HAND ARM VIBRATION

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Vibration Reduction of Pneumatic Rock Drill for Rock Face Stabilization Sector

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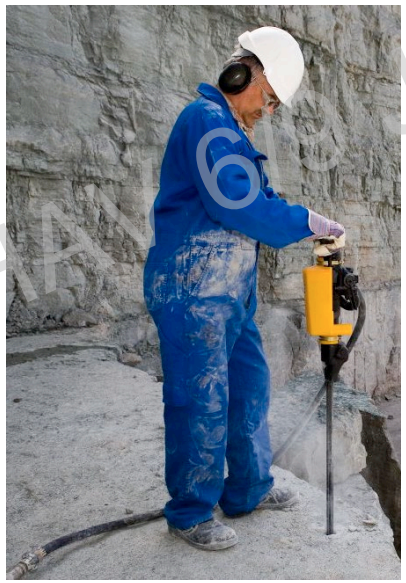
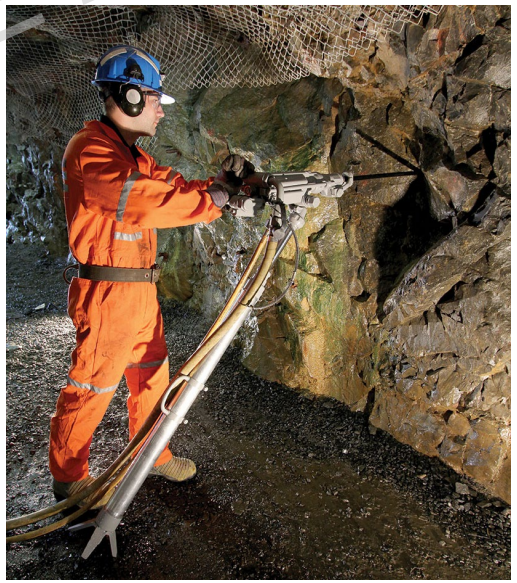
Rock face stabilization in Norway

Background

- Rock face stabilisation is necessary to prevent rocks from falling on people and infrastructure
- Pneumatic rock drills used with high vibration exposure
- Ergonomically challenging
- Heavy dust exposure

Pneumatic rock drills are also frequently used in construction of powerline, tunnelling and blasting work.

