

Aspects to consider for whole body and hand-arm vibration measurements

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- Preparation
- Taking measurements
- Frequency-weighting curves
- Vibration data
- Controls
- Health effects

Preparation

- Batteries
- Set-up
 - Whole body vibration
 - Hand-arm vibration
- Warm-up instrument
- Cable lengths

Preparation

- Batteries
 - Energizer, Duracell
 - Rechargeable

Preparation

- Set-up
 - Know the meaning of settings
 - Averaging, Slow, time in seconds, Direct, ICP, etc
 - Whole body vibration
 - Sensitivity
 - Frequency band Y/N
 - Filter Y/N
 - K-factor Y/N
 - Hand-arm vibration
 - Sensitivity
 - Frequency band
 - Filter
 - K-factor

Preparation

- Warm-up instrument
 - Allow electronics to reach optimal temperature
 - Low temperatures

Preparation

- Cable lengths
 - Whole body
 - Seated operators
 - Release length of cable required
 - Keep rest of cable rolled-up
 - Standing
 - Release length of cable required
 - Hold cable still during measurement
 - Hand-arm
 - Release full length of cable

Taking measurements

- Interaction with operator
- Whole body vibration
 - Seated
 - Standing
- Hand-arm vibration

Taking measurements

- Interaction with operator
 - Explain purpose to operator
 - Put operator at ease i.t.o. vibration pad
 - Obtain personal details of operator
 - Obtain in an informal way details on
 - Possible signs and symptoms related to vibration exposure
 - Exposure time
 - Overall condition of unit
 - Service cycle of equipment
 - Terrain
 - Travelling speed
 - Other activities he / she needs to perform

Taking measurements

- Whole body vibration
 - Seated
 - Broken / damaged seat pan = NO measurement
 - Broken / damaged back rest = NO measurement
 - Measurement duration: minimum 30 min
 - 1 cycle of operation or more
 - Standing
 - Measurement duration: minimum 5 min
 - Orientate pad in the same direction at all measuring points on structure/ work area

Taking measurements

- Hand-arm vibration
 - Feed cable underneath clothing / overall along arm towards hand
 - Use 3M Transpore™ dressing tape to attach accelerometer directly onto dorsal skin surface of hand
 - Tape cable to wrist and arm to avoid movement of cable

Taking measurements

- [Data sheet WBV ISO](#)
- [Data sheet WBV Non ISO](#)
- [Data sheet HAV ISO](#)
- [Data sheet HAV Non ISO](#)

Frequency-weighting curves

Table 1 — Guide for the application of frequency-weighting curves for principal weightings

Frequency weighting	Health (see clause 7)	Comfort (see clause 8)	Perception (see clause 8)	Motion sickness (see clause 9)
W_k	z-axis, seat surface Multiplying k-factor = 1.0	z-axis, seat surface z-axis, standing vertical recumbent (except head) x-, y-, z-axes, feet (sitting)	z-axis, seat surface z-axis, standing vertical recumbent (except head)	—
W_d	x-axis, seat surface y-axis, seat surface Multiplying k-factor = 1.4	x-axis, seat surface y-axis, seat surface x-, y-axes, standing horizontal recumbent y-, z-axes, seat-back	x-axis, seat surface y-axis, seat surface x-, y-axes, standing horizontal recumbent	—
W_f	—	—	—	vertical

Table 2 — Guide for the application of frequency-weighting curves for additional weighting factors

Frequency weighting	Health (see clause 7)	Comfort (see clause 8)	Perception (see clause 8)	Motion sickness (see clause 9)
W_c	x-axis, seat-back ¹⁾	x-axis, seat-back	x-axis, seat-back	—
W_e	—	r_x -, r_y -, r_z -axes, seat surface	r_x -, r_y -, r_z -axes, seat surface	—
W_i	—	vertical recumbent (head) ²⁾	vertical recumbent (head) ²⁾	—

1) See note in subclause 7.2.3.

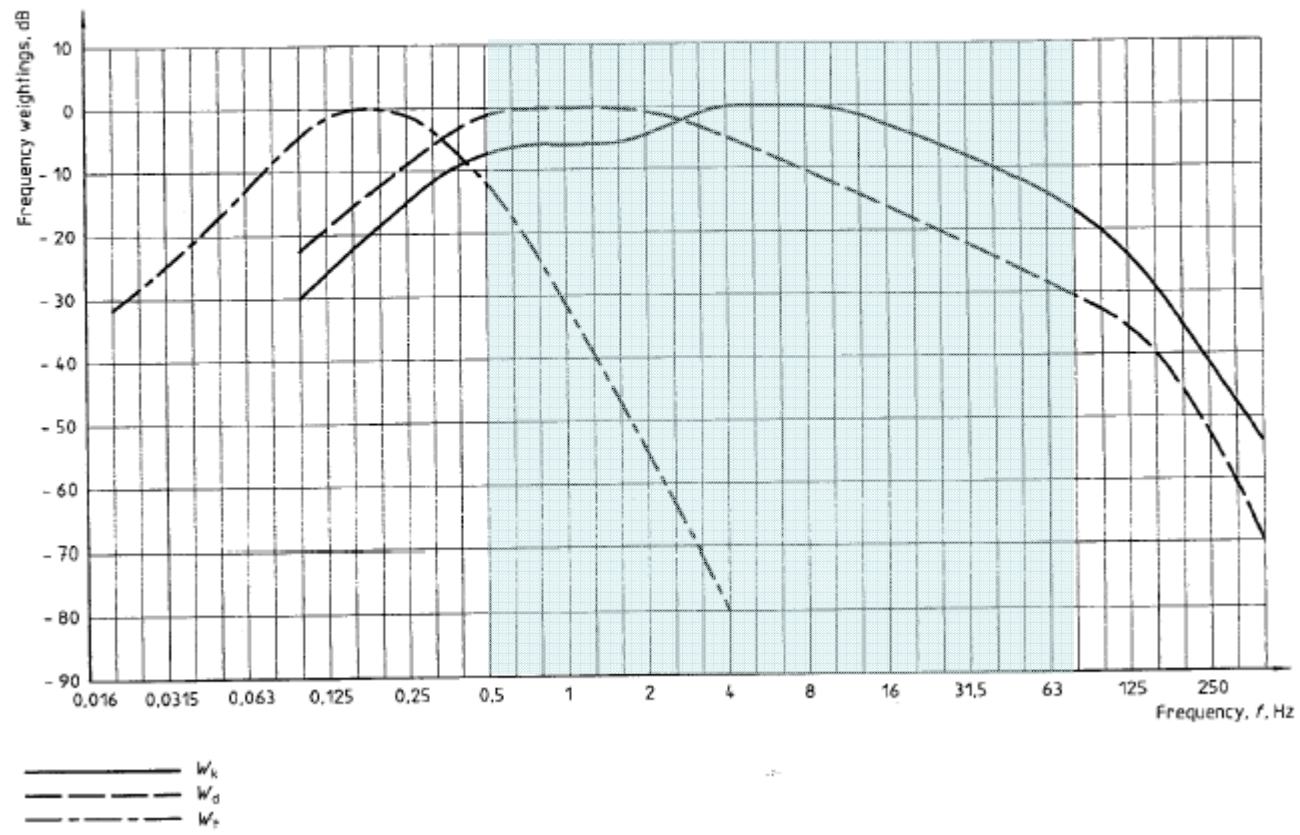
2) See note in subclause 8.2.2.3.

