding mask, safety glasses, ear protection, gaiter to shave and others.

The productivity of the sector given by the relationship between indicators. Efficiency, which combines indicators of the percentage of the movement of pieces by the interface which the brazier and the assembler, and the productivity, costs and has the limit considered acceptable if over 1.0% (not given access to the type of calculation in any of the indicators). Another feature of the company is recruiting people with technical training in methods of welding, as required specific training. Consultations the department of human resources of the company to demonstrate the systematic recruitment of employees from the removal of technical courses for industrial welder's SENAI (National Services of Industrial Learning) or schools for that purpose. The tasks require specialized almost more rigorous selection, which is the practical application often relevant to the function requested, held opposite points of soldering. There are also courses in business development of the workforce, usually targeted to the most qualified professionals.

The day's work distributed in three fixed shift of 8 hours, in non-rotating. In peak periods, where there is increased production and effective temporary, an accumulation of tasks, with imposition of accelerated rhythms and overtime (on average 3 hours per week) for better utilization of each stage of the process. These peaks are given in construction of hydroelectric power plants and particularly, but not have a characteristic average pre-set time. The rest breaks and lunch are fast (about 15 minutes), in the workplace, with
longer intervals for lunch (1 hour) in the company gym work (15 minutes at the beginning of the shift) and 10 minutes of dialogue Security (DDS) as always in the early rounds. It also has enough time to voluntarily the physiological needs.

The organization of production

The order for the manufacturing sector of the welding engineering sector of production, then, is the materials sector, which through budgets and purchases, provides the necessary expenses. The engineering of production defines the design of the piece and the service sector. In general, the planning of production varies according to the request and takes a day to 3 months, depending on the size of the project.

The welding industry depends on the punctuality of other sectors, such as heating, planning and warehouse, as is most often the last activity in the production of a play, as time begins to run before the play reaches the welding. In general, there are no delays. To set the time that will be employed with each order, the planner makes an estimate of the time previously used with similar items and with the completion of the piece, computed the time spent in its completion. When the order reaches the manufacturing sector in charge of this welder that will define the service, depending on the amount of tasks for each. The welder should then follow the procedures prescribed for their work, which delivered by responsible for the shift, which received the same area of production planning. The worker must record all events (time and code) for its work in the play of note in the bulletin of the workforce. After their work, the pieces are for quality control to verify the need or not to rework due to possible failures that occur in the solder joints that often occurs with the rework to remove the solder, cutters, hammer and the new process of welding and inspection.

The Engineer of Work Safety, the number of employees in the company declined in recent years due to societal changes in the company that reduced production and consequently the effective. However, in the case of welders, the renewal of the management of staff is difficult because not if you think the workforce available due to the growth of construction industry in recent years. The company's installations do not have a proper state of repair. The noise of the environment is intense, said the change in the PPRA 2006 (Prevention Environmental Program) are 82 to 95 decibels (93 dB on average) that sometimes comes from other sectors, or grinding equipment. The operation of equipment depends directly on demand. Therefore, the noise may be lower or higher, varying according to the number and type of activities in operation. From a brief analysis of the results of noise monitoring carried out by an external consultancy in 2005, concluded that the vast majority of employees exposed to noise levels that require the use of protection equipment and other measures to control noise.

Workers already use the ear protectors and the department of occupational health now identified conduct periodic audiometry, with no cases of hearing loss. The risks of smoke present in the welding industry regarded as the most critical condition in the literature. For the sake of direct exposure of the worker and the daily living environment in the sector which is minimized by fans and exhaust. However, not out the characteristic of an unfavorable environment for the health of those who develop their activities there. Also in the environmental monitoring carried out by external consultants, the levels are within limits and the EPI's (Individual Equipment Protection) listed are sufficient to minimize the impacts to human health. The lighting is good and efficient as well as the ventilation, due to large openings in walls. The floor is uneven in the shed covered by waste, grease, and dust particles that are slippery, making walking workers. There was large number of pieces of different sizes and work equipment scattered on the floor throughout the length of the sector, hindering the movement of workers and allowing sometimes accidents and falls. There are a few boxes of welding in the industry (4 existing), with quarters of work for small parts. At this point, the lighting is poor. The boxes have shelves, but there is not sufficient to house parts and tools.