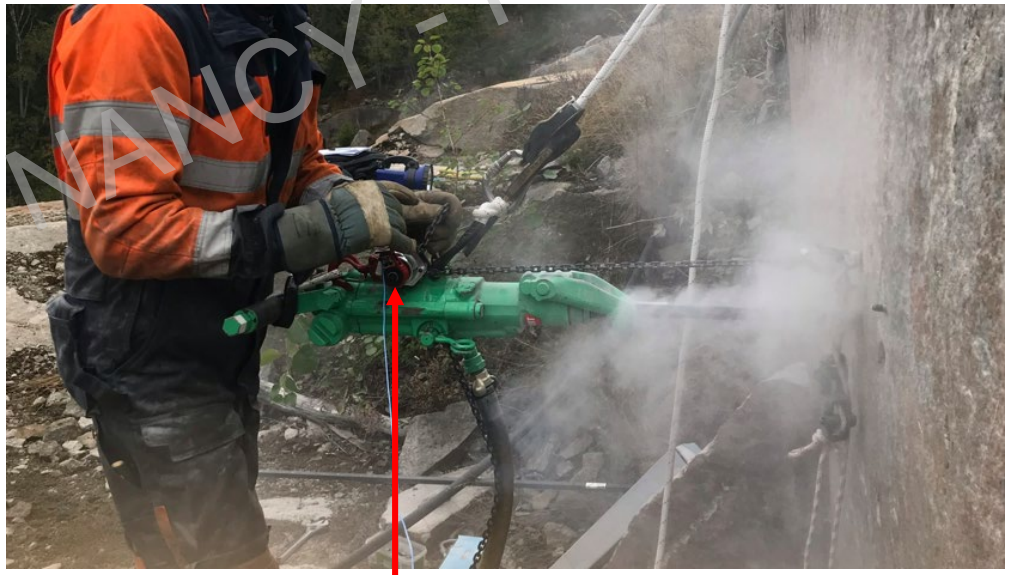




Initial measurements

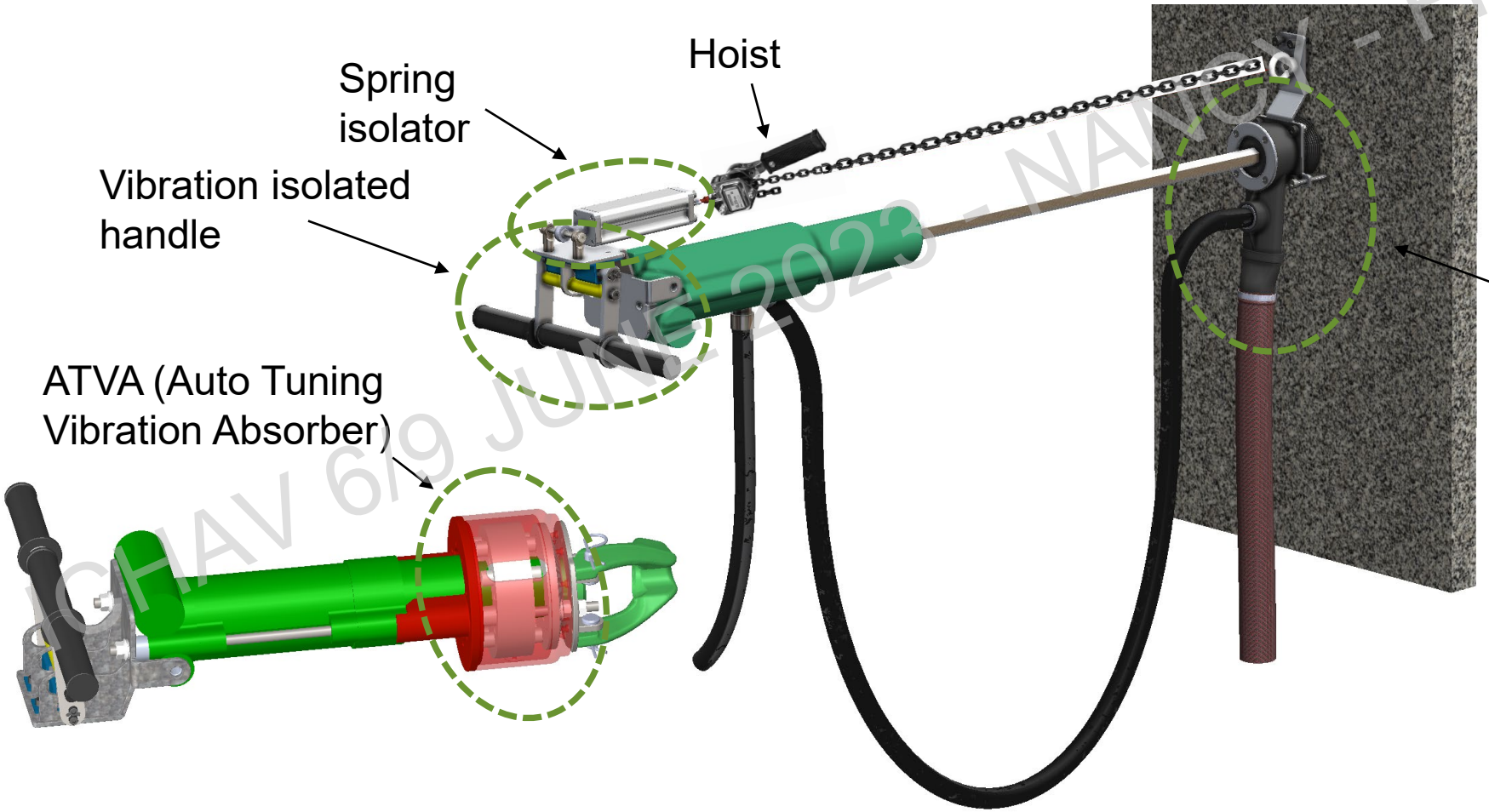
- Montabert T18 is commonly used when climbing, 20 kg
- Operator creates feed force by a hoist lever during drilling
- ISO 5349-1 vibration:
  - Drill handle 35-41 m/s^2
  - Hoist lever 25-41 m/s^2

