HAND ARM VIBRATION

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Vibration Characteristics of Ultrasonic-Activated Straightening and Forming Machines

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Introduction

- Vessel shipbuilding
- Need to perform straightening and forming operations by mechanical shocks with conventional tools including:
  - Sledgehammer and flattener

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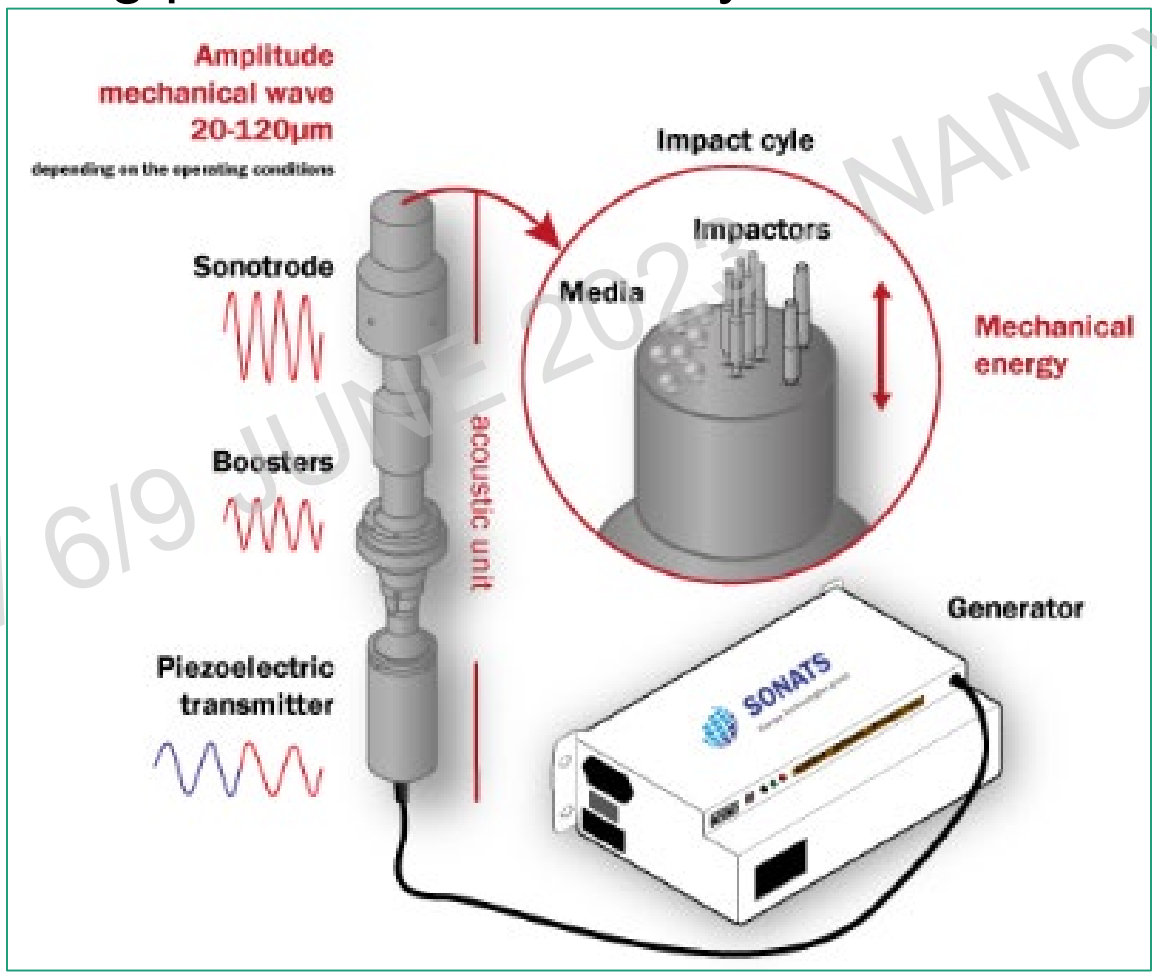
- Vessel shipbuilding
- Need to perform straightening and forming operations by mechanical shocks with conventional tools including:
  - Sledgehammer and flattener
  - Pneumatic riveting hammer
  - Pneumatic chipping hammer mounted on trolley
- Support by CARSAT to reduce the risks associated with these operations by evaluating the vibration characteristics of the various processes including tests of **ultrasonic activated hammers**

