

Translations : German,
Italian
Distribution : Enterprises

Technical Report N° 21

MEASURES TO REDUCE THE WORK LOAD
ON THIN-SHEET BUNDLERS

Source : Ergonomic Team of the Luxembourg Steel Industry
Project N° 3

Author : Dr R. FOEHR

Reference period : 1.7.1971 - 30.6.1974

65.015

EUROPEAN COAL AND STEEL COMMUNITY

DOC. N° 3391/74 e RCE

Community Ergonomic Research

Orig. French

Translations : German,
Italian
Distribution : Enterprises

Technical Report N° 21

MEASURES TO REDUCE THE WORK LOAD
ON THIN-SHEET BUNDLERS

Source : Ergonomic Team of the Luxembourg Steel Industry
Project N° 3

Author : Dr R. FOEHR

Reference period : 1.7.1971 - 30.6.1974

Financial assistance was provided for this study by the
European Coal and Steel Community

CONTENTS

I. INTRODUCTION

1. The general situation
2. Means of overcoming the problem

II. THE MEASURES TAKEN

1. X-ray examinations and staff placement
2. Ergonomic improvements brought about by technical means
3. Teaching of correct handling techniques

III. THE RESULTS OBTAINED

1. Trend of staff transfers
2. Absenteeism
3. Results of heart-rate measurements
4. Productivity trend

IV. CONCLUSIONS

Annex: Case illustrating a growing awareness of ergonomic problems

MEASURES TO REDUCE THE WORK LOAD ON THIN-SHEET BUNDLERS

I. INTRODUCTION

1. The general situation

Following my appointment as works doctor at the ARBED works at Dudelange, Luxembourg, I was surprised at the number of complaints I received from workers in certain jobs who claimed that their ailments, accidents and absenteeism stemmed from unsatisfactory working conditions. Depending on the season the chief complaints were firstly the heat and bad weather, then bad posture resulting from their work and finally, to a far lesser extent, loud noise and occasionally dust. I very soon became convinced that one of the most important tasks of the works doctor was to study and analyse these problems and to help in establishing objective criteria for the assessment of the existing situation, so as to be able to advise management and the workers involved and thus to improve the situation. I was therefore pleased when in 1965 we managed to set up in the Luxembourg iron and steel industry an ergonomics team under my direction and comprising members of the managerial staff of the ARBED works, assisted by research workers from the Laboratory of Applied Physiology of Strasbourg University, in particular Dr J.J. VOGT and the Director, Professor B. METZ. This team has been working since 1965 on ECSC supported ergonomic research projects. Since 1966 two problems in particular have claimed our attention: physical work involving exposure to heat and the problems raised by bad working postures. We managed to devise a method for measuring heat and muscular loads at work; this helps us to assess physiological stress in jobs requiring physical exertion and possibly also involving exposure to heat.

We then studied various practical problems as part of the research subsidized by the ECSC:

- The improvement of working conditions near blast furnaces.
- The rational posting of staff by means of a predictive test based on the reaction of the heart to metabolic and heat stresses. This test can be applied in the consulting rooms of works doctors.

In addition to this research my team now has equipment enabling it to measure noise, vibration and lighting.

This report, however, is mainly concerned with improving the job of bundling. In the early 1960s this job was highly unpopular with the staff, and the situation became very serious; the working atmosphere and productivity were threatened. As in many other rolling mills, bundling has the drawback that as the sheets vary greatly in size a system of automatic or even semi-automatic bundling is difficult to devise. For this reason packing was carried out at ground level in our works. Piles of sheet were brought for packing on a trolley serving three or four teams of two or three men per trip. This system had two drawbacks:

- a) Awkward posture, particularly during bundling of the first packages; posture improved as the stock of packages grew and raised the working area, and then deteriorated again after a certain height. The optimum working height depends of the size of the sheets, as operators have to secure binding strips of thin sheet tightly around packages of sheet which are already wrapped in several layers of paper, and they may also have to add an extra layer of thin protective sheet with corner pieces adapted to the size of the package. The purpose of this packing is to

provide protection against corrosion and damage during transport. The need to secure the binding strips makes it necessary for operators to have access to practically the entire upper surface of the sheet packages, hence the interdependence of the height and size of the packages.