Frequency-weightings

© ISO

SANS 2631-1:1997

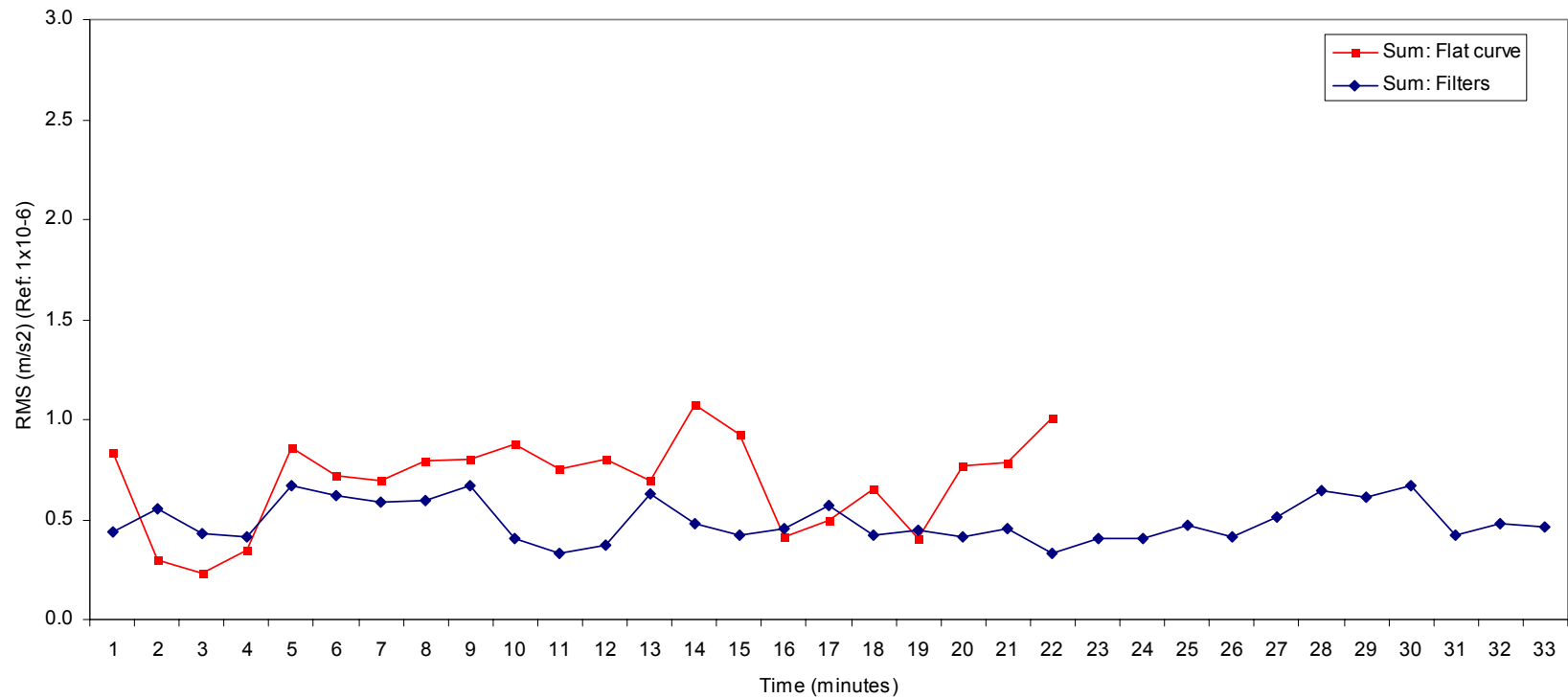
ISO 2631-1:1997(E)



Filter vs flat curve

Water bowzer

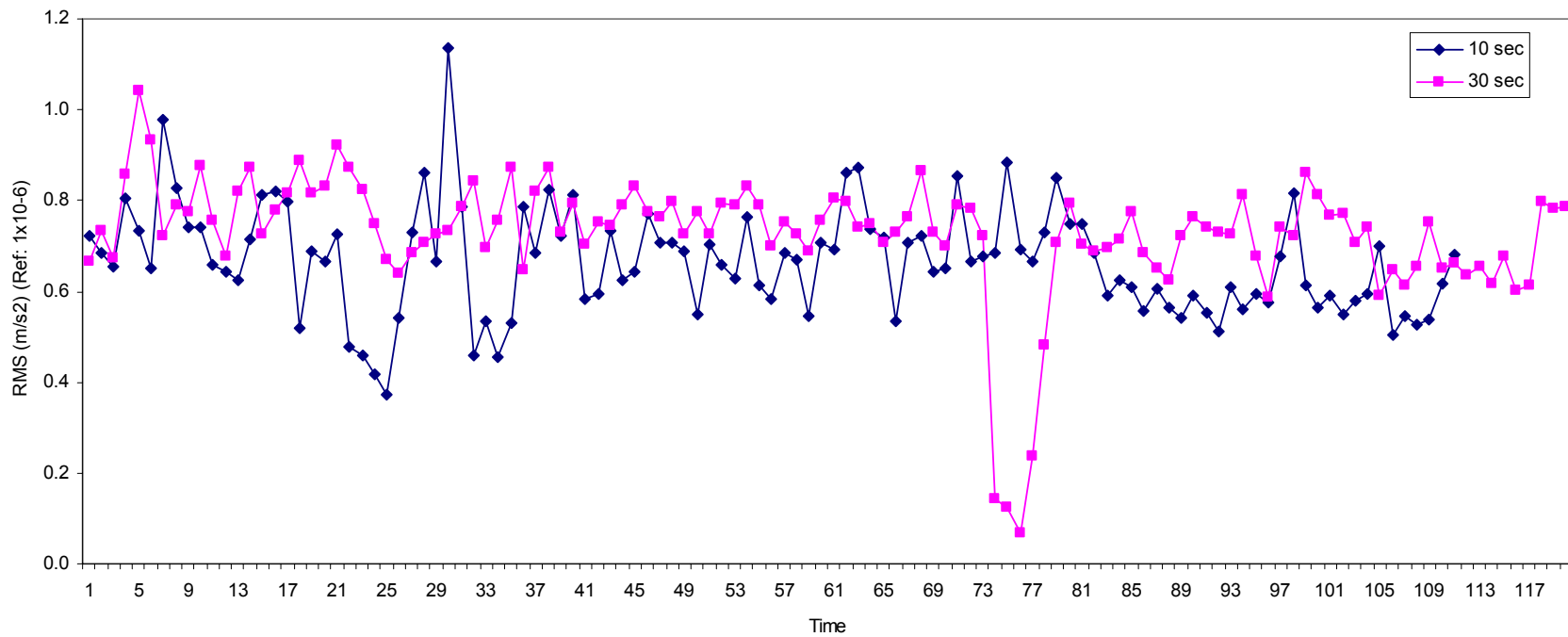
(Sum A(8))



