



Challenges Associated with Determining Hand- Arm vibration exposure for surface finishing operations

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Connaught Compliance



Difficulties

- Physically Undertaking Measurements
 - Attaching the probe to the workpiece
- Risk of Accelerometer damage
 - Caught in wheel;
 - Harsh environment
- Estimating daily exposure
 - Many different activities
 - Many different short term stages.

Grinding Turbine Blades



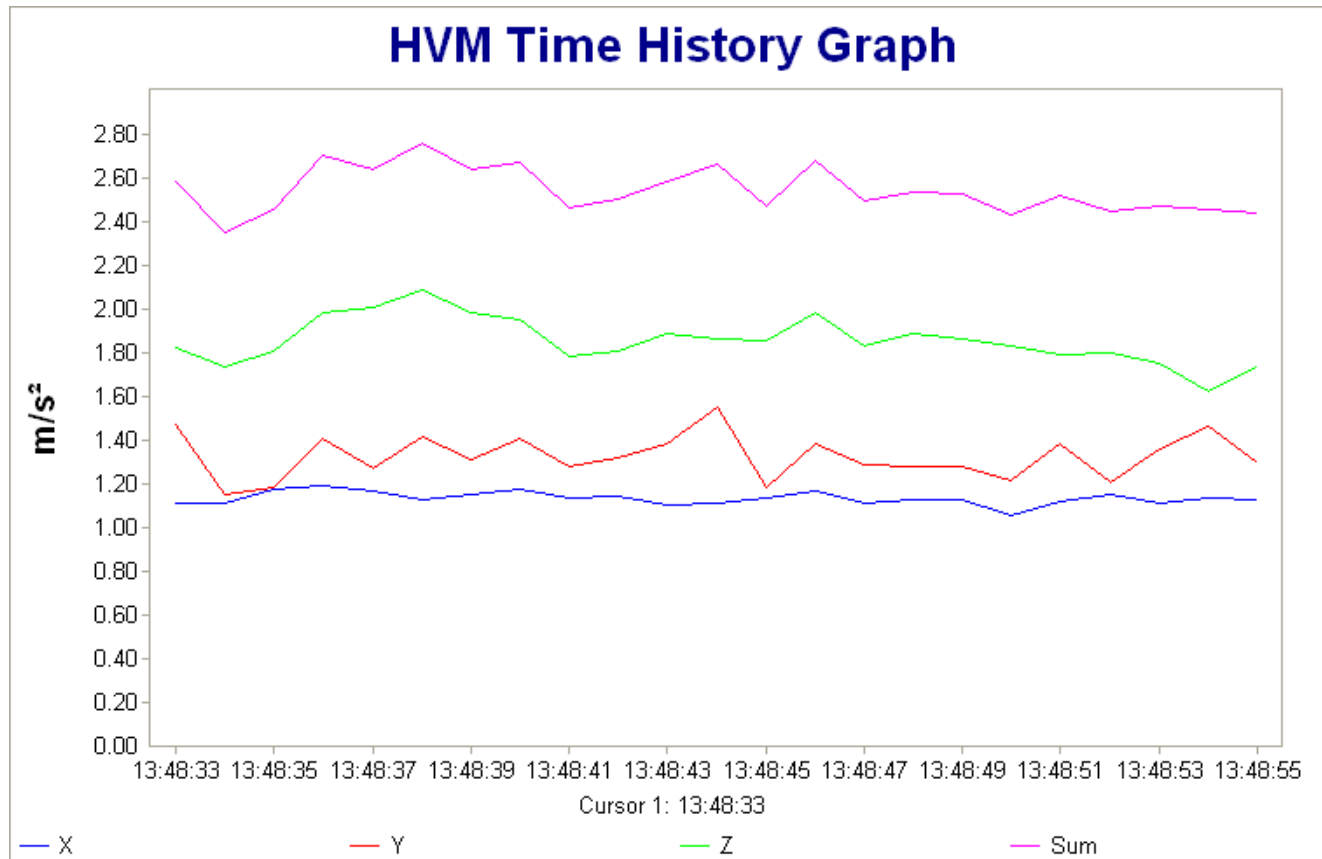
Turbine Blade Finishing

- De-burring, grinding and various finishing operations in a wide range of hard metals and materials.
- Grinding typically 10-20m/s²
- Linishing 3-4 m/s²
- Polishing <2 m/s²