- b) Time was sometimes wasted in waiting for the sheet to arrive. There was also a serious accident risk due to falling sheet or faulty handling when stocking the sheet or removing it. This led to injuries to fingers and hands and even to workers being crushed by falling sheet.

2. Means of overcoming the problem

The very uncomfortable working posture of bundlers was the main cause of numerous complaints and of low motivation: people complained of gastralgia and especially of lumbago, which led to absenteeism. This work had to be done by very young workers, frequently new recruits, and they obviously did not want to stay long in these unpopular jobs. It became obvious that this situation urgently needed to be remedied. This was also the opinion of the works manager and the managerial staff. With their agreement and helpful support we decided to pursue the following four objectives, after informing those affected and the workers' representatives, who have since given us very active support in all our research work.

- a) Improvement of staff placement from the start of employment. The workers required for these jobs had to be strong, young and of average stature (neither too tall nor fat). The selection process had to be made more stringent and based on the case histories (any previous gastric, cardiovascular, lumbar and osteoarticular disorders were carefully investigated). Objective criteria had to be found to determine the functional and radiological condition of the spinal column. It was therefore decided to introduce systematic X-ray examinations

of the dorsolumbar and if necessary the cervical spinal column during the recruitment medical, in addition to the functional examination of the spinal column and the full, conventional medical examination.

- b) Examination of these jobs with a view to ergonomic improvement by means of technical changes.
- c) Improvement of the training of bundlers by means of better general instruction and by teaching correct handling techniques.
- d) Monitoring of results by measuring the work load by cardiac telemetry.

II. THE MEASURES TAKEN TO IMPROVE BUNDLING

1. The importance of systematic X-rays of the spinal column in industrial medicine

I should like in this connection to draw attention to the paper I presented in November 1965 to the Society for Industrial Medicine and Hygiene at Strasbourg. This was drawn up in collaboration with Dr. H. HOFFMANN, radiologist at Dudelange Hospital. Every works doctor is aware of the social effects of disorders of the spinal column - loss of sense of wellbeing due to persistently recurring pain, incapacitation for shorter or longer periods, premature unfitness for work which they frequently bring about, and problems connected with the reemployment in the works of people who are partially disabled owing to a spinal disorder.

I shall quote only one figure: according to German statistics applications for early retirement due to disorders of the spinal column account for 60 % of all such applications, and 85 % of these are prompted by the degeneration of the intervertebral discs alone.

The main purpose of the X-rays is to ensure that each worker does the work which the condition of his spinal column enables him to do, thus preventing persistent absenteeism and subsequent early retirement.

We shall give only a brief outline of the numerous X-rays of the spinal column (in 1965 there were 684 and now there are over 3,000) carried out first among all newly employed workers, and then among workers doing particularly strenuous jobs, with a view to their possible transfer.

The results are obviously not difficult to classify in the case of clearly defined diseases such as confirmed discopathies, spondylolisthesies etc., but difficulties are unavoidable when numerous radiological signs are observed which point more or less directly to Scheuermann's disease.

Dr. HOFFMANN was guided by certain theoretical considerations when establishing the classification we adopted. This may explain the perhaps surprisingly high proportion of cases listed as linked with Scheuermann.

The ergonomic application of data supplied by X-rays represents a completely different problem for works doctors. Obviously only serious cases can give rise to special precautionary measures. A disorder may be said to be serious where there is a very pronounced isolated symptom, a combination of a very high number of symptoms or marked clinical indications. Although in theory a sub-division into minor, average and serious cases may have all the disadvantages of a subjective appraisal, it has proved essential in practice. Account should be taken in this appraisal of the familiar contrast between the absence or benignity of subjective symptoms during the early stages and the seriousness of subsequent disorders. To facilitate

the interpretation of the figures it should be pointed out that our examinations usually comprised a frontal X-ray photograph of the lower half of the dorsal column and the lumbar column, and two lateral photographs, one of the dorsal and the other of the lumbar region. A special examination of the lumbosacral joint was made only if the other X-rays led us to suspect an abnormality.