10 sec vs 30 sec Averaging

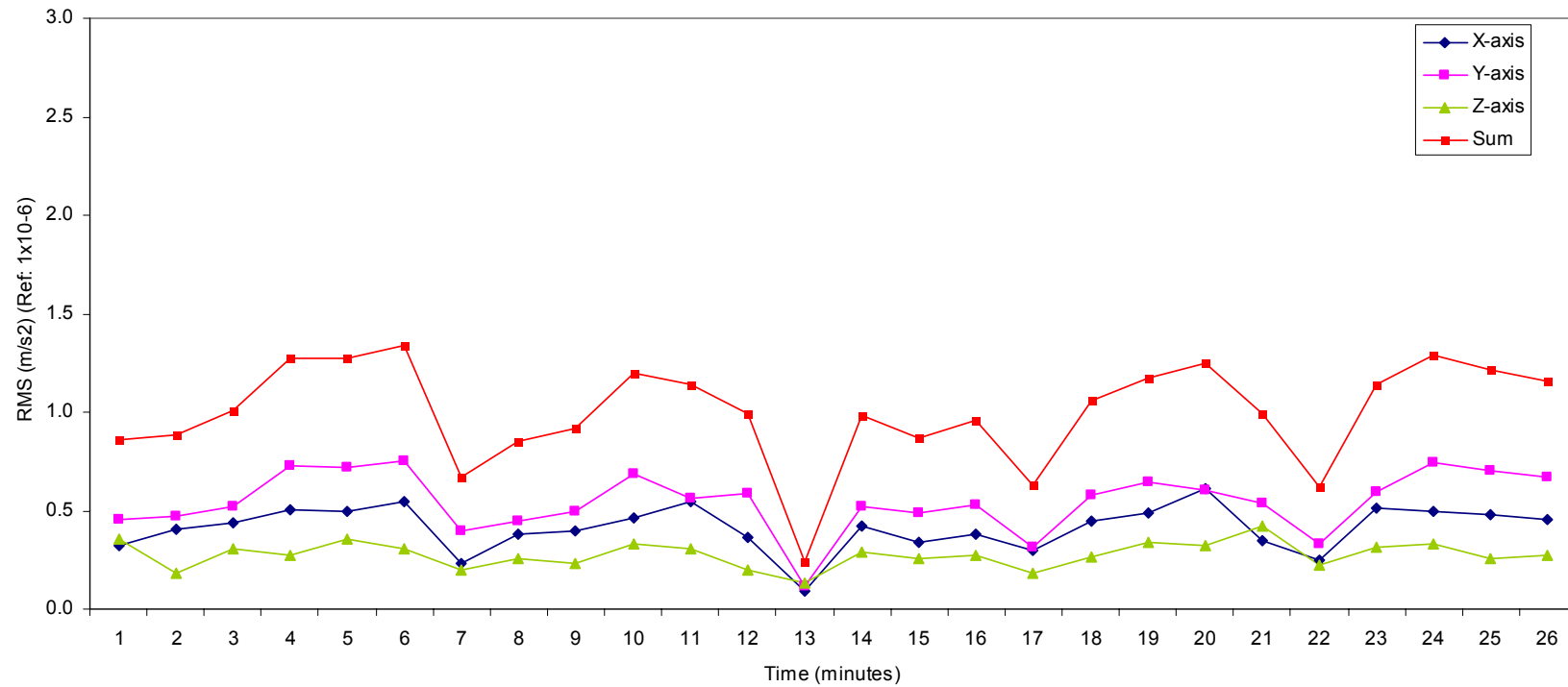
Abnormal load vehicles

(Sum A(8))



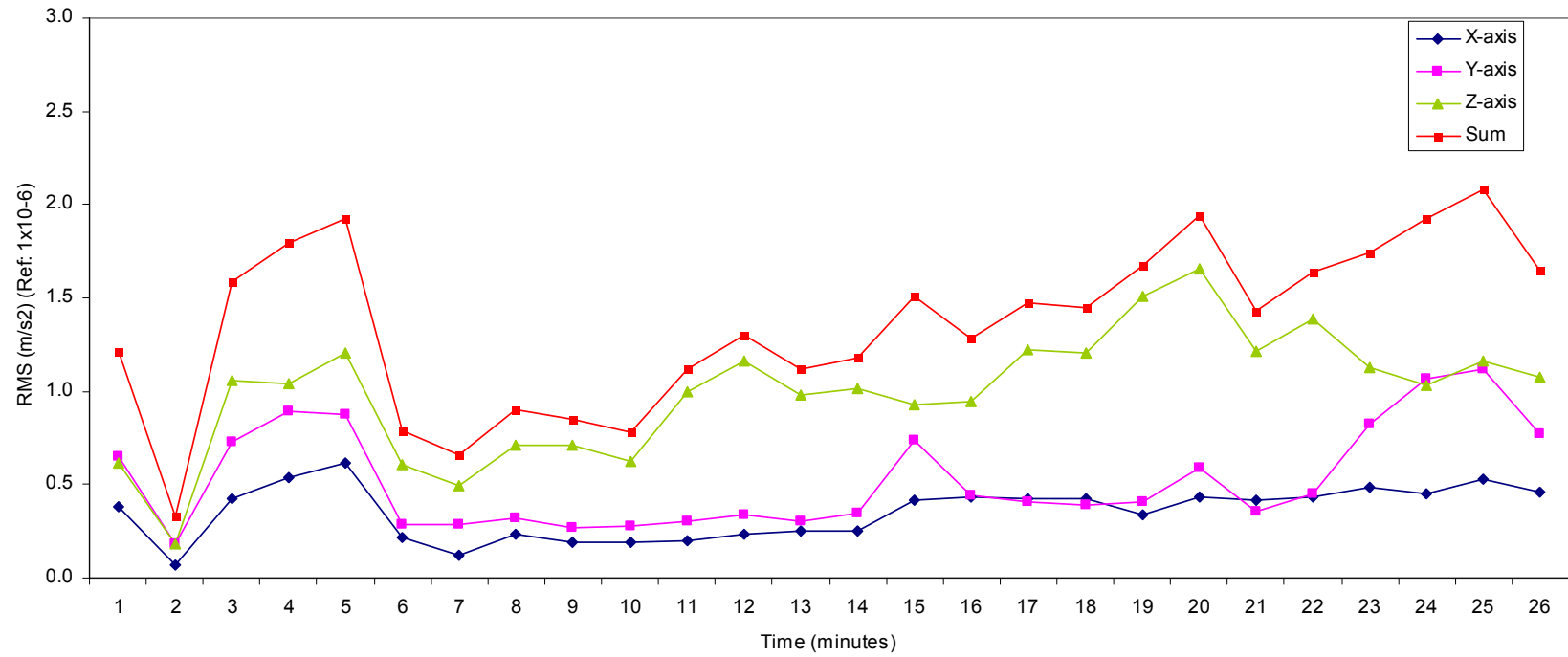
Front End Loader

(Sum A(8))