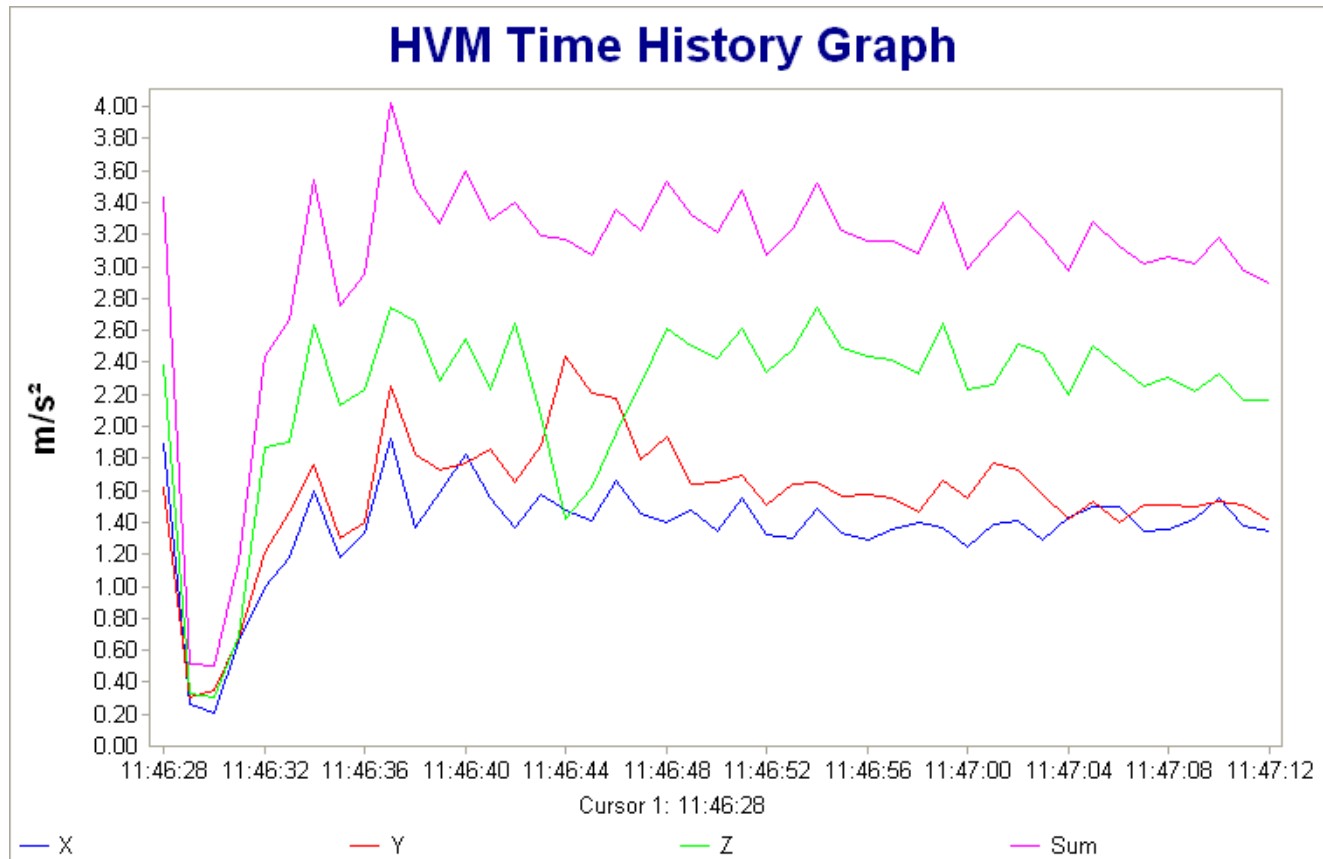
Artificial Limb Implants

- Generally small items;
- Hard materials;
- High degree of finish required.

