October 2001

Hand Arm Vibration Syndrome and how to prevent it!

- Presentation by Lawrence Waterman, Managing director, Sypol Limited

As this was a Construction Meeting, **Warwick Adams, Construction Section Chairman,** introduced the speaker and referred to their past professional association on motorway contracts. **Lawrence** introduced his topic with an anecdote about the harmful effects of Hand Arm Vibration. He related the story of a foundry worker, many years ago, who had contracted Vibration White Finger (VWF) so badly that his wife used to place his bus fare in his lunch box so that the bus conductors could take it out! He went on to describe his own involvement in the field with a mention of the Securing Health Together initiative and the CONIAC Health in Construction Campaign. In this connection he alerted us to the **Occupational Health Service for Construction** and the pilot study in the Midlands. He also mentioned the many ways in which his company suported the improvement of healthy working and displayed its mission satement to work with customers and to be truly efficient, profitable and sustainable.

Lawrence addressed his subject by defining vibration as the **"Rapid movent of a tool or workpiece in contact with a worker, away from a position and back again"** It can occur in a solid, liquid or gas and can be stedy-state or transient, or random. Typically, for HAVS, the contact point is the hands. HAVS is characterised by cold-induced vasoplasm, indistinguishable from Raynaud's disease. It is caused by too much energy being being transmitted into body tissue where it causes damage to nerve endings and blood vessels. It can be graded clinically in four stages from **'symptomless' to intermittent or persistent numbness and loss of manual dexterity'.** A specific result is VWF which occurs in periodic attacks, usually provoked by cold, the symptoms being blanched, numb fingers and loss of sensitivity, follwed by painful throbbing. The classic Taylor-Pelmar classification refers to condition of the digits and work interference.

The physical effects of vibration are:-

- Neurological damage
- Circulatory damage to the blood vessels, typically **Vasospasm** where the muscles in the walls of the vessels contract and restrict the flow of blood. Vasospasm is moat commonly observed in the finger tips.
- Damage to bones and joints.

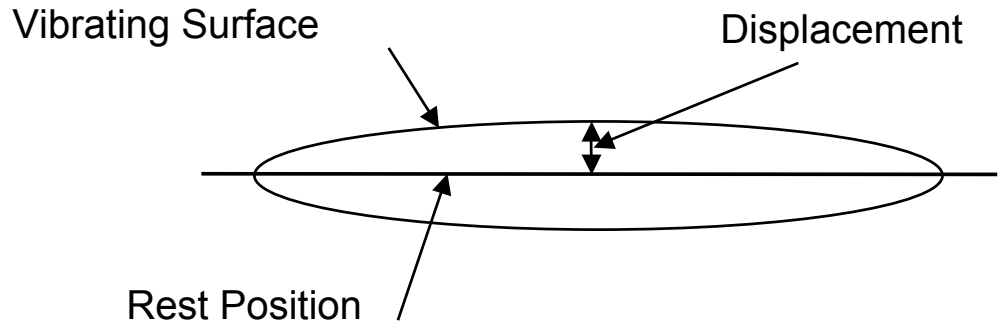
These effects are proportional to these **Measurement Parameters**: -

- Vibration magnitude
- Vibration frequency
- Vibration Axes (Direction of movement)
- Vibration exposure

- Vibration Duration.

All of these parameters are aggravated by cold temperatures in the workplace. The condition leads to Sickness Absence (It is a reportable disease), disability, Compensation Claims and, ultimately, Increased Insurance Premiums. In recent times there have been many well-publicised calims for HAVS, notably in the NCB, and they are rising quickly.