Support activities in the areas of steel mill customers, there is an activity of high criticality, the welding of resistance of pots and ovens. Here the activity performed in open air or improvised sheds with canvas. In the sender pots, the operator is common to spend two days in the development of a piece, with a daily demand service. With respect to tools, there is a routine preventive maintenance for these vehicles and most of them are outdated and extremely heavy. The wheels of the carts have no welding and specific lubrication carts with wheels locked where the operators have to drag the equipment. The EPI's are used for specific purposes indicated, however, for the helmet, it is poorly preserved, heavy and sometimes we can hardly see through it, allowing it only to see sparks from welding.

As the organization of equipment on the desktop, it was observed that the sector does not provide safe working conditions according to the improper disposal and the large volume of inputs and other instruments deposited in the workplace, there are risks of injuries and falls in handling sectors. Accordingly, the issues are out of the clutter of traffic of people and in particular the workers, as well as the reduction of physical dimensions for the assembly of equipment, thus characterizing a condition of employment with sufficient potential to cause accidents and damage to physical integrity of the worker and the other operating in place. Regarding safety, all staff said that the company provides and ensures the replacement of individual protection equipment (EPI)
necessary to carry out their duties and said that the company requires the use of EPI's, agreeing with the officials the need of them, but feel uncomfortable.

In searching the internet, we found several suppliers of equipment for welding, not the same distribute (sell) more existing models in the company (the models in this study). Today, a helmet can found around 60% lighter than those used in the company can and the advances in technology to combat the inhalation of smoke from welding are great. It seems that the company did not have to worry about updating the equipment and insists on staying with the same old and even with improvisations.

When asked about the dangers of the work, they perform the majority of workers considered dangerous due to the very nature of work. In addition, in the field trip, it noted that at times attempting to store the materials in the optimization of space to occupy the smallest space possible. There are shelves on which the welding carts are stored at times not recommended for the proper handling postural therefore require that the welder stay the same weight to save on the shelves. This shows the great concern of the firm on the issue of workplace accidents due to the rigor of the Brazilian labor legislation [2].

In explanation of what the most critical and uncomfortable to work, all were unanimous in citing the pans. The pans take longer time, because cracks have to weld which sometimes have more than 1 m in length and up to 10 cm in diameter. This makes it more difficult to weld and takes positions that require more time. For no specific locations for this activity, it is the entry of customers or sectors in the external area opposite the hangar for maintenancery and do not have a suitable cover, with characteristics of a specific sector of solder. During the afternoon, or when the midday sun, there is activity being carried out in these parts, which are very uncomfortable to welders. The head of the industry claims that this activity carried out sporadically and recently, more exactly 3 years ago had an increase in demand and yet not adapted to a specific sector that. Says that the company has not yet approved a specific location, but there are projects for that. I question where they are and he laughs say the head of personnel.

### III. ERGONOMICS ANALYSIS

**Comparison of initial findings with the task force**

For a comparison of findings at first examination, the researcher works throughout their working day (480 minutes) in various tasks observed three. These comments then followed in the chronic form of activities, which enabled the development of the steps below:

- Preparations start in the industry - Before starting their duties, the welding part of a DDS (Security Dialogue) where they discussed issues of production, the company’s management, health, work safety, with activities in gymwork;
- Receipt of instructions - with the leadership, the welder receives instructions from work orders through the service and by informal means;
- Displacements - Walk throughout the company in search of parts, materials, equipment, instructions, among others;
- Meals - Food Main and coffee;
- Preparation of materials - Adjustment on equipment, materials and parts;
- Physiological needs - Bathrooms, water, among others;
- The consultation procedures - the consultation documents, orders of service, boilermakers and leaders;
- Inspections in the service - Verification of the service performed in the play and equipment;
- Welding - Output of solder in itself;
- Standby Time - Time spent waiting and other features in which the employee performs breaks from the process

In general, it perceived that the tasks of the welder does not restrict the solder itself. The welder most often perform tasks such as preparation of welding, soldering, sanding, inspection and marking, which are inherent duties in this role. One of the most important constraints in this task is that there is great variability in posture due to the diversity of parts, creating static postures moments specific to each piece or point of solder, which maintained for periods that were determined by the characteristic point of welding. For example, the higher the place to welded, the greater the residence time in a static posture. The errors considered hazardous by characteristic relevant to welding. One example is that the official in an attempt to weld a fast can cause lack of fusion and penetration in the weld and this leads to cracks and reduce the resistance of the solder. This then is one of the reasons that makes the employee is in a long position or holding a piece, because if it is fast, no fusion of solder. Improvisation of the seats also occurs due to variability of postures necessary tasks. In certain moments, there is a need for support or to sit, to which no specific equipment for such behavior, because the engineering processes do not provide them and supervision, where the welder improvises something to support or to sit and this improvisation for it is often useful and begin to developed / used by other welders.