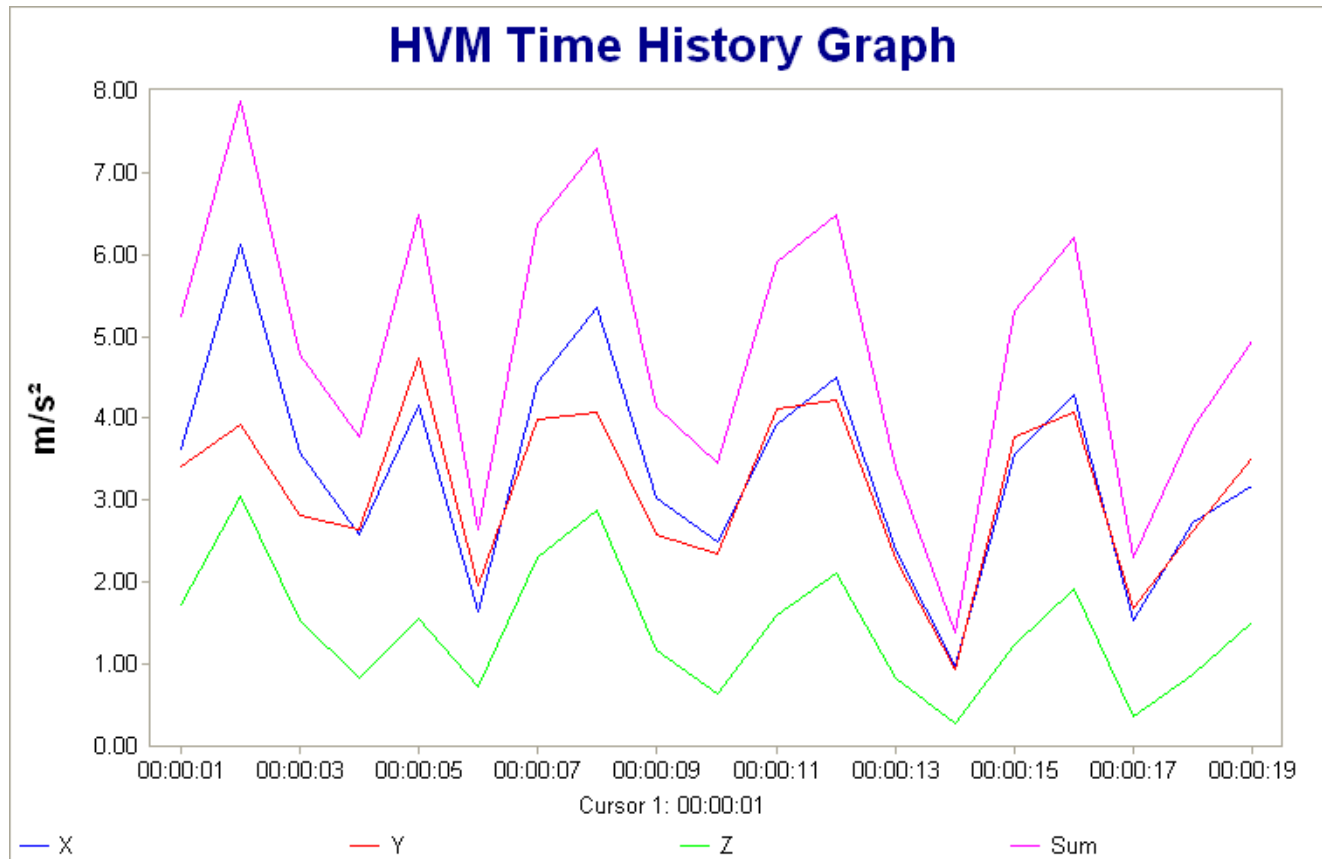
Steady Readout (Aquablast)



