

## **USING PNEUMATIC SCREWDRIVERS – ELIMINATION OF RISKS ARISING FROM HAND-ARM VIBRATION EXPOSURE**

### **1. Organisations involved**

Electrolux Zanussi SPA factory, Forli

### **2. Description of the case**

#### **2.1. Introduction**

Increasing attention has been paid in recent years to work-related upper limb disorders (WRULDs), and this has been justified by growing confirmation at the epidemiological level and by the inclusion of these pathologies among those recognised as relevant to the occupational arena. Such pathologies are characterised by the constant functional involvement of the various sections of the upper limb, shoulder, elbow, wrist and hand, and of their musculo-tendonous structures. Current practice is to assess exposure to risk through a multifactorial approach which takes into consideration all possible factors of an occupational/organisational nature. From a biomechanical point of view in particular, a general analysis model should focus on certain elements which are considered to be the main factors responsible for the onset of risk, which are:

- repetitiveness of the actions (frequency);
- application of force;
- awkward postures;
- inadequate periods of recovery;
- prolonged exposure.

To these may be added a series of complementary factors such as the use of vibrating instruments, exposure to unfavourable microclimatic conditions, the need to use personal protective equipment such as gloves and carrying out precision work, all of which contribute towards increasing the overall conditions of discomfort.

The Forli Electrolux Zanussi SPA factory produces electrical kitchen appliances. As a result of increased levels of production and the corresponding need to introduce new workers to the assembly lines — primarily women with no previous work experience — WRULDs have been on the rise.

At the Forli factory there is continuous daily use of pneumatic appliances (screwdrivers) in many workstations. The Prevention and Protection Service suspected a correlation between the vibrations generated by these tools and the increase in WRULDs in the factory.

The pneumatic screwdriver is a tool which, powered by compressed air, has an internal motor which causes the rotation of a connector of a shape suitable for the screwing of screws, nuts, bolts.

The level of vibration generated by a pneumatic screwdriver depends on the power of the internal motor and on the construction technology of the clutch which intervenes in reaching the tightening torque.

The vibrations of screwdrivers should firstly be reduced at source. For this purpose, the most modern screwdrivers are equipped with a clutch which automatically and immediately stops the feeding air when the preset torque is reached. Screwdrivers of the traditional kind, however, use a mechanical slip clutch, in which two toothed steel components, placed against each other, slide against one another and thus produce high levels of vibration.

# CASE STUDIES

In addition to generating significantly lower levels of vibrations, screwdrivers equipped with automatic air shut-off devices also reduce the duration of operator exposure to vibrations. In fact, these screwdrivers automatically and immediately stop when the preset torque is reached, whereas in the more traditional screwdrivers equipped with slip clutch the arrest of the screwdriver is left to the discretion of the operator. In the case of screwdrivers equipped with automatic air shut-off devices, vibration exposure time is four times less than with traditional screwdrivers.

## **2.2. Aims**

The aim was the elimination at source of the risk from vibrations transmitted to the hand-arm system by bringing the vibration exposure to below the action values defined by Directive 2002/44/EC, by substitution of the pneumatic screwdrivers that produce higher levels of vibrations.

## **2.3. What was done, and how?**

The following actions were taken:

- an inventory of the screwdrivers existing on-site;
- vibration tests in the laboratory;
- vibration surveys on the production line;
- an intervention plan for substitution of screwdrivers.

### *Inventory of screwdrivers*

An inventory was made of all screwdrivers on the assembly lines, and then the tools were divided into families and types.

It was found that at the Forli factory there were 1 167 screwdrivers of different types and of these 801 had a slip clutch while the remainder had an air shut-off clutch. There were 97 different types of screwdrivers, 49 with slip clutch and 48 with air shutoff clutch; 9 types of screwdrivers with slip clutch however amounted to 78 % of the number in use at the factory, equivalent to 628 implements.

### *Vibration tests in the laboratory*

The various families of screwdrivers undergoing inventory were subjected to tests. The equipment used was a Larson Davis 3200L/1 spectrum analyser equipped with a suitable accelerometer. For each type of screwdriver, five screwings were carried out using the mechanical brake defined in ISO/DIS 8662-7 Standard.

The screwdrivers with slip clutch in the laboratory showed values of weighted acceleration from 2.042 to 5.66 m/s<sup>2</sup>, whereas for screwdrivers with air shut-off clutches the interval was from 0.9 to 2.21 m/s<sup>2</sup>.

### *Vibration surveys on the production line*

The types of screwdrivers tested in the laboratory were then used directly on the production line. The most representative phases of the assembly lines were selected for carrying out the vibration surveys. The tests were first performed on all the machines with slip clutch and then on those with air shut-off clutch.

Using the data thus obtained, a calculation was made of exposure to the total equivalent frequency-weighted acceleration during the eight hours of the preselected phases.

The comparison of exposure values using the two different types of equipment confirmed that when only equipment with air shut-off clutches was used on the production line, exposure could fall below the action values defined in Directive 2002/44/EC.

### *An intervention plan for substitution of screwdrivers*

# CASE STUDIES

The company management decided to carry through a systematic plan of substitution of the tools with slip clutch.

The first phase of the plan was to substitute all screwdrivers at workstations showing equivalent acceleration exposure values above the action value (2.5 m/s<sup>2</sup>); the second, to be completed during the following year, provided for the complete substitution of the older pneumatic tools by new ones equipped with automatic air shut-off clutch, which had the effect of reducing the vibrations generated to below the action level defined by Directive 2002/44/EC, thereby attaining the lower level of vibrations which applied on the assembly lines.

## **2.4. What was achieved?**

The conclusion of the plan anticipated that 88 % of the work phases (312) should produce vibrations below the value of 1 m/s<sup>2</sup>, and that around 12 % should present a value of between 1 and 2.5 m/s<sup>2</sup>. The complete substitution of screwdrivers, including the remaining 173 screwdrivers that presented difficulties because they were utilised for particular processes, further improved the values but did not significantly influence the above data.

Progress in cases of WRULDs was monitored by the factory infirmary on a monthly basis. The introduction of the new screwdrivers had the effect of gradually reducing the number of operators affected by upper limb disorders, by 55 % in the course of one year.

## **Problems faced**

It was not easy to find a screwdriver which, in addition to reducing vibrations, had characteristics specifically tailored to the activities carried out in the factory. Initially a product was sought on the market that would satisfy both these requirements, and then attention was focused on researching, designing and producing an ergonomic screwdriver within the Zanussi engineering department.

Substituting the screwdrivers cost the company a considerable amount of money.

## **2.5. Success factors**

The major success factor in this project was to have the capacity, at company level, to properly assess the risk from vibrations and to reduce the risk at source through a well designed intervention plan.

## **2.6. Further information**

Contact information:  
Electrolux Zanussi SPA — Factory of Forli  
Prevention and Protection Service  
Via Bologna 298  
I-47100 Forli  
Internet: <http://www.electrolux.it>

## **2.7. Transferability**

This experience is easily transferable to all sectors in which pneumatic screwdrivers are used.

## **3. References, resources:**

- <http://osha.europa.eu/en/publications/reports/TEWE09001ENC>