The observation in working highlights the rigidity of posture, muscle contraction, the extreme angles, environmental risks, and the discomfort of EPI's. Employees perceive the negative impacts mainly of posture and environmental conditions. The physical burdens, with forced postures are stores in almost all activities of the
welder, whether in the handling of parts, use of machinery and tools, among others. Complaints of pain in the arms and physical fatigue are the most common reports of physical overload. The worst condition given according to the reports of the solder pots, to require much time in the same posture and sky.

The distance from the electrode to the piece influences the posture for long periods of trunk flexion in order to close the welding, because the greater the distance, the greater are the problems of fusion and low resistance of the solder, which leads also to crack and cracks that lead the future rupture of the piece. The loads with significant professional standing or moving parts and characterized by the welding equipment during the operation of final selection of the piece and at its assembly. Of comments, most of them stop and carries a maximum 15 kg. Loads above 30 kg cannot be handled individually, according to company rules, but what you see is the individual handling up to 60 kg at times, but low frequency of approximately 10 to 15 times per turn (as reported the welders). Hydraulic equipment, forklift, and traveler usually transport higher volumes or carving, depending on the location is ready, but they are all moving in the same place.

Regarding the prevalence of musculoskeletal pain, the welders used expressions such as back pain, problems in the spine, back pain and arthritis of the knee. Complaints of shoulder are also common, as several times adopt the posture for lifting the arms into position above the static level of the shoulders. One of the constraints is the most typical disruption throughout the industry. In observing the layout of the sector there has, in most cases, the area available for storage of material and equipment is insufficient obstructing the movement of work from the sector. Thus, the trader uses to stock immediately, close to their place of welding, which require everyone to move constantly between pieces. There is also a need for welder’s frequent travel in search of tools, which are not always available on your desktop, because according to them, no one keeps the equipment in part exchange. This is because the lack of places for this organization.

The production process is very dynamic. Several operators working at the same time in different parts of the same machine as the determinations of the supervisor, except in the activities of the solder pot, which is fixed. Notes from the field, variability of time pressure and does not note the time of production during the field research.

The pre-diagnosis as the target of systematic observation

As such, maintenance of postures for a long period identified as the main difficulty of welders, since these lead to fatigue, leading to accidents and musculoskeletal pathologies. They stay for a long period in the play needed for the solder does not present problems of fusion and escape the control of the operator. For more to try to maintain good posture it is not possible for the necessary condition for good fusion of solder, which requires that the welder stay longer and closer to solder.

The cases of removal by musculoskeletal disorders is increasing in recent years, mainly for symptoms related to the spine and shoulder. Among the reported activities, requiring muscular discomfort there is a solder in pots, which will generate uncomfortable postures for long periods, held in the open. This increase has been a common feature the work of welding, which require efforts of biomechanical welders. This pre-testing provides an explanation for the problem initially in demand. From this point will be chosen the most appropriate methods to work in the clippings will be made in the activity.

The systematic observation of the condition in biomechanical analysis of activities, the systematic observations made based on pre-diagnosis. It outlined a plan based on a cutting remark. For this initial phase was chosen stock variable time to understand how they are distributed along a weld. The task identified as the most critical positions in the maintenance of these structures forced by long period is the maintenance of cookers. In general, is to hold patches cracks in the pots used in steelworks and forge the steel industry customers. The operator who performs the solder remains for days in this activity. The solders have large diameters and thicknesses, requiring more time in carrying out activities. According to their reports, the welder stays by 2 to 3 days in one piece, but the demand for parts is continuing and the client needs this piece routinely repaired. This activity is even avoided by the operators, but generally end up with more experience are better considered and more in the company because it is a piece of risk of the customer and a service of welding accidents can trigger bad run with the casting of liquid steel pan, or even to break the pot.

There was the analysis of actual activity of work, considerable gap between job requirements and work. The solder pots, it was noted that not all employees enjoy this task. Traders attributed that to "know" that this activity takes longer to pay, more time to remain in static position. The reason related to the care that the welder must have finished in each of the cracks (the local soldiers are). Then perform some type of voluntary pause, because if he weld "part" of the crack, the place can cool until even if it exposed to air and dust, making it possible to crack occurring in this region. Counting which usually presents a pan 3 to 4 cracks and that each crack can take up to 3 hours to welded, the welder is to remain for days in the piece. Thus, while other activities of lead solder and less time to complete and therefore less time in static position, are theoldest in the task involved in this activity. This fact leads him to understand that this activity by having to move less, is less tiring, without
thinking whether it is in this pot, it required more time in prolonged static posture and the risk of quality of welding (cannot stop not to generate cracks) is higher in this task.