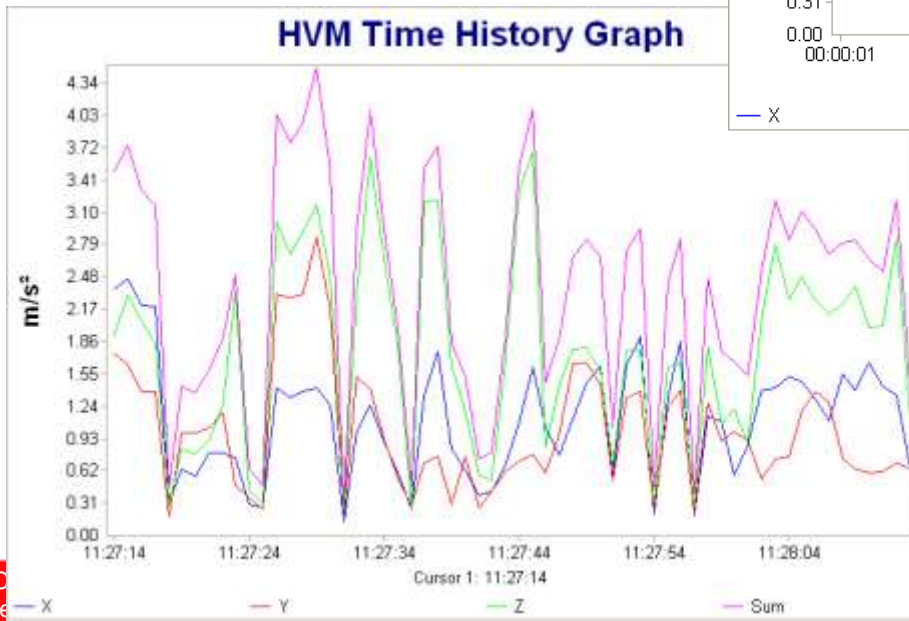
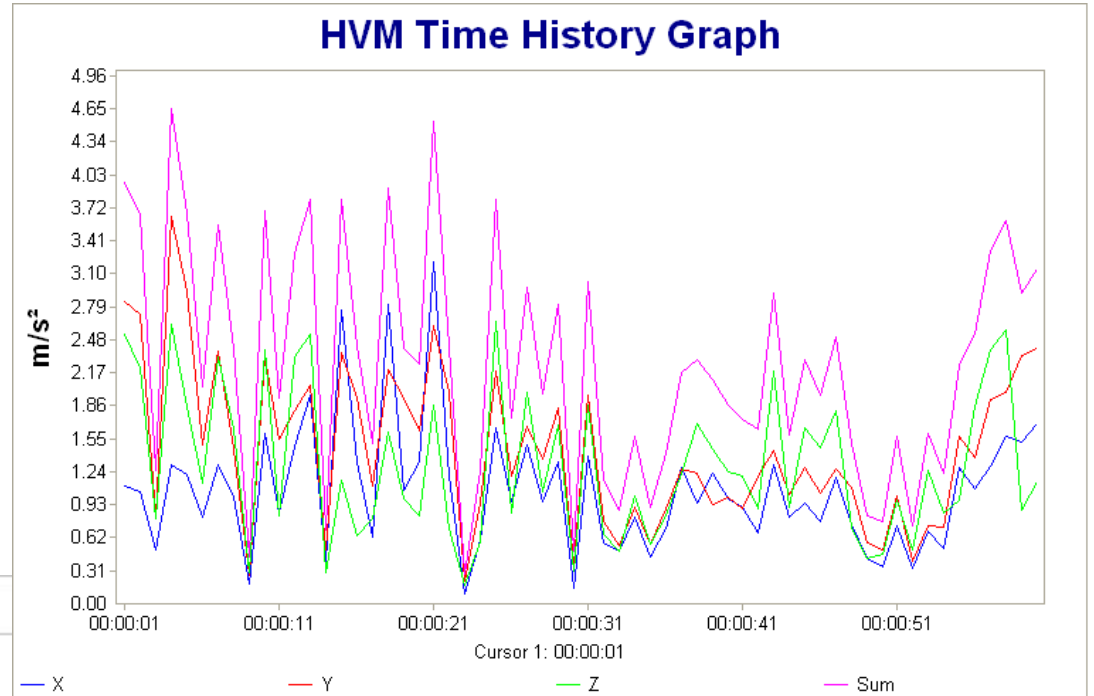
Higher pressure blast