Ultrasonic activated hammers: overview

Ultrasonic activated hammers: operating principle

- The hammering process activated by ultrasound:



Ultrasonic activated hammers: machines measured

- The hammering process activated by ultrasound:
  - SONATS Stress Voyager and its different heads (PR10/PR13/PR17)

Materials and Methods: classical machines

- Tests carried out in the Boilermaking workshop
- Accelerometer fastened to the machine or hammer handle

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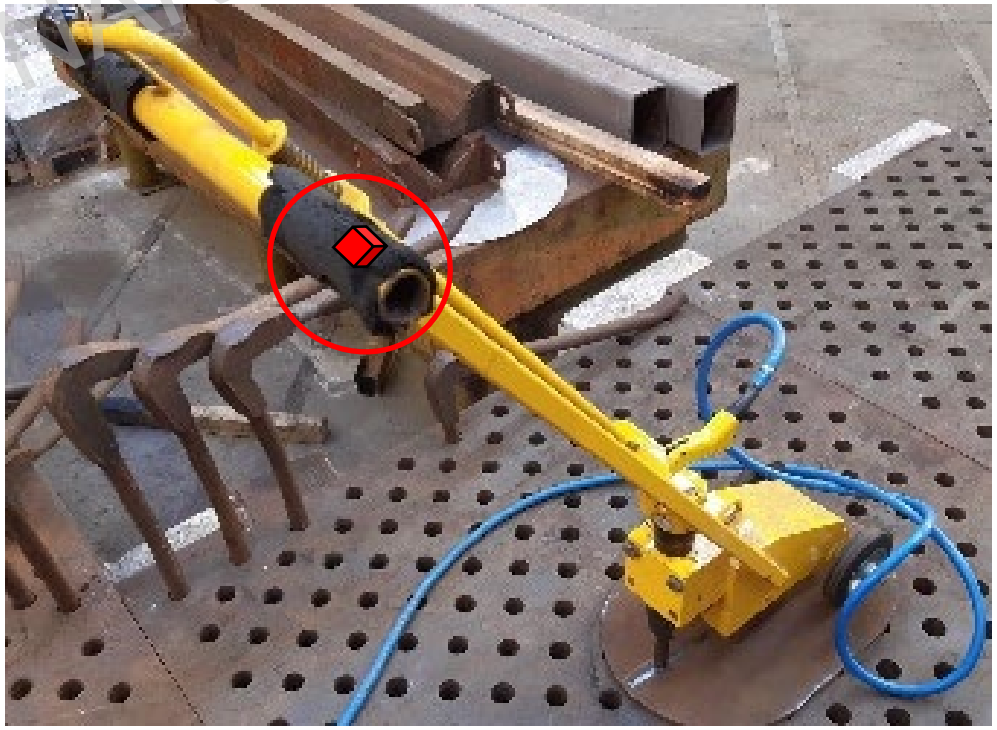


Materials and Methods: ultrasonic activated hammers

- Tests carried out in the Boilermaking workshop
- Accelerometer fastened to the machine or hammer handle

Materials and Methods: experimental condition

- Steel sheets (thickness = 10 mm) for conventional processes

Materials and Methods: experimental condition

- For ultrasonics activated hammers:
  - Aluminium sheets (thickness = 1,5 mm):

  - Welded steel parts (3,0 mm):

