HAND ARM VIBRATION

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Evaluation and Damping of High-Frequency Vibrations on a Tightening Tool

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Presentation Outlines

- Introduction
- Background
- Measurement set-up and procedure
- Test results
- Post-paper studies
- Conclusion

A Few Applications with Atlas Copco Tools

Grinding

Scaling

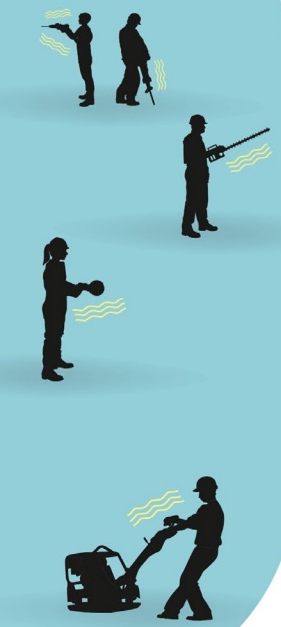
Drilling

Tightening

Chipping

Background

- Pulsating tightening tools are common in most industries for their high torque-to-reaction-force ratio
- The pulse mechanism may generate harmful vibration levels
- Choosing an oil dampened pulsating tools over an impact tool will reduce vibration levels
- A tool with a shut-off mechanism that stops when the correct torque is reached will reduce vibration exposure time
- Tightening tool with pulse unit and shut-off => Atlas Copco ErgoPulse PTI-range
- EP7 PTI55 provided a useful test case with potential for field tests
- Low vibration emissions according to ISO 28927-2
- Potential for high frequency vibrations due to pulse unit
- Experimental study for evaluation and damping of high frequency vibrations



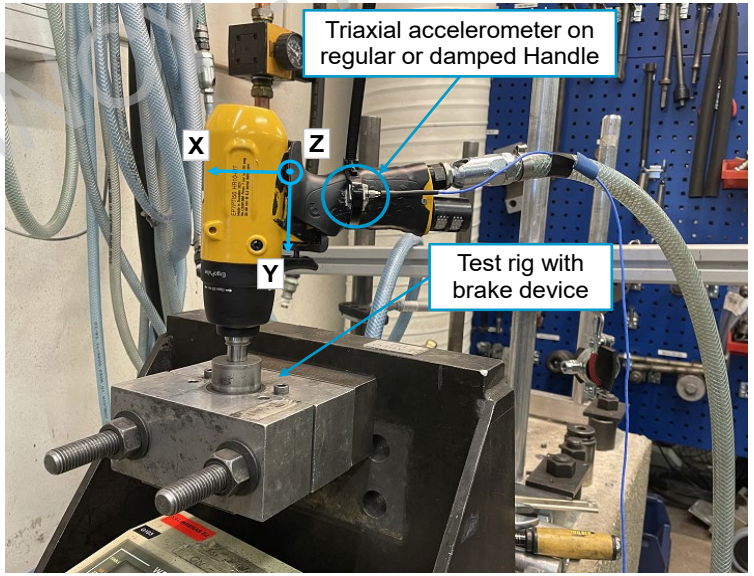
Measurement Procedure

- Vibration levels were measured by using a triaxial accelerometers located on the handle of the EP7 Tool run in the C.2 Brake device described in ISO 28927-2 Annex C.
- The measurements were conducted according to the guidelines given in ISO 28927-2. However, the procedure was simplified by using only one machine run by two operators that each performed five runs of 10 s.
- An initial series of measurements was conducted with a factory new tool, which was retrofitted with dampening material underneath the regular handle's rubber cover.
- The time signals were acquired with a sampling frequency of 65.536 Hz and in addition to a digital low-pass filter at 10 kHz.
- The time signals were evaluated for Vibration Peak Magnitude according to: $VPM = \sqrt{\frac{\sum a^{2+2k}}{\sum a^{2k}}}$ with $k = 2$