Belt sanding 400 Grit

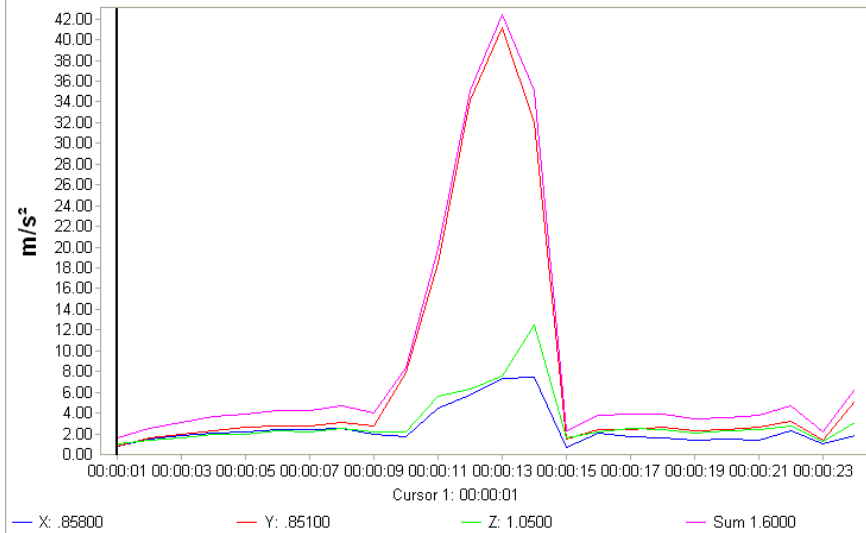


Sanding A6 Belt

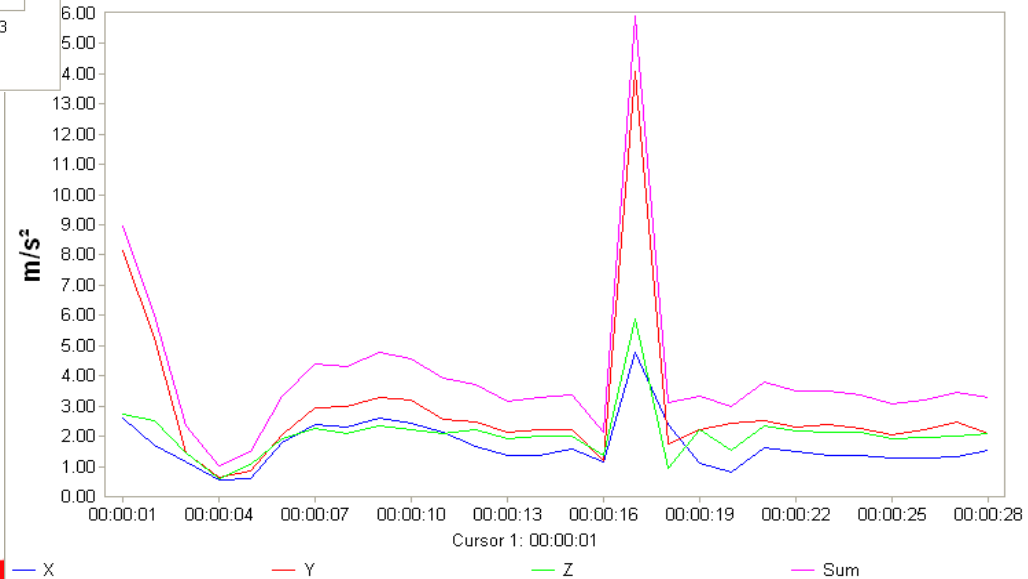


Time History: distorting peak

HVM Time History Graph



HVM Time History Graph



Estimating Exposure

- Finishing a single item can involve many stages
- This can involve different surface finishing operations for short times
- Difficulty in precise estimation of 'Trigger times'