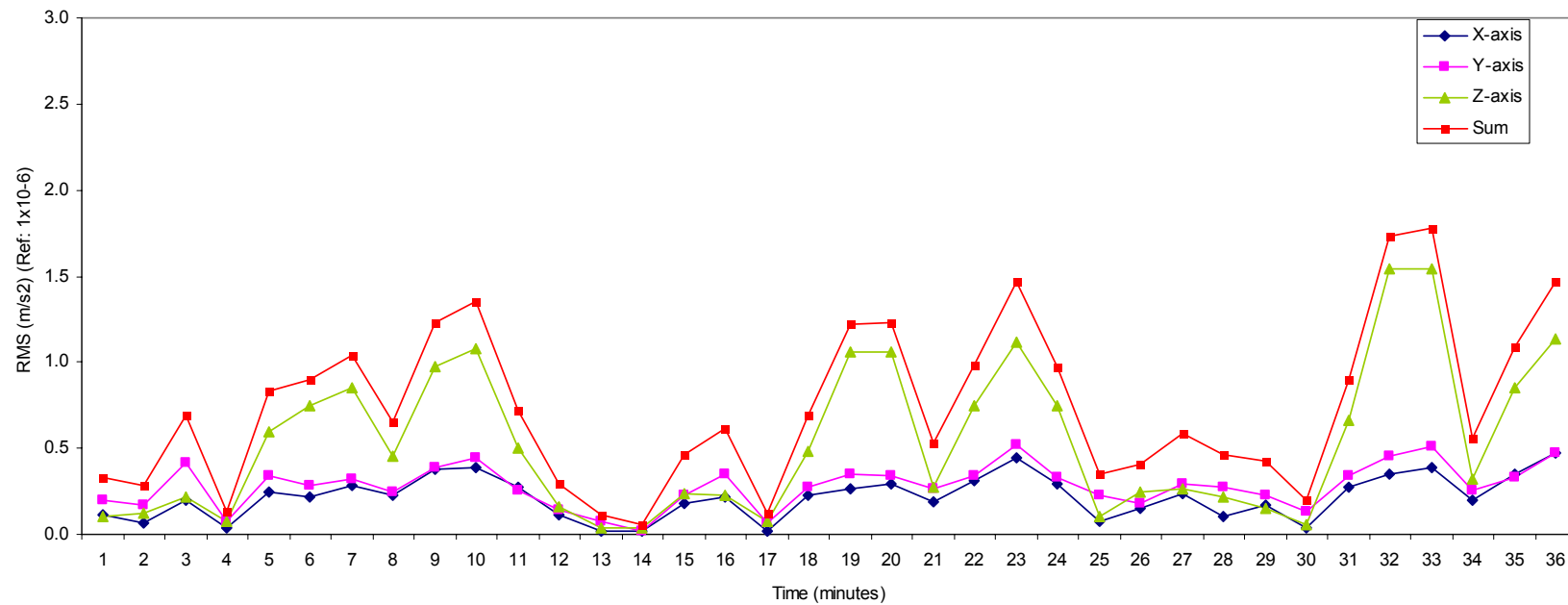
Haul truck: 1 x cycle

(Sum A(8))



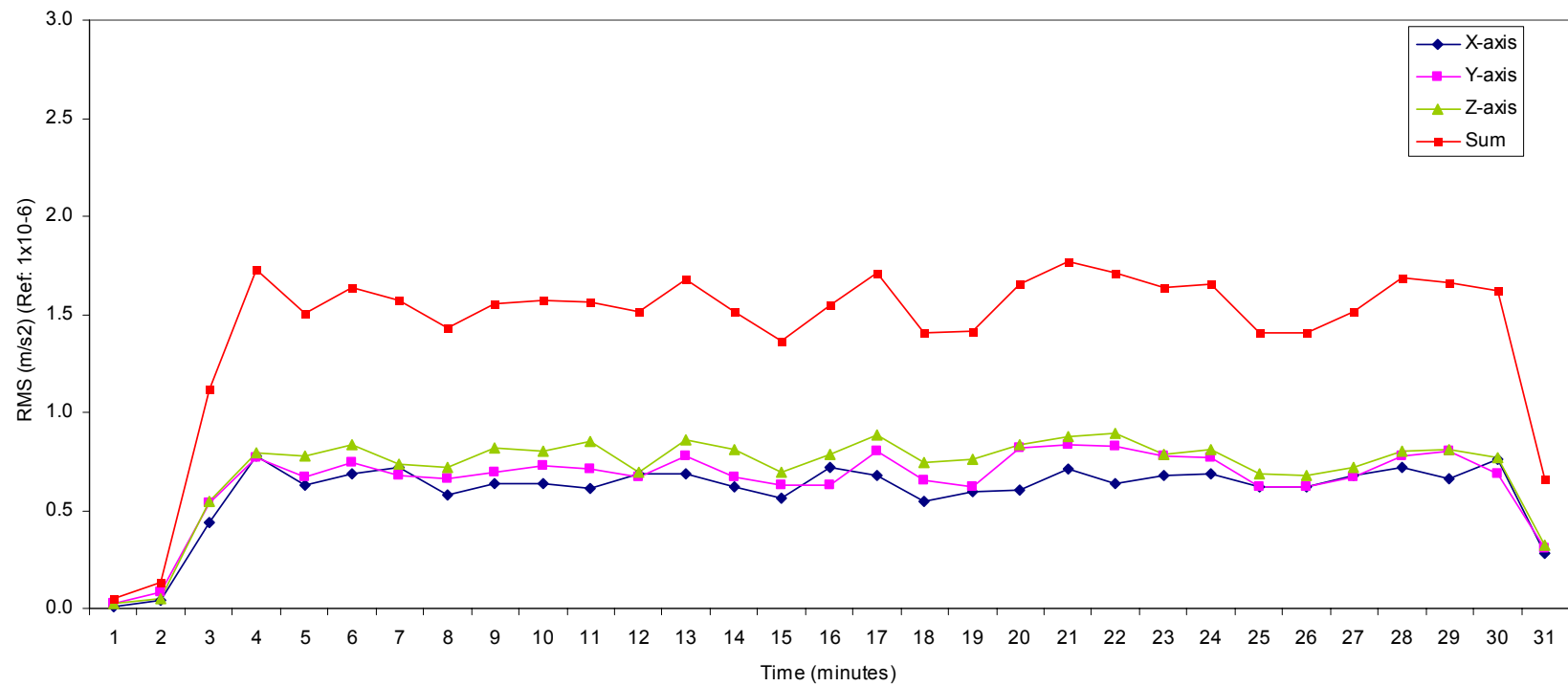
Haul truck : 2 x cycles

(Sum A(8))