Details results of the X-ray examinations are given in the table below.

These results are used to improve staff selection and placement, to check the validity of applications for transfers from people suffering from dorsalgia or lumbago, and to set up a system of documentation to improve knowledge of the after-effects of traumatism related to the spinal column. In most cases only X-rays taken before the occurrence of the traumatism can show whether the latter is the result of an accident. Much argument and unhappiness would be eliminated if cases could be assessed in this way.

Is there, however, any relationship between the results of X-rays and the subjective condition of the workers? Do young workers (practically all between 16 and 30 years old) whose X-rays often show clear alterations in their spinal columns, quite unknown to them, necessarily have a predisposition to pain and organic deterioration?

Surprisingly little conclusive scientific documentation on this subject is available in world literature.

However, these questions may, broadly speaking, be answered in the affirmative. The following information has been obtained to date: people whose cases show the following features are particularly susceptible to dorsal pain and to a deterioration in their condition in the absence of adequate treatment and prevention:

- a serious case of Scheuermann's disease during their period of growth;
- a "flat back", the thoracolumbar form of this disorder;
- spondylolisthesis, scoliosis, hemisacralisation or degenerative diseases of the lumbar column (such as osteochondrosis, spondylarthritis and spondylosis);
- serious injury to the dorsolumbar spinal column involving morphological changes.

To prevent these diseases it is obviously essential to carry out systematic X-ray examinations on children of school age. Only in this way may these disorders be detected in their initial stages and early treatment be provided to ensure the best results.

Other measures which those responsible for the education of the young should be urged to carry out are the introduction of supervised orthopaedic gymnastics, the improvement of chairs and desks in schools and apprentice workshops, the wearing of school satchels on the back and the re-appraisal of vocational guidance, which should take account of physical aptitudes, and thus of the bone structure.

With the help of these measures the number of disorders of the spinal column will be reduced, and consequently the number of disabled young job applicants.

Outline of the percentage of spinal abnormalities observed

Dysostosis of the Scheuermann type or direct sequelae	82 %
Scolioses	65 %
(of which associated with a Scheuermann- type dysostosis).....	46 %
Deforming spondylosis and deforming intervertebral arthrosis	
a) associated with Scheuermann's disease	28 %
b) primitive	11 %
Discopathies (other than those directly associated with a Scheuermann-type dysostosis)	
Possible or probable	11 %
Confirmed, isolated	9 %
multiples.....	7 %
Costotransverse or costovertebral arthrosis	10 %
Interarticular spondylolysis with or without spondylolisthesis	
certain	4 %
possible or probable	0,7 %
Other vertebral displacements	6,5 %
Transitional lumbosacral variations	11 %
Spina bifida	24 %
Other congenital abnormalities	2,3 %
Traumatic sequelae.....	1 %
Sequelae of spondylitis.....	-
Suspected rheumatic pelvispondylitis in its initial stages.....	0,4 %

Observation: As the spinal columns of some individuals may have several abnormalities, the total of the percentages given obviously exceeds 100 %.

The following procedure should be adopted in the works: placement of staff should take account of the X-ray taken at the recruitment medical examination. Work involving considerable physical exertion, continuous bending or an uncomfortable working posture, the handling of heavy weights, the use of pneumatic drills and exposure to vibration should be reserved for those whose spinal columns are undamaged.