The times in a welding of pans obtained through observation of five welders in five times of each operator and the average obtained. Systematic observation of a spreadsheet was prepared to be able to monitor the transition from one action to another and the interval between them. All actions confronted with the demand and given by the removal of variables that relate to the growing number of injuries and complaints of symptoms related to shoulder and lumbar spine during the welding activities. Posture of flexion of the lumbar spine during the execution of activities and posture and motion in flexion of the shoulder during the execution of activities. Generally, this occurs by specific requirements and the task of welding and not misconduct of the welder as shown. These movements and postures adopted by welder repeatedly, for years, can affect your muscles and even its constitution-articular bone, especially the spine and limbs, resulting in short term, in which pain extends beyond office hours and long term, can result in permanent injuries and deformities. Many authors studied in this work, the welder’s are particularly susceptible to injuries in the back by the fact that they remain in this position for long periods. In the case of the welder of pans, this period may be even greater.

A systematic analysis given on an observation of 30 minutes, which is the average time that the operator remains in the activity without pause. Extrapolating these data to the average time for completion of the welding activities of systematic observation (124 minutes in the day), which represents 26% of the total time of the day. Thus, given the sample refers to 25% of the total time of welding. For the evaluation of variables, were used the necessary footage and interviews in an attempt to identify the main constraints. The temporal data recorded, as shown in the related items below.

- Sequential welding: weld the part, inspect the weld, welding electrode exchange, get the helmet to view the weld, get the helmet to continue welding, cleaning of the part / welding, no action;
- Changes in the lumbar spine: standing, sitting and crouching down (all positions examined in lumbar flexion and neutral position);
- Movement of the shoulder: the act of welding, a bending of the shoulder against resistance in which they were assessed as in flexion and in neutral position.

Based on these findings we can observe that:

- Helmet - This activity performed with a movement of flexion of neck motion in acceleration and stop, making the weight of the helmet by the kinetics of the movement close up. The stride can cause long-term pain in the neck and can be harmful if the individual has degenerative pathologies in the cervical region. Were performed 20 movements in the sampling period, where this extrapolation on the total day, up to 160 movements per day;
- Lift the helmet - This activity carried out with the opening of the helmet with the upper limb, most often the left and presents no significant risk. Are carried out in order to display the (inspection) of the welded area is reduced when the helmet is closed due to the blurring of the worker protection.
- Operators perform these activities in the inspection of the welding helmet that is handled (open and close), it does not display automatically (already available and low cost in current technology) and that was not acquired by the company due to ever be asked (and leader of the second area) to the general direction. It is worth highlighting that: the greater the time to stop to inspect the weld betweenan electrode and another, the greater the risk of forming cracks, but this parade is physiologically beneficial to the welder so he can get out of a static posture for long periods. This inspection is performed to stop constantly to "see if it does not bubble," according to the operator. The leader also said that when asked if have to do this, because if you play the bubble can generate and weld cracking, predisposing to accidents. This does not occur as determined by the company and, yes, but security strategy adopted by operators.
- Inspection or cleaning - are made in cleaning burrs sporadically. Among the range of an electrode and another is a visual inspection done quickly. The absence of such favors the corrosion of solder. Exchange of lead - in period of observation were 19 exchanges of electrodes, in which extrapolation of the working day on average represent 76 trade. You could say that the exchange considered beneficial, because now there is that both the shoulder and the spine remains in neutral position. The mean change observed was 04 seconds, with minimum of 02 seconds and maximum of 07 seconds. Several precautions must take with electrodes. It begins the same size as your gauge varies as the size of crack or notch to weld. This difference in size is also with the welder change constantly according to the gauge thickness where the crack in time. Others talk about the storage and handling should made to have a good weld.
- Welding - The welding activities are the main risk associated with musculoskeletal disorders in the spine and shoulder in this work. The welder when welding remains in long period with flexion of the spine and shoulder flexion (bending motion in the shoulder against resistance). A prolonged stay in this position may then lead to the tables above. The posture of the shoulder flexion maintained by 21 times, representing 70% of the time of the sample (then totaling 21 minutes). Whereas throughout the day, remains so for approximately 01 hours and 20 minutes. The minimum observed was 02 seconds and a maximum of 01 minutes and 03 seconds with an average of 25 seconds. In lumbar spine, the activity of solder integrated part of other activities such as bending in standing
posture, in sitting posture and posture under knees, which together represent the same period observed in posture associated with the shoulder;