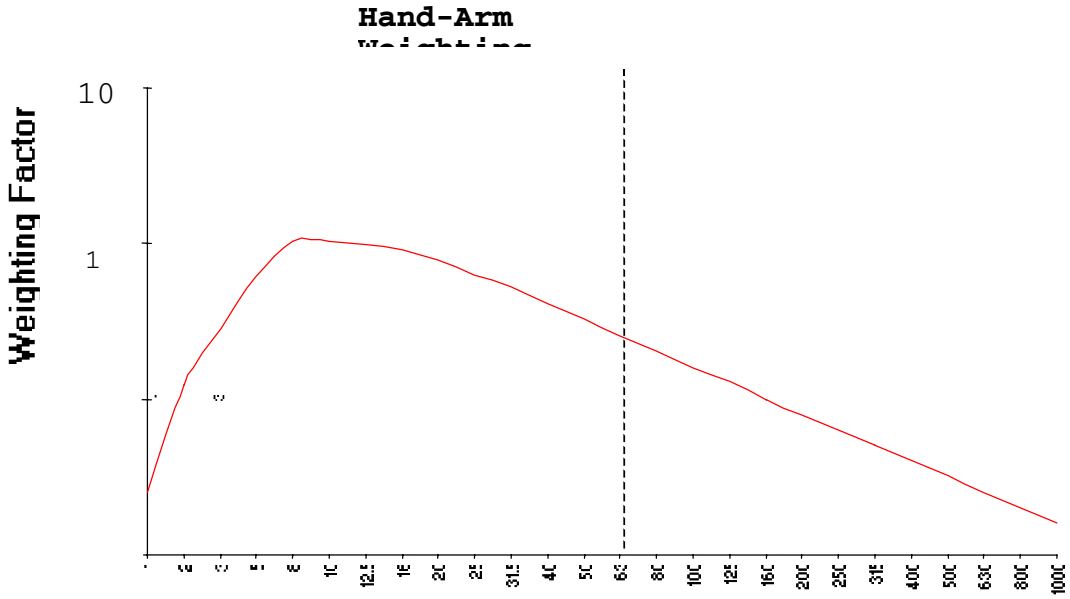
The the Mechanism of Vibration and its Terminology is simple, but must be understood to gain an appreciation of the subject. These are illustrated in this diagram which shows the **Surface** moving either side of its **Rest Position** and magnitude is is defined by the amount of displacement



- DISPLACEMENT
  The distance moved - in mm
- ACCELERATION
  The rate of change of velocity – ms^{-2}. This is greatest as the surface changes direction at the outer limit of its movement
- VELOCITY
  - The speed of movement - $mms^{-1.}$ This is greatest as the surface moves through the Rest Position.

The technique used to quantify vibration risk is called **Hand Arm Risk Measurement (HARM),** related to **Hand Transmitted Vibration (HTV) and VWF.** The severity of harm from vibration varies across the fregquency sectrum, with some frequencies being worse than others.

The vibration is measured on a response scale which compensates for this variability and calculates the **Root Mean Square (RMS) acceleration value for the vector sum, based on an eight hour working day.** This compensation is called a **"weighting"** and is built-in to the meters like the A scle for noise on the folowing curve: -



Because the vibration can occur on three axes, the measurement has to be done with this in mind. Historically, Lawrence said, in the UK all three axes were measured and control measures were set to manage the highest value. The new Directive (Physical Agents) **(PAD)** requires all three to measured and and used to calculate the total, as follows: -

$$V_{Tot} = \sqrt{(X^2+Y^2+Z^2)}$$

Lawrence than displayed examples of some Accelerometers for taking measurements and said that product sheets from Castle were available with the handouts after wards. He added that measurements were subject to errors from: -

- Accelerometers do not respond well at all frequencies
- Rotational vibration Elements
- Method of use – high/low levels, at awkward angles, strong grip for a forceful task

This could result in cumulative errors as much as ± **50%!,** so this means that control measure must NOT be based solely on the basis of measurements. The assessment strategy should also include provision for moving the sensors to different positions and keeping a diary of events, related to sample measurements.

According to **BS6842** there is an **Action Limit of 2.8ms^{-2}** for Acceleration over an 8-hour working day. This is equivalent to 4ms^{-2} if a normalising day of 4 hours is used. BS6842, however, indicates that there is some evidence to suggest the limit of 2.8ms^{-2} may cause finger blanching in about 10% of the vibration exposed population after 8 years. This estimate is subject to some uncertainty and the action limit, therefore should not be considered to be a completely 'safe' level.