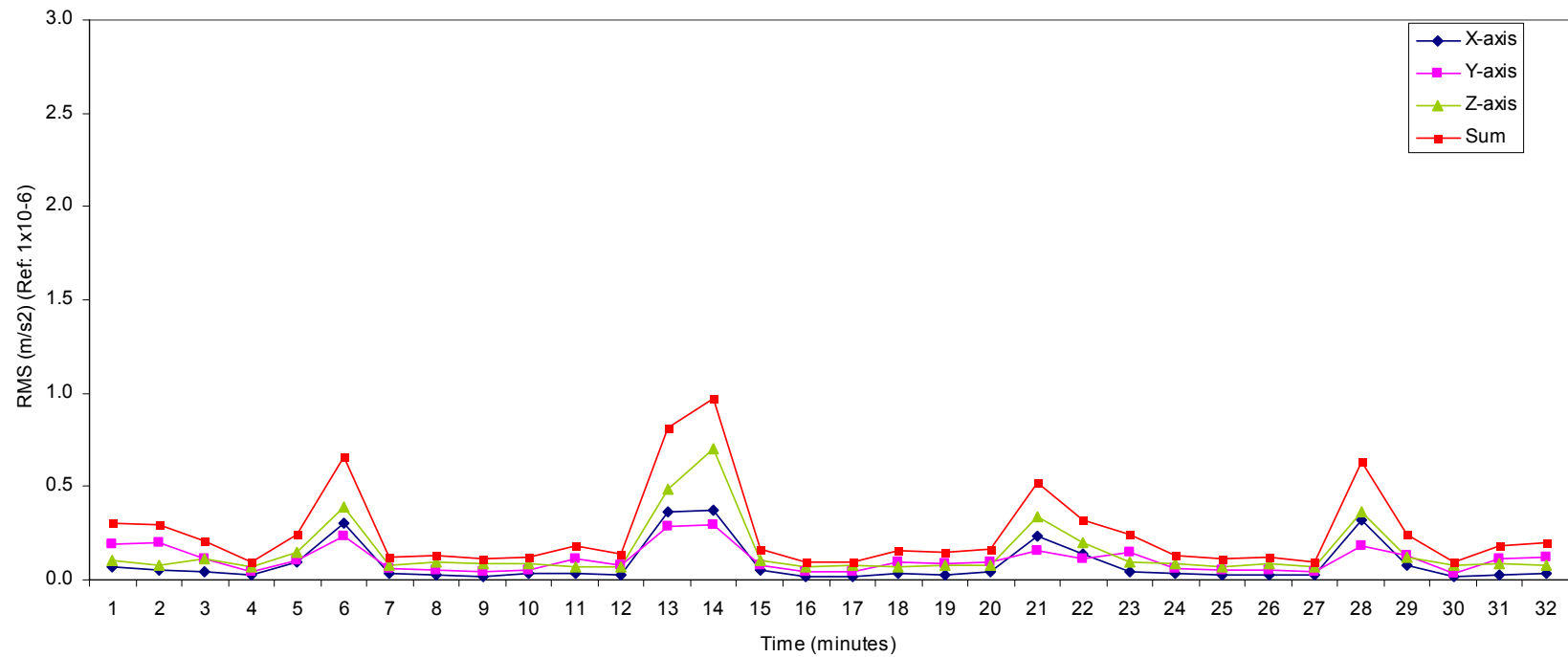
Bulldozer

(Sum A(8))



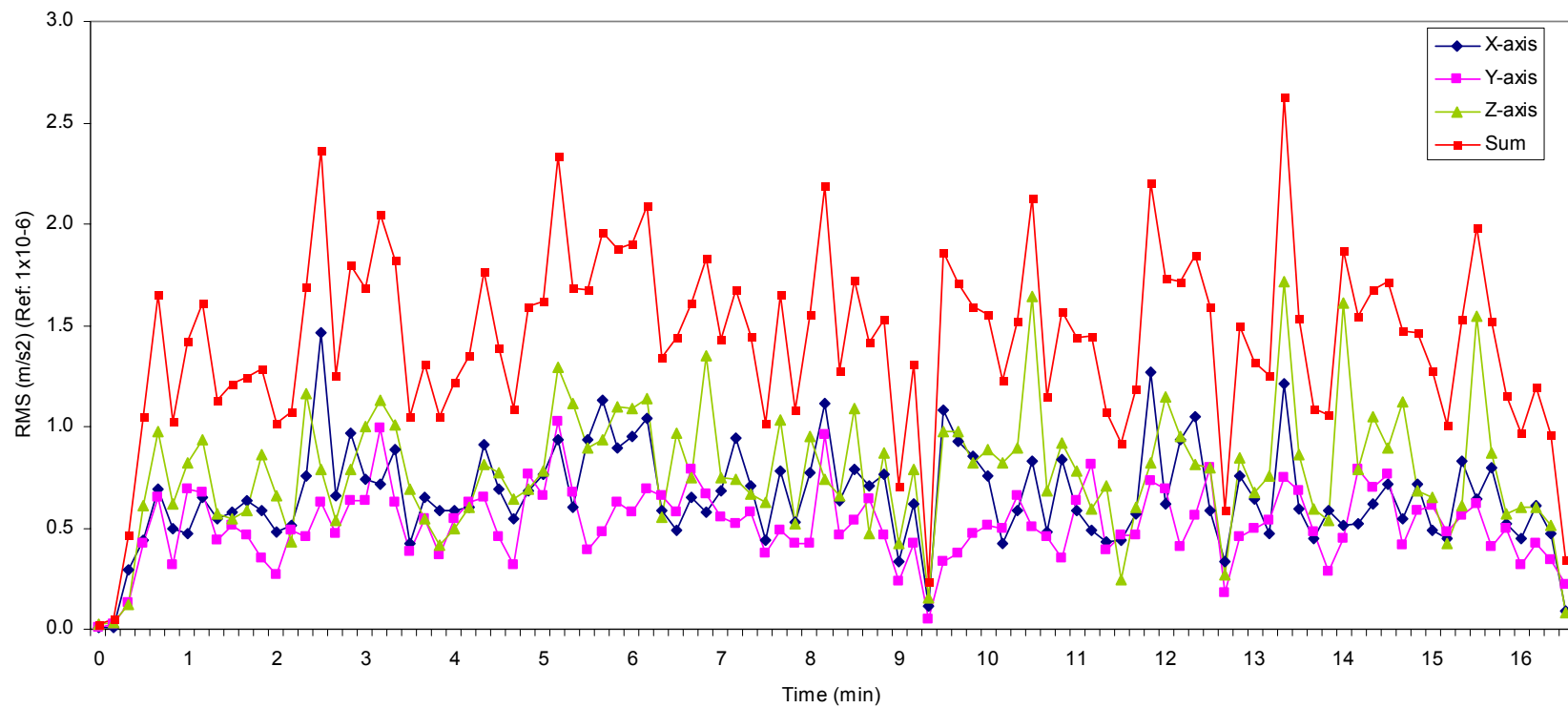
Coal drill

(Sum A(8))