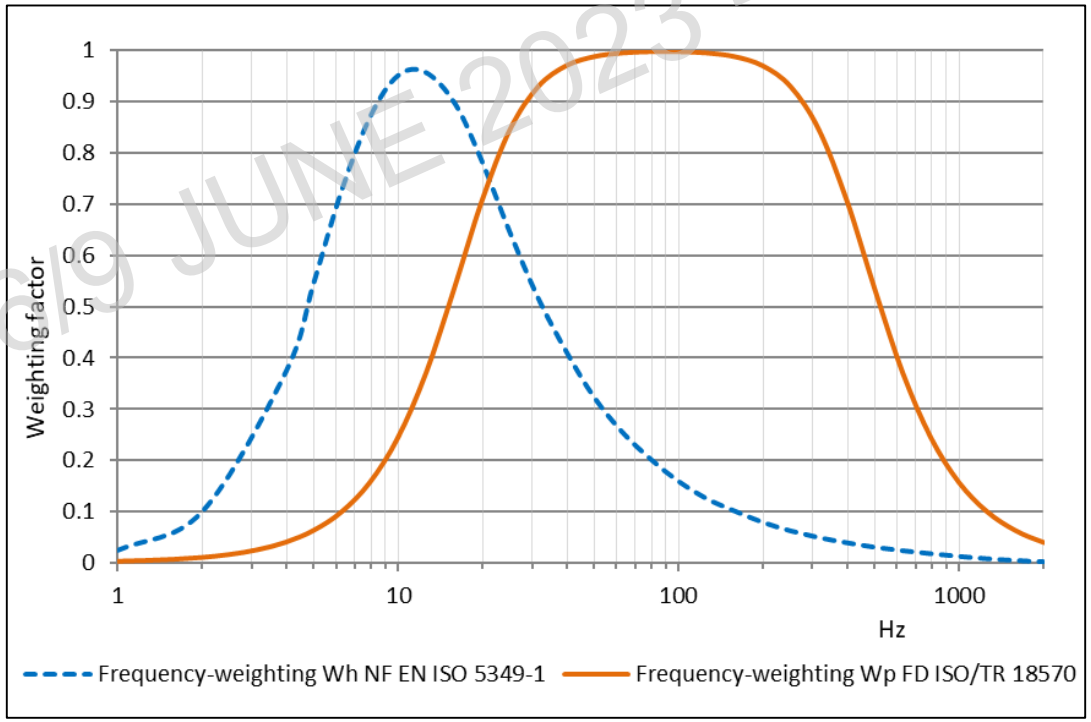
Materials and Methods: experimental setup

- Vibration data acquisition with:
  - triaxial accelerometer PCB 356B20 (1 mV/g ; 5000 g ; 2-7000 Hz)

  - Acquisition front end Siemens LMS SCADAS XS (Sampling rate = 2560 Hz et 10240 Hz)

Materials and Methods: standards

- Vibrations measurements were carried out in accordance with NF EN ISO 5349-1&2 and the documentation booklet FD ISO/TR 18570 for process with ultrasonic activated hammers :
  - Frequency-weighting W_h and W_p:



Results: conventional processes

Measured Configuration	*Vibration Level (m/s^2)*
	a_{hv}
Riveting hammer Atlas Copco RRH12	6.3
Chipping hammer Atlas Copco RRC 75B-01	3.3
Flattener (7 shots—duration: 15 s)	12.9
Masse (5 shots—duration: 9 s)	21.9

Results: ultrasonic activated hammers

Measured Configuration	*Vibration Level (m/s^2)*	
	a_{hv}	a_{pv}
Head PR10 aluminium sheet, main handle	4.6	26.0
Head PR10, steel piece, main handle	4.8	28.1
Head PR17, steel piece, main handle	1.0	9.5
Head PR17, aluminium sheet, main handle	1.2	13.1
Head PR13, aluminium sheet, main handle	2.4	10.4
Head PR13, steel sheet, main handle	1.7	13.1