- Postures - There is a predominance of crouching down position (52% of the time), followed by sitting (44% of the time) and standing (4% of the time). The sitting posture may be adapted by an improvised seat by the welders. In the standing posture, the worker stayed for less time, but depending on the place of welding, this may be higher. Have the attitude under knees, in addition to load spine, may also pose risks of injury associated with knee joint. All the above positions observed in neutral and flexed postures. Welders should force into positions that do not even want because he is closer to the weld. The extreme distance of the electrode can also generate the problem of fusion and penetration that leads to cracks in the solder. The distance also favorsexaggerated the aspersor of solder, which thencomplicate the cleaning of the garment and can be the starting points of corrosion. The angle of solder influences the quality of welding. If the welder does not use proper angles according to the places ofwelding, the weld can become fragile, and have difficulties with porosities of fusion. To ensure these angles, forced postures as the trunk and upper limbs are required for longer periods. The positions of flexion of shoulder and lumbar spine are always associated with muscle tension is maintained by the same, whether the context of apprehension in performing an activity in a solder point. Furthermore, the static posture is one of the staff responsible for the development of pain (musculoskeletal).

To show fatigue in the shoulder, was held in the collection electromyography welder, which were used two electrodes positioned in the deltoid muscle, the middle portion, in their points of origin and insertion. We observed a decrease in initial median frequency when compared to end, from 652.98 in the initial collection (held 09:00 pm) and 572.98 in the second collection (held at 11:00 pm the same day). Index clearly the presence of multiform from the second collection, made 2 hours after the initial collection. In flexion of the shoulder evaluated, could observe inflexion associated with abduction of the shoulder than 45°. The opening of the arms considered excessive since graduation going beyond this to be a contraction of the muscles and supra-spinous upper trapezius, which undermines the cervical spine and scapular waist.

After reviewing the positions, it was possible to identify the key attitudes that adapted during welding. Deflection with abduction of shoulder, Deflection of the lumbar and cervical spine, more pronounced in the lumbar region leading to lack of support for the lumbar spine, tilt the head to visualize the solder, inadequate support and inadequate seating. These postures trigger pain, discomfort, fatigue and predispose to acquire the professional musculoskeletal diseases. The welder does not perform scheduled breaks during the day, but takes voluntarily ranges between a solder and another to chat, reflect on the work performed (options to better point of solder) and when required for the activity for coffee, a water and achieve physiological needs. Work performed with both hands and this choice leads the welder to adopt a position of work where he must be near the piece of equipment and materials. This makes it lead solder with a higher degree of tension due to static posture of the trunk and shoulders. The welder has to move to different positions depending on the point or path that needs to welded. This system of work will be stressful to work on the working time, but may encourage the breaks in static postures held for long periods.

A risk factor, skeletal muscle can defined operationally as a generic term for the factors of work that have association with musculoskeletal diseases. The main determinants of these factors work disorders are fixed postures, repetitiveness of movements, and use of excessive force, vibration, and low temperatures. Thus, the ill are related to several factors that act of working together, not allowing the workers to adapt physically and mentally for situations at work and that, therefore, any preventive action should consider the capacity of all persons involved to seek strategies for transformation of working conditions. The nature of the work of the welder requires the adoption of positions away from the central axis that regulates the field vertically and horizontally. This is more important where the duration of the task is a factor of aggravation. In the case study identified as unfavorable positions on these.

The welder adopts positions that are static, with short movements, and it can take a certain position for half an hour or even a whole day, which represents a factor of physical stress. Most studies on the problems of the musculoskeletal welders focuses on problems related to the shoulder joint complex, for the most part receive the load from both the posture and the maintenance of the hand tool, with a consequent increase in time on the shoulder, was evidenced in this study. The welders have high prevalence of musculoskeletal symptoms and signs because, first, that the load on the shoulders, neck and lumbar region. Thus, the work of welders can be described as "a work with static postures typically characterized by specific patterns of movement of the articular complex of the shoulder and spine." For each general posture of the body, there are variations in the positioning of the arms and hands, for which the task of the welder requires their position and attitude in space is of high precision. The muscle fatigue characterized as the fatigue experienced in regional muscles in response to stress and posture, and manifest as pain, has also decreased engines.