Bobcat: Uneven terrain, 10 sec

(Sum A(8))



Summary of average, minimum and maximum 8- hour sum equivalent exposure levels of mobile equipment

Mobile equipment	Sum A(8)			X-axis			Y-axis			Z-axis		
	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max
Bulldozers												
Drills												
Excavators												
Front End Loaders												
Haul trucks												
Light Delivery Vehicles												
Locomotives												
Shovels												

0.5>x≤1.15 Action value
 x>1.15 Exceed exposure limit value

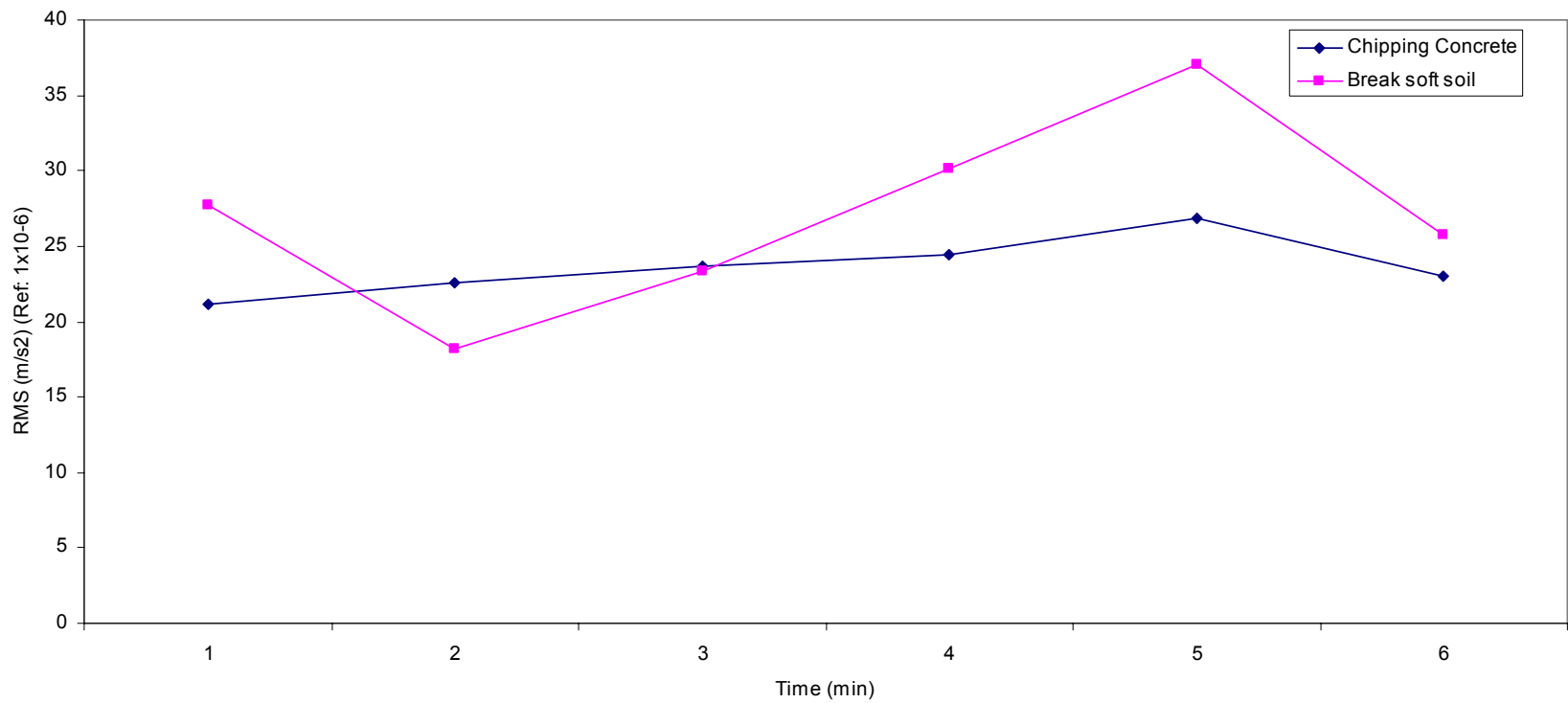
Summary of average, minimum and maximum whole body vibration dose value (VDV) levels of mobile equipment

Mobile equipment	Sum (VDV)			X-axis			Y-axis			Z-axis		
	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max
Bulldozers												
Drills												
Excavators												
Front End Loaders												
Haul trucks												
Light Delivery Vehicles												
Locomotives												
Shovels												

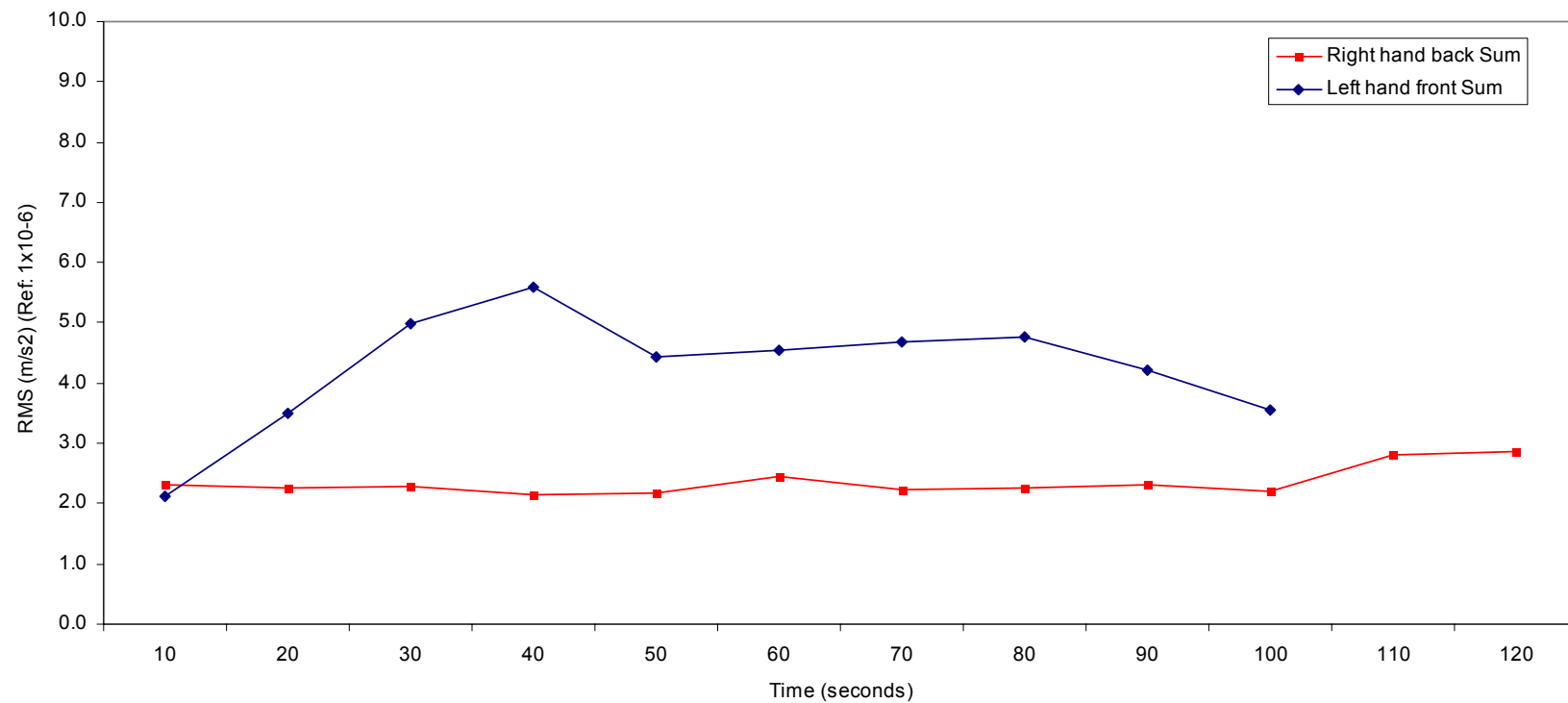
$x \leq 8.5$ Unlikely health effects
 $8.5 < x \leq 17$ Caution: Health risks are indicated
 $x > 17$ Health risks are likely