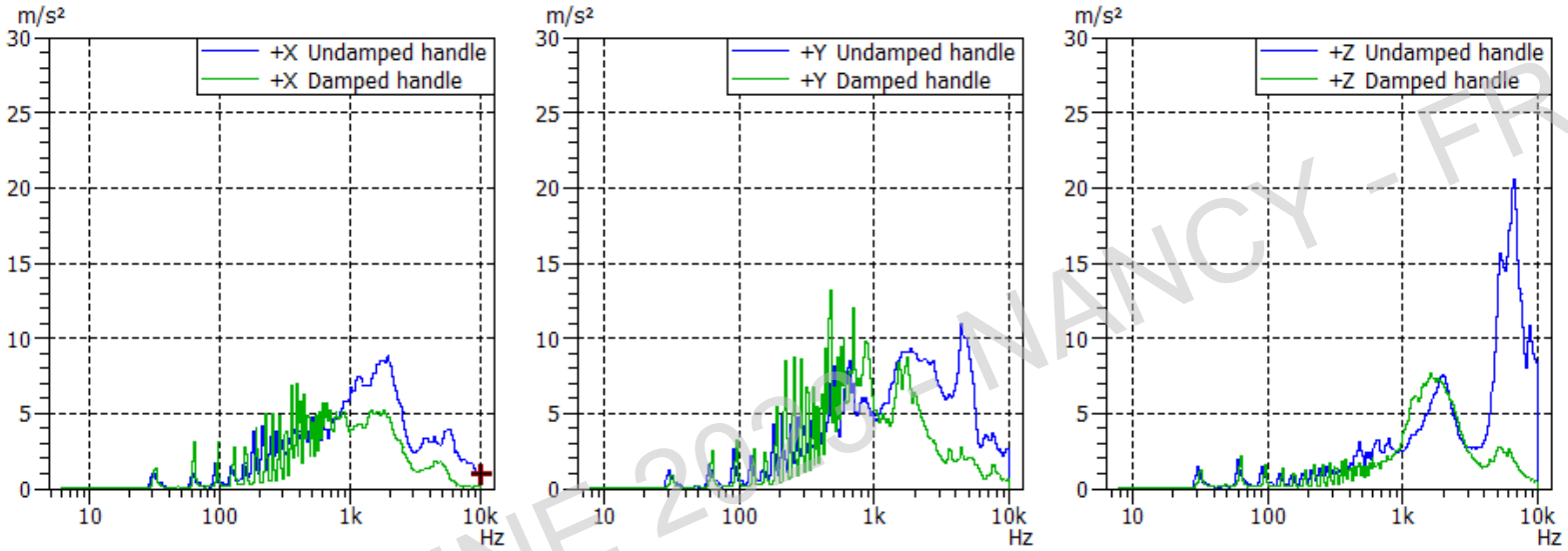
Experimental Set-Up

Added vibration dampening foam

Re-Covered with new original rubber cover



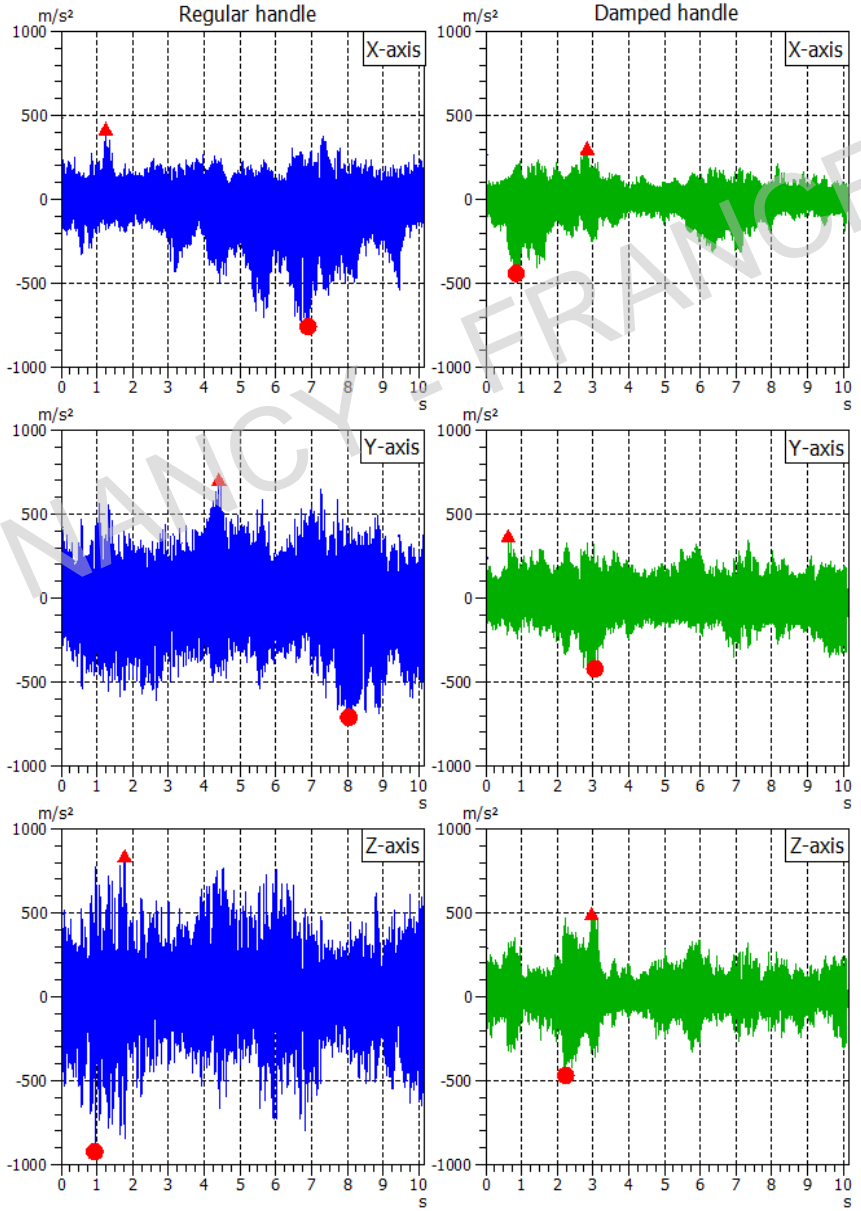
Test Results



Tool	Regular handle		Damped handle	
	VPM (Std. deviation) [m/s²]	a_{hw} (Std. deviation) [m/s²]	**VPM** (Std. deviation) [m/s²]	a_{hw} (Std. deviation) [m/s²]
X:	415,1 (77,0)	1,8 (0,1)	253,2 (66,9)	1,5 (0,1)
Y:	458,6 (46,8)	2,0 (0,3)	326,4 (83,2)	1,7 (0,2)
Z:	618,9 (170,0)	1,7 (0,4)	268,5 (52,0)	1,1 (0,1)
Norm (X, Y, Z):	888,6 (113,9)	3,1 (0,4)	500,3 (80,7)	2,5 (0,2)

Lab Test Summary

- Slight decrease for the declared vibration emission value from 3.1 m/s² to 2.5 m/s² cannot be fully attributed to the added damping. Official declaration value for the EP7 PTI55 is 3.3 m/s² with an uncertainty K = 0.9 m/s² .
- VPM was reduced from 888,6 to 500,3 m/s² with the most significant reduction in the Z-axis (normal to the handle surface)
- VPM is indicated to be a reliable value for high frequency vibrations

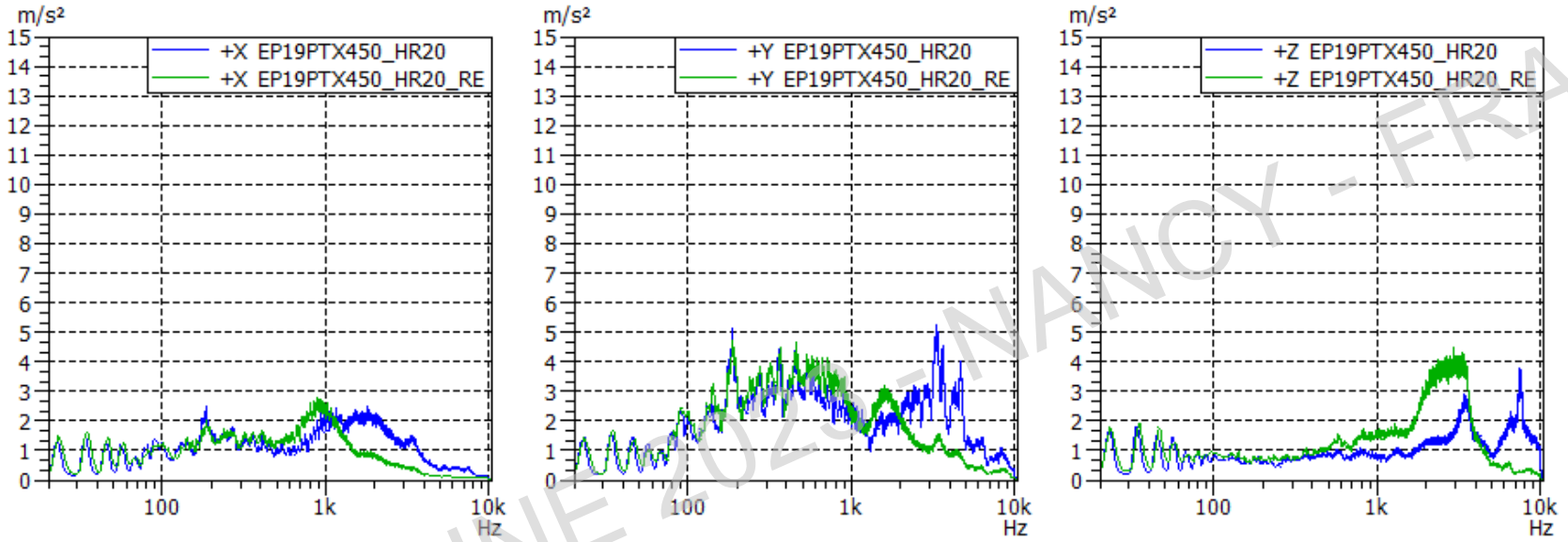


Continuation: post-paper field test

Four tools were field tested for one month at a customer comparing 2 different dampening materials.

- One material type lost its dampening property before the month was over, which the operators could feel
- The other material had a small dampening reduction but not statistical significant
- Each tool was positioned at a work station in a production line with the same amount of joints per day to ensure equal test conditions
- Operator feedback was very positive

Continuation post-paper: Tool for higher torques, EP19PTX450



Tool	Regular handle		Damped handle	
	VPM (Std. deviation)	a_{hw} (Std. deviation)	**VPM** (Std. deviation)	a_{hw} (Std. deviation)
Norm (X, Y, Z):	**1671,4** (431,8)	5,8 (0,4)	**2121,0** (652,3)	6,8 (1,3)

Conclusions

- VPM is a suitable parameter for evaluation of high frequency vibrations
- There is clearly a high frequency content above 1 kHz for pulsating nutrunners which VPM captures
- More field tests are required, especially for durability of dampening materials.
- Material selection should be made specifically for each tool