Typical tool vibration levels are shown in this table: -

TOOL VIBRATION LEVELS

TOOL	a_{hw} (ms^{-2})	TIME - HOURS
ORBITAL SANDER	51/2	2
IMPACT WRENCH	4	4
HAMMER DRILL	11	0.5
ANGLE GRINDER	5	2.5
RIVETING HAMMER	6	1.7
PNEUMATIC DRILL	17	O.2
SEWING MACHINE	1	>24
ENGRAVER	5	2.5
NEEDLE GUN	16	0.25
PNEUMATIC SCREWDRIVER	3	7
FLOOR POLISHER	3	7

EXPOSURE TIME TO PRODUCE AN A (8) EQUAL TO THE UK ACTION LEVEL OF 2.8 ms^{-2}

It is essential to have an effective management plan to control vibration risks. Although 'measurement is not management' it should be a useful guide to purchasing decisions. The key elements are: -

1. Identify hazards in your work - tools, activities

- Manufacturers' Data - be careful, but use the information on vibration "emissions" - and if in any doubt, measure real world use of the equipment
- Evaluate usage, work patterns, etc.
- Decide on priority areas - high levels, long exposures, external work (winter), etc.

2. Work out how significant - what is the risk?

- This may require measurement, you may be able to evaluate exposures based on generic data.
- Document your risk assessments. There have been prosecutions for NOT having assessments, but not many for exceeding action levels.

3. Look for alternatives

- Alternatives may eliminate vibration (e.g. Scabbling)
- Use jigs to hold workpieces

4. Appropriate, well-maintained equipment

- Anti-vibration mounts, decoupled handles
- Tool supports (reducing operator's grip)
- Sharp cutters require less manual force

5. Trained, protected staff

- They need to know sources, health effects and precautions
- How to recognise early signs and symptoms
- Correct selection and use of equipment
- Maintenance of good blood circulation (temperature, smoking!)

6. Health Surveillance

- Pre-employment and routine
- Access to advice, and regular checks
- Document your risk assessments

Members' Questions

The **Construction Chairman, Warwick Adams of Interserve Project Services,** pulled rank and posed the first question by asking if **Lawrence** had any advice on the effectiveness of anti-vibration gloves. Lawrence replied that it was difficult to establish any significant benefit.

Francis Quinn, of Birmingham City Council, passed the comment that it was Council policy to hire tools on a 1-year contract because vibration worsened so much with length of use. At the end of the contract it was then possible to upgrade with a better design and newer components.

David Elliott of Clydesdale Forge asked about work on pedestal grinders. Lawrence replied that the use of jigs reduced exposure levels by about 30%. Although it took extra time to mount workpieces in the jigs, he said that this was more than compensated for by a reduced amount of time taken in rest breaks to recover from the higher fatigue of manual operation. He added that Piece-Rate systems could often conflict with the implementation of control measures and that the workers liked the traditional methods because of the higher earnings!

John Sharpe of Pinnacle Training Services askked if the physical damage was permanent. Lawrence said that even significant damage could be stabilised and that workers often modified their methods of workers in the light of their own experience. The damage to nerves was usually permanent, in the same way that hearing loss is permanent. With the blood vessels, however, a certain amount of self-healing could take place.

Frank Hill of GPU Engineering asked if a weekly average exposure level could be set and Lawrence confirmed that it could. Frank went on to ask how effective rest breaks are. Lawrence said that recovery times were greater than a few minutes and that they did not really have much effect.

Mike Light of Glendale Managed Services enquired about carrying out Machinery Assessments, was it necessary to hire consultants to take measurements? Lawrence

said that shared data was available for use between organisations and that benchmarking was a common technique in construction. Another technique used a generic approach which used the worst case tool operated in extreme conditions.

Mike Ware of Edge Tancred asked whether, regarding compensation claims, there were any discovery dates for VWF. Lawrence confirmed that there were but the dates varied for different industries, with Shipbuilding being earlier than Engineering. He added that most employers were generous with pension payments and out-of-court settlements as a way of managing the situation. This was not a good way of controlling the health risks in the future! He commented that there case histories going back to 1970-78 in the Engineering Industry, whilst from 1978 onwards there were many cases in the Construction Industry, following the introduction of power tools.

Warwick Adams concluded the Questions with comments about a review of 40 claims in 10 years which revealed many flaws in management controls. He then thanked Lawrence for his excellent presentation and asked the members to show their appreciation in the normal way.
The Chairman thanked the speakers for their presentation and asked the members to show their appreciation in the traditional manner.