Jackhammer

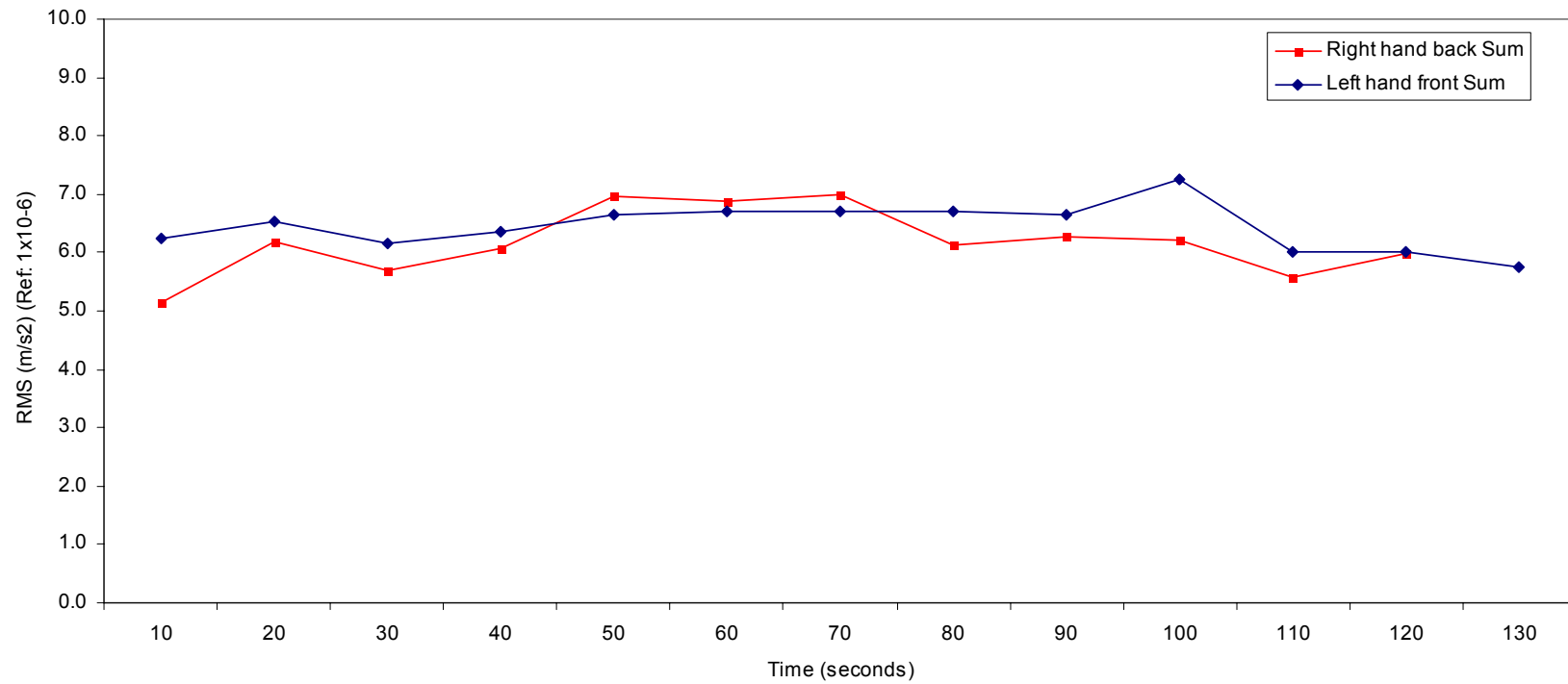
(Sum A(8))



Grip strength 115 mm angle grinder (Sum A(8))



Grip strength 230 mm angle grinder (Sum A(8))



Controls: Management

- Seek technical advice from vehicle and tool suppliers as well as from experts in the field of vibration
- Seek medical advice from scientists and medical practitioners that specialise in vibration
- Develop a check list to determine employees' exposure and to evaluate the effects of vibration on the human body
- Induct operators
- Train operators with regard to operational procedures
- Review exposure times
- Develop a policy on removal from work

Controls: Action at the workplace

- Measure vibration exposure
- Provide appropriate equipment/ tools
- Maintain equipment/ tools
- Inform management of possible over exposures

Control: Medical surveillance

- Pre-placement screening
- Annual medical checks
- Record all signs and symptoms related to vibration
- Advise operators on the consequences of over exposure
- Inform management
- Encourage employees to report vibration related symptoms to onsite health clinic

Control: Exposed operators

- Take responsibility to use equipment/ tool correctly
- Avoid unnecessary vibration exposure
- Adjust seat properly (Whole body only)
- Minimise grip and push forces (Hand arm only)
- Adopt a good sitting posture (Whole body only)
- Check condition of machine/ tool
- Report defects immediately to supervisor
- Wear gloves when safe (Hand arm only)
- Minimise smoking (Hand arm only)
- Report symptoms to supervisor and seek medical advice at the health clinic of the company
- Inform employer of relevant disorders