I normally classify the results under two main headings: N (= virtually normal) and A (= completely abnormal) with the following three subdivisions:

- | | |
|---|--|
| N ₁ no special features whatever; | A ₁ fairly serious anomalies preventing work in certain jobs; |
| N ₂ very slight non-evolutive deterioration which does not affect capacity to work; | A ₂ fairly severe anomalies requiring special work and regular medical supervision; |
| N ₃ slight deterioration with no particular risk of further aggravation provided special checks are made during periodic medical examinations. | A ₃ severe evolutive anomalies which temporarily prevent all physical work. Two possibilities exist:
a) medical treatment (case to be reviewed after treatment)
b) definitive condition entailing temporary or permanent incapacity for work. |

Twelve years' experience have shown this procedure to be extremely useful in my day-to-day work.

To conclude this aspect of our study it should be pointed out that the teaching of correct handling techniques, and the carrying out of ergonomic studies at places of work are also very important.

2. Ergonomic improvements by technical means

Workplaces should be designed to take account of the physiological aptitudes of the human body. The layout of workplaces

seats and controls, and any muscular force required should be closely examined, and workers should be supplied with well designed tools and equipment for handling heavy loads. Moreover, if workplaces are examined systematically from the ergonomic point of view many improvements will be discovered which will not involve great expenditure and which will invariably increase productivity.

a) The situation before the improvements (before 1965)

This has already been discussed briefly. The following is a detailed description of the operations carried out.

Bundlers used to carry out the following preparatory work in the conditions outlined earlier:

- laying wooden boards;
- positioning the binding strip;
- placing the lower protective sheet of the package;
- fitting the wrapping paper;
- conveyance of the pack of sheets: the packs are removed from the store near the shearing machine by a moveable bridge with a chain sling. The bundler is required to hook and unhook the packs;
- preparing the corner pieces;
- fitting the protective corner pieces;
- placing the upper protective sheet of the package;
- folding the binding strip;
- securing the binding strip with pneumatic equipment;
- fitting and fastening the clamps onto the ends of the binding strips;
- painting to protect against corrosion;
- indicating the addressee.

Number of workers per team: 2 to 3. Number of teams: 3.

Working hours: 3 x 8 (44 hrs/week in 1962, now 40 hrs/week since 1972)

Depending on the size of the sheet ordered packages may be 1500 mm long, between 600 and 1500 mm wide, and up to a maximum of 500 mm high.

Workers have to bend to a greater or lesser degree over the sheets. The packing and the size of the sheets vary according to the recipient, and changes are made on average after every fourth pack. The plan to introduce an automatic packing line had to be abandoned as existing equipment could not be adapted to these varied and constantly changing operations.

b) The situation after the improvements

As automation was impossible efforts were made to achieve the following improvements:

- 1) improved working posture;
- 2) improved mechanization making the work easier;
- 3) reduced accident risk.

Rather than describe each part of the work in turn and the many intermediate stages of the progress achieved, we shall give the following list of changes arrived at as result of our studies.

Improvements in the working conditions of bundlers and shearing machine operators in chronological order

- 1964 - Acquisition of rollers for paper rolls
- 1966 - A steel sheet about 20 m long was placed at a slight angle on the ground to facilitate the bundling of coils.
- 1967 - Design and installation of a dozen bundling tables for packages.
- Height of each table: approx. 400 mm

- 1967 - Study culminating in the installation of roller clasps.
- 1968 - Construction of a monorail above the exit of shearing machine line 60.
Purpose: bundling is now no longer dependent on the main travelling crane.
- 1968 - Installation of an electric trolley to transport packs of sheets between lines 44 and 60.
- 1970 - Purchase of "Stanley" pneumatic equipment to facilitate tightening of the binding strips.
- 1971 - Installation of pneumatic hammers to drive nails into wooden frames required for some consignments of sheets.
- 1972 - Purchase and adaptation of a forklift truck for the transport of material.
- 1972 - Construction of a monorail above the exit of shearing machine line 44.
- 1973 - Study leading to the partial clearing of metal shavings from the shearing machine by means of a magnet.
- 1974 - Purchase of a second trolley for the transport of packing material.
- 1974 - Installation of an automatic package grab (5 t) for monorail 44.
- 1974 - Purchase and adaptation of an automatic package grab (8 t) for monorail 60.