To demonstrate the findings, elements of the activity could then be broken down again, now taking into account the systematic observations given in the activities, with their main problems and considerations that lead us to the diagnosis. The activity of welding presents biomechanical requirements, a static posture of shoulder in
flexion with support of the helmet; static posture of the trunk flexion (lumbar and cervical), uncomfortable postures of legs in the squatting position (held in a few moments, given the flexibility posture), requiring concentration and attention to avoid rework and soldering problems. Given the findings of the validation and confrontation with the players, the activity of the welder still needs care as:
- The arc length directly affects the width of the pool that should fill the crack. You must be the shortest arc possible, so you get as near the weld. This control of the length of the arc voltage is to be done so carefully, observing the other parameters such as contamination of the electrode, improper feeding of material addition, changes in temperature in the electrode and the electrode erosion;
- The speed of progress affects the penetration and width in the process, the latter much more affected. Its importance lies in the fact it determined the cost of the process to closely link to the speed of the process. However, many times the speed it is only a consequence from the definition of quality standards and uniformity. In the case of speed, coukers may not be high because it cannot fill the voids properly. Is increasing the speed of feeding the wire, solder it produces less penetration and decreasing convex profiles to increase speed to penetrate, which is not the case of pans. The low speed also favors the posture of the welder, favoring the table of postural fatigue in low back pain;
- The shape of the feed material for the addition is another important parameter. In manual processes, the way the material added influences the number of passes and the appearance of the finished weld. The more electrodes USA is in the same weld, the greater the chance of cracks and flaws, as the composition of the material may be slightly different. It tries to end a piece when it starts to work on it.
- The contamination must be avoided, but more a factor to stay for long in one piece. The contamination occurs when the electrode accidentally dip the electrode in the pond or playing the lead with the addition of metal. An improper protection can also cause oxidation of the electrode and consequent contamination of the solder. Other sources of contamination: vaporization of metals in the arc, eruptions of aspersion pond caused by trapping the gas and evaporation of surface contamination. Contamination can affect the characteristics of the arc and cause inclusions in the weld metal. If this occurs, the operation should be discontinued and the contaminated portion of the electrode should remove, with new grind in accordance with therequired characteristics at the tip. This creates even more work to the welder. The atmosphere on the opposite side of the solder can also contaminate the solder. To avoid this problem, the same welder at low speed; not stopping until they finish the face welded and it may take up to 3 hours.
- It must take not to be too much pressure, especially in the last five centimeters, to prevent blowing of the pond or concavity of the root, which is losing the solder in pots.
- Any stop in the filling of a crack pot of (pond) generates discontinuity. When these discontinuities lead to the material does not meet the requirements of the work to done they are classified as defects. The typical causes of these inclusions are in contact with the electrode tip pool, the addition of material contact with the heated tip of the electrode, the electrode contamination by aspersion of the pond; extension of the electrodes beyond the torch, resulting in overheating; Electrode improperly arrested; inadequates of gas or excessive winds, defects as cracks and broken. Along with these factors, the age of the welders considered in the research on the effects of work on the musculoskeletal system, as older workers to remain in solder pots. Despite complaints of shoulder, pain had been associated with the worker’s age, characteristic of older workers are not, and however, a phenomenon solely dependent on age, may appear in younger welders. The main difference lies in the fact that in most new welders, relaxation and exchange of work can result in regression of symptoms that, in older, tend to become chronic. Thus, in addition to the experience of the welder does not guarantee immunity against localized muscle fatigue, you should consider also that the cumulative effect of fatigue can affect the body’s response to the continued work in inappropriate positions.

The exercise of the profession of welding leads then to use the same intense way of the upper limbs and spine, which can cause musculoskeletal pathologies. However, in addition to fixed posture, stress as a component that can enhance the conditions of work. Allied to this are also the hereditary characteristics and lifestyle adopted by each. The issues driving the activity of work presented in the aspect of physical and cognitive work. The cost of upper limb posture and spine in the activities of solder pots (major cause of complaints among welders) are due to the size of parts, length of stay and they need to see well the solder to avoid cracks and rework other. Therefore, that contrary to what you think in the activity of soldering (handwork) is very prompt and intellectual attention. Thus, the questions turned to broader issues related to technology and distribution of employees into the company.

**Terms of conduct ergonomic**

For the recommendations suggested in the workplace evaluated, it considered for both the views of social actors involved in the task force. Now, it added because of the inter-relationships and by selecting some recommendations that deemed important, emphasizing the critical points that observed. Some ergonomic proposals are impractical and costly in the short term and others in the face conditions under which the work...
executed are independent of the emergency core charges. As can see on visits to the achievement of this research, there are factors that converge in the technology and insecurity in the activity as a whole, starting with the location of buildings, always in the open areas and lack of technology to support the pieces. This deficiency of technology used at the solder pots causes of accidents and injuries among workers. The data collected in the field through interviews and footage on video, along with the assessment of attitudes certify this disability, requiring improvements in layout and equipment support.