Health effects 1/2

Whole-Body Vibration

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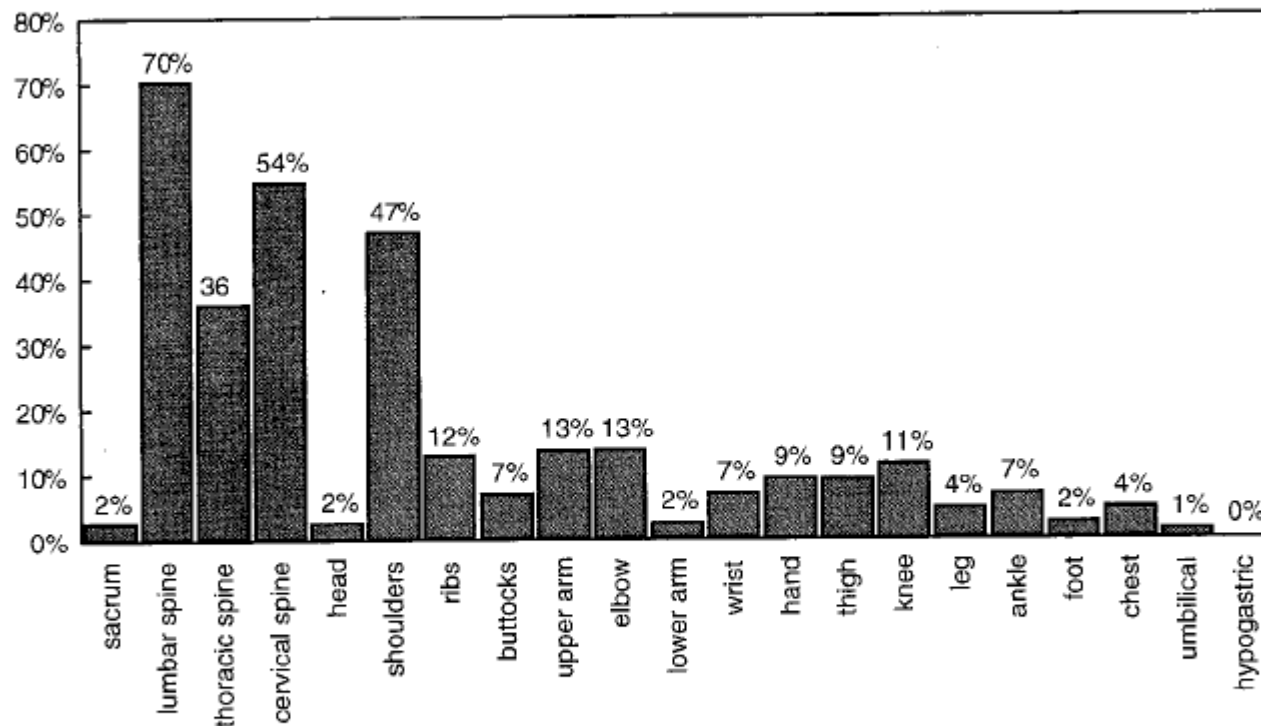


FIGURE 2.7 Prevalence of pain, aching, or discomfort following rallying for 90 drivers and co-drivers. [Adapted from Mansfield, N.J. and Marshall, J.M. (2001). Symptoms of musculoskeletal disorders in stage rally drivers and co-drivers. *British Journal of Sports Medicine*, 35, 314–320.]

Health effects 1/2

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Human Response to Vibration

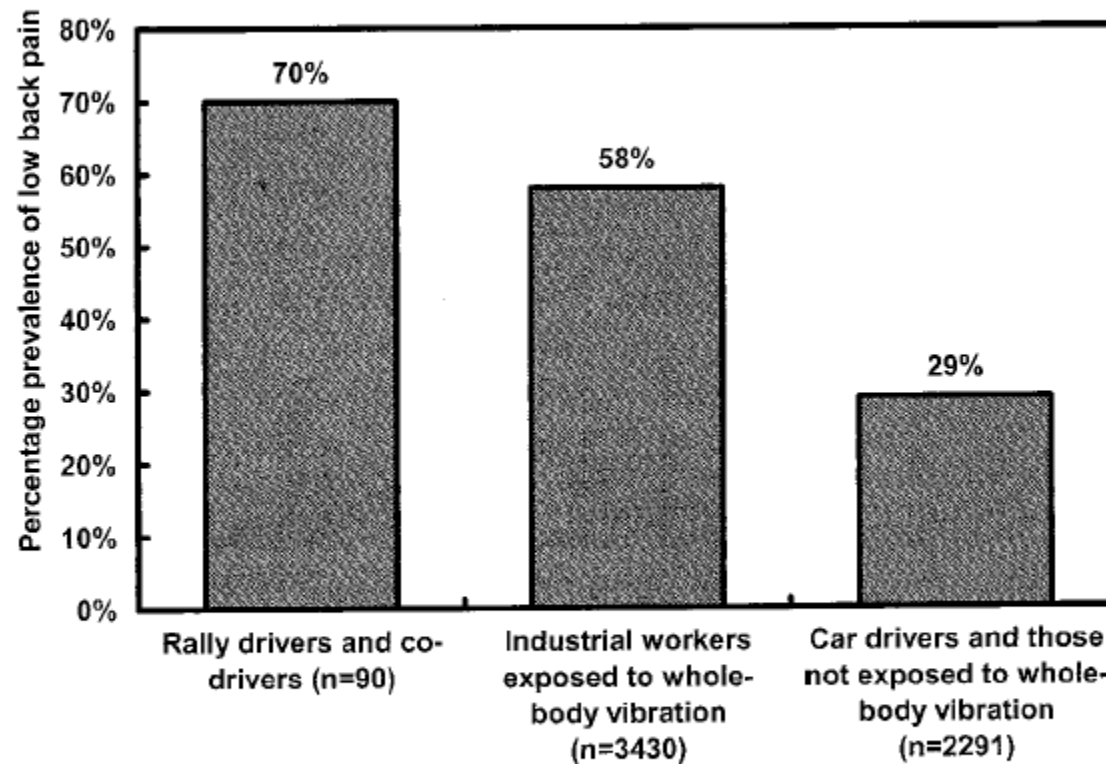


FIGURE 2.8 Percentage prevalence of low back pain for rally participants, those exposed to industrial whole-body vibration, and those not exposed to whole-body vibration (data from Mansfield and Marshall, 2001).

Medical terminology 1/2

- Arthrosis
 - A general term for any joint disease
- Carpal tunnel syndrome
 - A disorder caused by compression at the wrist of the median nerve supplying the hand, causing numbness and tingling
- Endogenous
 - Originating from within the body or produced from internal causes, such as a disease caused by the structural or functional failure of an organ or system
- Hand/wrist tendinitis
 - Inflammation of a tendon in the hand or wrist. A tendon is a tough rope-like tissue that connects muscle to bone.

Medical terminology 2/2

- Musculoskeletal disorders
 - Disorders that can affect the body's muscles, joints, tendons, ligaments and nerves. Also referred to as MSDs
- Osteochondrosis
 - A disease affecting the ossification centers of bone. It is initially characterized by degeneration and necrosis, followed by regeneration and recalcification
- Spondylosis
 - A degenerative disease of the spinal column, especially one leading to fusion and immobilization of the vertebral bones
- Vibration-induced white finger
 - Develops due to cold-induced vascular spasm in the fingers due to prolonged use of vibrating hand-held tools

Thank you