Calculation of the Vibration Dose

- The average vibration dose and exposure time are summed as follows:

$$A(8) = a, h, w \sqrt{(t/8)}$$

- If there are lots of vibration exposures throughout a day, these will need to be summed as follows:

$$A(8) = \sqrt{[A_1(8)^2 + A_2(8)^2 + A_3(8)^2 + \dots + A_n(8)^2]}$$

Breaking Down the operation

Preparation of Implant Item				
Operation	Detail	Vibration level (m/s ²)	Contact time (seconds)	Partial Exposure A _v (8) m/s ²
Fitting Part 1	Use of a 120-grit belt to do the outside of the part .	4.64	10	0.086461295
	Use of a 400-grit belt to do the side of the part	4.33	10	0.080684786
	Use of a 400-grit belt to do the outside of the face of the part	7.42	10	0.138263537
Fitting, Part 2	Use of a 600-grit belt to do the side of the part	5.38	10	0.100250381
	Use of a 600-grit belt to do the outside of the face of the part	9.28	20	0.244549472
Polishing	Use of a 600-grit belt with grease for the side of the cylinder.	5.28	20	0.139140217
	Use of Cool air mop with paste to polish the full surface	6.15	60	0.280707811
	Use of scotch brite wheel for the side	0.93	10	0.017329527

Totalling Exposure

- Average Exposure per Operation = 6.22 m/s²
- Trigger Time per operation = 150 Seconds
- Total Partial Exposure per Operation Ai(8) = 0.448 m/s²
- Number of Items per batch = 20
- Time per Batch = 1 hour 30 minutes
- Trigger Time per Batch = 50 minutes
- Partial Exposure per batch Ai(8) = 2.00 m/s²
- Exposure Points per Batch = 64

HSE HAV Exposure Ready-Reckoner

All values are exposure points
Colours show exposures re. EAV & ELV

	Above limit value
	Likely to be above limit value
	Above action value
	Likely to be above action value
	Below action value

Vibration magnitude m/s ²	Daily exposure time									
	15 m	30 m	1 h	2 h	3 h	4 h	5 h	6 h	8 h	10 h
40	800									
30	450	900								
25	315	625	1250							
20	200	400	800							
19	180	360	720	1450						
18	160	325	650	1300						
17	145	290	580	1150						
16	130	255	510	1000						
15	115	225	450	900	1350					
14	98	195	390	785	1200					
13	85	170	340	675	1000	1350				
12	72	145	290	575	865	1150	1450			
11	61	120	240	485	725	970	1200	1450		
10	50	100	200	400	600	800	1000	1200		
9	41	81	160	325	485	650	810	970	1300	
8	32	64	130	255	385	510	640	770	1000	1200
7	25	49	98	195	295	390	490	590	785	865
6	18	36	72	145	215	290	360	430	575	720
5.5	15	30	61	120	180	240	305	365	485	605
5	13	26	50	100	150	200	250	300	400	500
4.5	10	20	41	81	120	160	205	245	325	405
4	8	16	32	64	95	130	160	190	255	320
3.5	6	12	25	49	74	98	125	145	195	245
3	5	9	18	36	54	72	90	110	145	180
2.5	3	6	13	25	38	50	63	75	100	125
2	2	4	8	16	24	32	40	48	64	80
1.5	1	2	5	9	14	18	23	27	36	45
1	1	1	2	4	6	8	10	12	16	20

Summary Presentation of Results

Item	Picture	Items Per Batch	Average vibration Levels m/s ²	A _v (8) m/s ² per batch	Points per batch	Total time per batch	Est. Trigger Time Per Batch	Number of Batches to reach A(8) of:	
								2..5 m/s ²	5 m/s ²
Item X		20	5.52	1.95	61	1h 30m	60m	1.6	6.6
Item Y		30	4.63	1.6	43	6h	60m	2.3	9.3
Item Z		5	3.69	0.5	5	3h 30m	10m	20	80