These simple factors preventing a valuable aid to reducing the physical constraints of the worker: the use of hydraulic turn in support for the piece, allowing the lifting equipment, displacement, and lateralization of the movement against the operator pans and placing this activity in a sector covered. For tools, you should seek EPI’s more comfortable and, through testing, replace the existing ones. This not done until today according to the company (director responsible) for the request get no leadership, because if no one ever complained formally, this information has validated among welders.

Studies should focus on trying to improve the quality and regular maintenance of equipment, with the current market of equipment more comfortable and lightweight for use in the company. It also observed that workers improvise banks, stairs, supports, where equipment that even more sophisticated improvised, mended with wire, ladders and stools made by the officials. In general, to avoid improvisation should made available more tools and equipment for the tasks (seats, ladders, platforms, etc.). In addition, closets for better organization of the sector (to prevent a lack of local materials are scattered). In relation to redefine the layout of the workplace, it is proposed to resize the physical plant of the hall is located where all the activities related to the assembly of equipment in the management of parts and materials to improve the opportunities for work and display the same. The greater purpose is to ensure the movement of workers in safety, when the activities, being necessary to rearrange the tools available on shelves, to the rational use of space, to increase the area accessible and facilitate the procedures for cleaning. The activities carried out in pots, it is necessary to establish a specific area for this activity where the welder not exposed to weather, building a shed where the tasks performed.

The floor of the site must kept free from cables to ensure safety. Thus, the entire supply for the equipment, such as electricity, gas and wire, it came up. In cleaning the office and order must remain, the only recommended equipment really needed to work. Says nothing to guide the employee, require a good attitude, if it generated because of ensuring a good weld without aspersion, broken, points that facilitate the corrosion and porosity. It is important to note that the phenomena of oxidation depend on the working conditions and the length of the arc, which provided when the operator approaches the piece, tilting the trunk and pushing your posture. A long range (long distance operator in handling the equipment) will lead to oxidation reactions more important than a short arc (uncomfortable posture).

Adopt the true concept of work for four hands is certainly a solution to reduce the stress and increase productivity, but as adjustments to reduce fatigue, exposure to occupational risks and to work with two hands in the current context are following:
- Insert basis of turning water to drive the parts to weld. In the case of pots, a large hydraulic equipment should be developed, because the pots have common characteristics and are frequently performed maintenance. These equipment spin, usually called positioners, devices are controlled by electric or automatic controls that allow the turning of the piece in both horizontal and vertical, allowing various combinations and greater control of the positioning of the joint. The nice (sort of platform pantographic mechanical) can elevate the piece to weld to a certain height. This will relieve the worker to climb the structure or to maintain uncomfortable postures for long periods and reducing the risk of accidents.
- Insert chairs, ladders and platforms from various according to a bank of suggestions given by welders, official projects of accessories to replace the improvisations of welders;
- Replace the helmet used for lighter equipment and automatic display, which avoids that the employee has to lower and raise the helmet in order to repeat each need to display;
- It must seek to reduce musculoskeletal efforts through the placement of tools and work plan, to ensure that the welder can perform their tasks with the hands in optimal position (between the waist and the level of the shoulders), no need to assume postures that twisted or tilted forward;

When it comes to lifting weight, you should establish that any object that is handling heavier than 10 kg should be loaded with about the use of balance, tables, hoists or similar aids. The torch of the weight bearing on the static muscle load, and recommended that the welding torches have reduced weight to reduce the risk of fatigue and musculoskeletal disorders, occurring also affected the shape of the torch, as it also affects the degree of muscle activation.

The format depends on the correct grip size, but also with attention to the design of its cross section and surface texture of the handle, so to facilitate comfortable and firm grip of the tool, with a minimum of effort. The trigger for activation of the torch should also receive special attention, for that requires little under pressure. Furthermore, it is important that the welding torches are flexible cables and capacity to absorb vibration. The weight of the tool is dependent, also the sizing of cables and the electrode. There are welding torches that have a
system of extraction of fumes generated during the process, which can influence on your weight. These torches are a result of an evolution whose initial attempts at removal of smoke near the source consisted of the addition of products from the extraction of smoke flare. This system contributes to the weight of the tool and is responsible for extraction of up to 40% of the smoke generated in this case, the suggestions should be suspended, and the welding cables.