Test in granite quarry

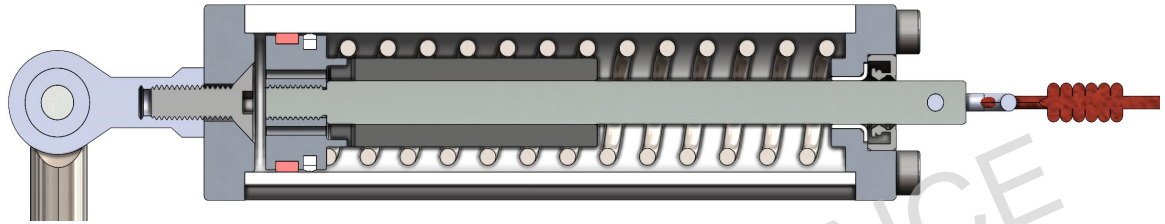


Modifications – Montabert T18

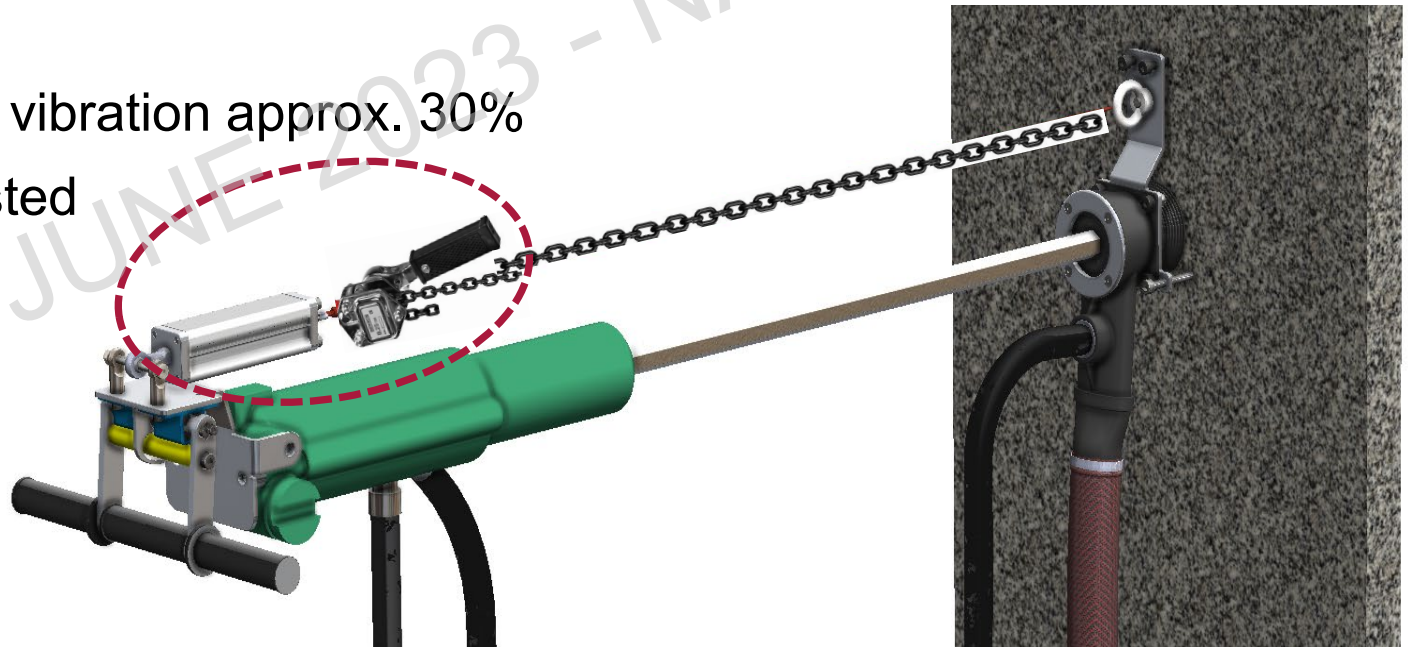
Original machine



1: Hoist chain spring-damper

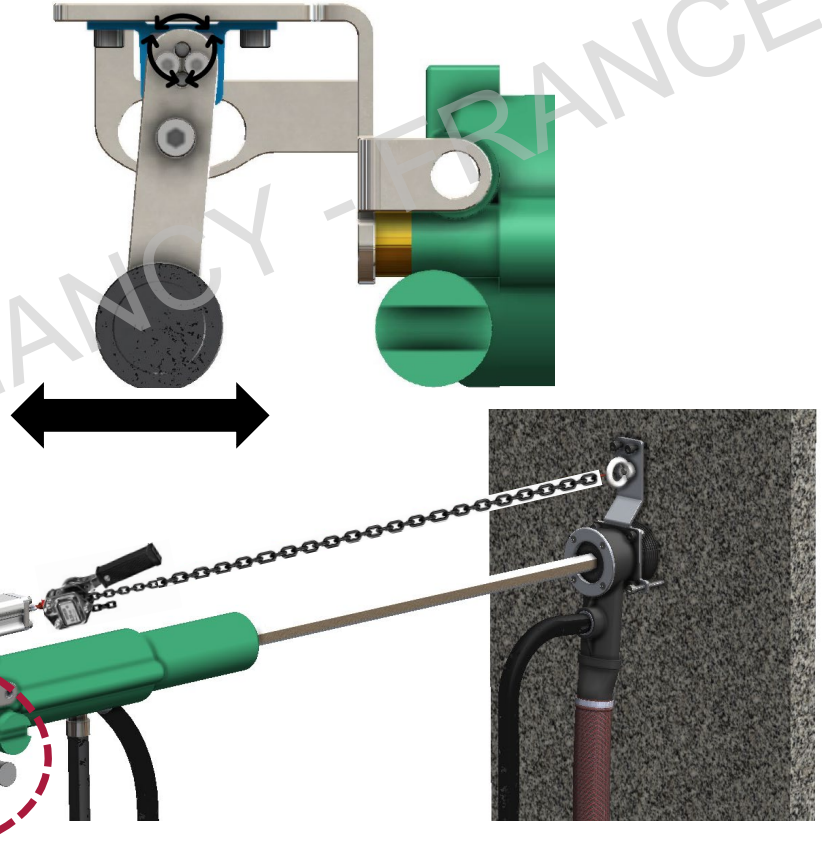


- Hoist handle attached to the solid rock and isolated from the vibrating machine
- Stabilises feed force and increases productivity
- Vibration reduction on hoist handle with 80%, 27 m/s^2 => 6 m/s^2
- Reduces the machine vibration approx. 30%
- 5 prototypes being tested



2: Vibration isolated handle

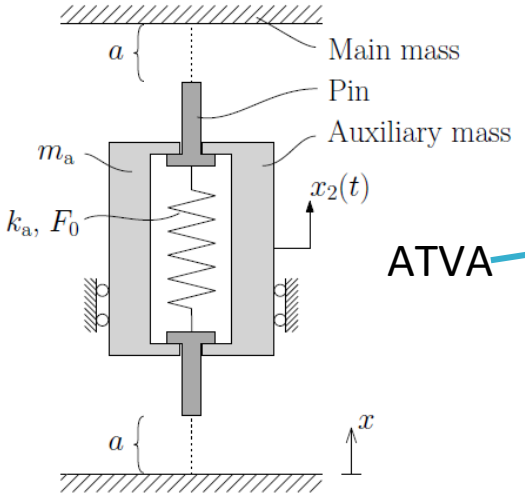
- The vibration on the handle is dominated by the drilling direction
- Handle on a lever arm
- Two torsional isolators connect the lever arm to the baseplate
  - Maximise isolation in drilling direction without sacrificing controllability
- Vibration reduction machine handle, approx. 60%, 37m/s^2 => 16 m/s^2
- 5 prototypes being tested