Discussion

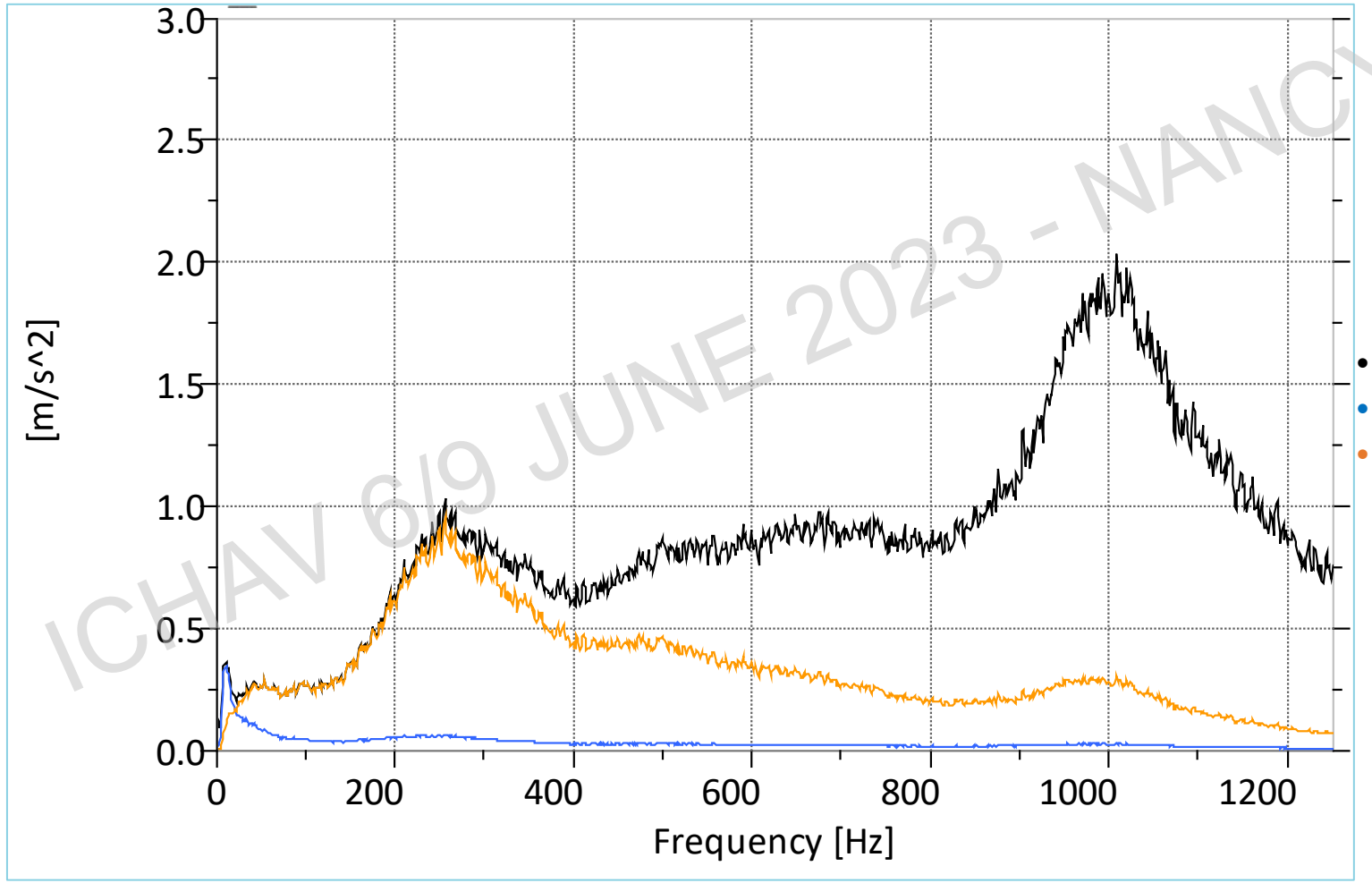
- Reduction of vibration levels with ultrasonic activated hammers according to the regulations
- Test conditions deemed unsuitable by the manufacturer of ultrasonic activated hammers ➔ ***Sheet thickness too low***
- Additional tests at the manufacturer workshop:
  - Aluminium specimen: 300 x 100 x 25 mm

Measured configuration	*Test Ship manufacturer*		*Test HFMI manufacturer*	
	Vibration level (m/s²)			
	a_{hv}	a_{pv}	a_{hv}	a_{pv}
Head PR10 aluminium sheet, main handle	4.6	26.0	2.0	16.6

- Confirmation of lower levels for the PR 10 head with the aluminium specimen

Discussion: Spectral Analysis

- Significant spectral content above 400 Hz



- Raw signal
- A_{hwx} (W_h *frequency-weighting*)
- A_{px} (W_p *frequency-weighting*)

Conclusion

- Possibility to reduce vibration levels with these hammers activated by ultrasound but they need to be used according to the manufacturer's conditions
- Interest in evaluating vibration levels according to frequency weighting for the vascular component of hand-transmitted vibration syndrome (W_p), especially for these high-frequency vibrating tools
- Filling our database (Colphy)
- Without a limit value, it is difficult to assess the level of risk.