If existing technologies found in other companies, used on a small scale in the company evaluated can see that resources exist to reduce the physical constraints of the worker. Starting with the weight of the equipment, the display of welding by spinning gear, the hall covered with exhaust systems. Obviously, these technologies are not an end. You cannot specify whether the postures assumed by workers in these facilities are ideal. As can be seen in the posture review, some of the worst postures performed with the employee bent forward or crouching down. These positions are the points of welding also located at the base of pans. Therefore, a good project as a hydraulic gyro for example, must allow shareholders in areas close to the floor, to reduce constraint on the spine and legs of the worker.

The cost factor is one of the obstacles to improving this type. It is natural that entrepreneurs want to reduce your operating costs and these costs include an inexpensive equipment. This, then, is one of the reasons why are still focusing on how the implementation of solders constructs and equipment in maintenance and hinders the implementation of improvements in this case. Recommended to pay attention to these issues, the realization of operational seminars. These seminars design to promote discussion of the problems of the sector between officials working in the field with management and leadership. Such actions promote the enrichment of the task by the staff and facilitate the understanding of real working situations.

IV. TO THE DIAGNOSIS OF REAL ACTIVITY

A case study research method also applied on this work [3]. The diagnosis as the factors to considered enabling a transformation of the work situation [4]. Independent of the parts to be welded are present the static postures held for long periods because they provide conditions for the focus point for soldiers and support to increase the precision manual. This fact leads the welder to position so that it can be comfortably close to the piece, hold and maintain the tools and parts required. This position requires a professional abducted and flex the left shoulder to position the upper member, perform a bending of trunk (lumbar and cervical) for the direct view of the face to weld. Connected to this, is the weight of the helmet that is obsolete, outdated technological front of the product.

Associated with these factors is the organization of work that leads to the professional conduct many shifts and movements necessary to find the desired material that seems to cause physical fatigue, but may facilitate the maintenance of pauses for long periods in static contraction. Because different parts, the variability of posture requires great constraints, to the maintenance of forced postures that may compromise the physical integrity of workers. In the case of solder in pots, the maintenance of posture is more critical and required longer on this constraint intensifies it. The support of the same static posture for long period’s cause muscle fatigue and musculoskeletal pathologies. The task of welding allows postures with lumbar solicitation degrees because the successive postures in flexion of trunk, aggravated by handling of heavy loads during the operations to handle the pieces. Contrary to what is said in many literature and research on the biomechanical conditions of welding required for activity, escapes the control of welding to maintain the so-called "correct posture" in the activities. Because they are kept independent of the control of welding because it is required to obtain a good fusion of the solder, good arc welding, the lack of aspersion and porosities in the weld. If these positions not forced to approximate the parts, such items are impossible to guarantee and no current technology available to ensure this. In addition, these factors contribute negatively on the reappearance of signs and symptoms related to musculoskeletal system. The poor sector about the organization and layout, the discomfort of the EPI's, environmental risks, the dissatisfaction by maintenance of low wages and bad postures for long periods in static muscle contraction.

You can say, before the observed reality, that workers are subject to a variety of types of risk, which varies in relation to the frequency, the intensity and time of exposure, to ensure the quality of welding. The bending of the spine and shoulder highlighted as the activities of greater risk in contributing to the general framework of reports of musculoskeletal disorders, but this posture is difficult to avoid in the variability of industrial welding postures required by different types of parts and then need to ensure good fusion and penetration of the solder. The precarious conditions of space and poorly organized tools intensify the constraints of the welders. For welding maintenance, work, such as cookers, held in open sky, with the welder exposed to excessive weather in a region dominated the heat, besides the difficulty of moving material to the area with the client, as mentioned in pre-diagnosis.
V. CONCLUSION

All these factors, alone or in interaction, requiring the operator to adopt new methods and leave the settings used during daily activities, without incident, to ensure the control and management of risks of mistakes and accidents at work. This behavior, which is outside the control of the welder, reduces the margin of an attitude of prevention, submitting to a situation of physical constraint, with the results achieved through changes in the internal state of workers, which can lead to, over time, attacks on health.

The construction of an ergonomic analysis of work and focus on the activity of workers was crucial to understanding the real situations at work. There were not only risks related to biomechanical postures adopted to meet the demands of work as well as cognitive to the "good weld". The difficulties encountered by operators in performing their tasks contributed to the emergence of postural constraints the procedure adopted by them, characterized by the submission of requirements for inspection and attention to welding and other development necessary for the completion of the activity.

The action of all these factors indicates the presence of identified risk factors for the development of musculoskeletal disorders arising from work activity, especially of muscle-skeletal disorders of the lumbar spine and shoulder.

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