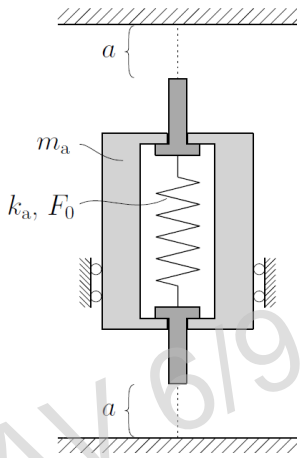
Tool	Handle Vibration (m/s^2_{haw})	Hoist Lever Vibration (m/s^2_{haw})
Original handle and hoist chain	34.6–40.8	25.4–40.9
Isolated handle and spring on hoist chain	15.7	5.4

3: Auto-Tuning Vibration Absorber (ATVA)

- ATVA auxiliary mass with nonlinear springs creates a counter force to the piston
  - Tuned to the operating frequency
  - Nonlinearity increases the effective frequency range
- Large potential for weight reduction
- Vibration reduction approx. 80% in axial reduction
- One prototype built

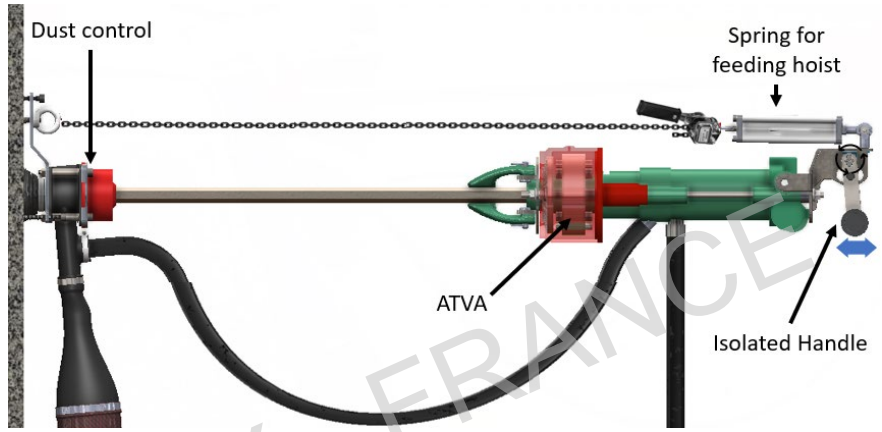


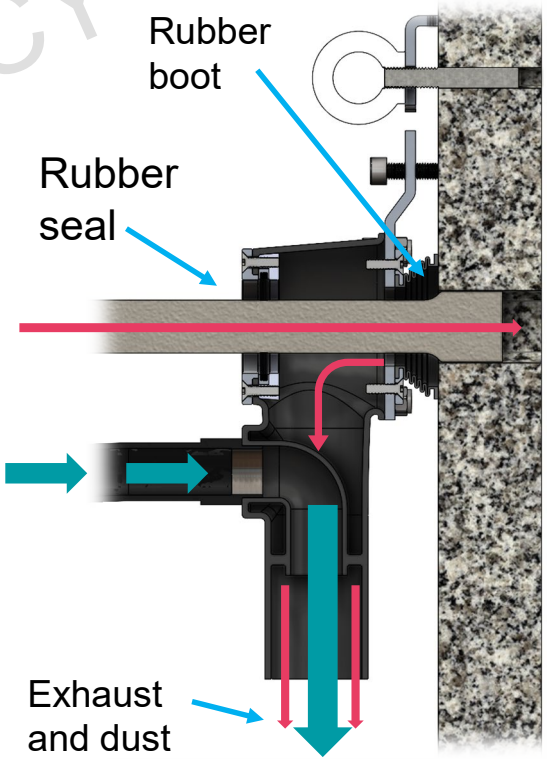
3: ATVA - Uses the machine vibration and creating a force



4: Dust control - Project spin-off

- Uses exhaust air to create ejector suction around drill hole and redirects dust from the operator
- Eased drilling start by drill guidance
- Noise reduction from machine exhaust outlet
- 5 prototypes being tested





Test of dust reduction

Before

After

Summary

- Vibration reduction total:
  - Machine handle: 67%, 37 to 12 m/s^2
  - Hoist handle: 80%, 27 to 5.4 m/s^2
- Reduced drill dust exposure
- Potential weight reduction with ATVA

Results can be significantly improved if implemented in new designs from the beginning!

New project will start this fall continuing the development☺

Come on now!
You can do better! Why has nothing happened the last 60 years with these machines???

T. Clemm