With all these improvements, in particular better organization of the jobs, the mechanization of certain operations, the establishment of an optimum working height we aimed to achieve, conditions which would be not just acceptable but completely satisfactory to the workers.

3. Teaching of correct handling techniques

Alongside these improvements, we also thought it necessary to improve staff training in the handling of bundling equipment and accessories and in manual handling techniques.

Training was begun in 1965 and is now carried out at all the ARBED works.

The first training courses were directed by a works doctor and a safety engineer. Two instructors were then trained at the INRS (French national institute for scientific research into industrial accidents) in Nancy, and since then these have trained other instructors.

Instruction is both theoretical and practical and includes the following subjects: general accident prevention, various handling techniques, and the anatomy and physiology of the spinal column.

This measure has certainly helped to improve the previous situation.

III. THE RESULTS OBTAINED

The following four headings trace the development of the situation.

1) Trend of staff transfers

1963 - 64	14	transfers
1965 - 66	11	"
1967 - 68	23	"
1969 - 70	11	"
1971 - 72	10	"
1973 - 74	2	"

The increase in 1967-68 was the result of intensified checks by our teams and the realisation by workers that their grievances could be remedied if they were justified.

2) Trends in general absenteeism at the posts since 1963

The figures for reported accidents between 1969 and 1974 show that the number of accidents fell by 25 % below the average

for the 6-years period from 1963 to 1968. Figures for general absenteeism caused by both accidents and illness also improved in the 6-years period between 1969 and 1974. For example, the figures for 1972 to 1974 show an improvement of 33 % over those for 1969 to 1971.

3) Assessment of work loads by the telemetering of workers' heart rates before and after the improvements

The work done by the bundlers is described above.

a) Before the improvements the average heart rate during bundling was 34.2 beats/m.

b) After the improvements this average fell to 26.2 beats/m.

The readings recorded before and after the improvements were of course taken from the same subjects under similar atmospheric and environmental conditions.

4) Productivity trend

During 1972 and 1973 productivity was 17 % higher than in 1966 and 1967.

Output and the number of staff employed in the finishing bay and the cold rolling mill have fluctuated somewhat over the past ten years. The increase of 17 % just referred is likely to be even greater during 1974.

IV. CONCLUSIONS

This report has shown that the various measures taken for the benefit of bundlers have led to a considerable ergonomic improvement of the situation.

Although once very unpopular bundlers' jobs have lost their bad reputation and job satisfaction and motivation have improved. Productivity and the number of applications for transfers (staff rotation), absenteeism and accidents, and work load have shown the results obtained to be most satisfactory.

The results provide further confirmation that ergonomic measures are always profitable and benefit both management and workers, especially when one considers that only ergonomic improvements made it possible for bundling to be carried out under acceptable conditions.

CASE ILLUSTRATING A GROWING AWARENESS OF ERGONOMIC PROBLEMS

Research also made it possible to improve strip bundling in another part of the factory. One worker was employed on a Boecker (no 2) strip shearing line. He was responsible for operating the line, which consisted of a table with a movable top, a slitting cage, a lubrication system and a roller mandrel. The sheet is normally slit into 8 strips in a single operation.

The operator removed each coil separately from the mandrel and took it to the bundling table, where he arranged the coils side by side, and removed a separator disc between tups. After each trip he cut the ends off the coils, checked they were properly coiled and secured the ends by binding the coils (normally two to each strip). If necessary he made packages of two or three coils and then secured them with binding strip.

The next operation consisted of moving the packages about 2 to 2 1/2 m away, where the operator stacked them. Coils weigh on average between 15 and 40 kg and packages between 40 and 50 kg!

The following improvement was made: near the workbench a movable table with adjustable height was installed at the coil deposit point. Each time the operator removes a coil he adjusts this table to the height of his workbench, which is about 820 mm. Thus he has only to move the package along a flat surface and does not need to bend or lift it.

Secretariat of the Community Ergonomic Research
P.O. Box 237 - Luxembourg, Tel. 288-31 (247-239)