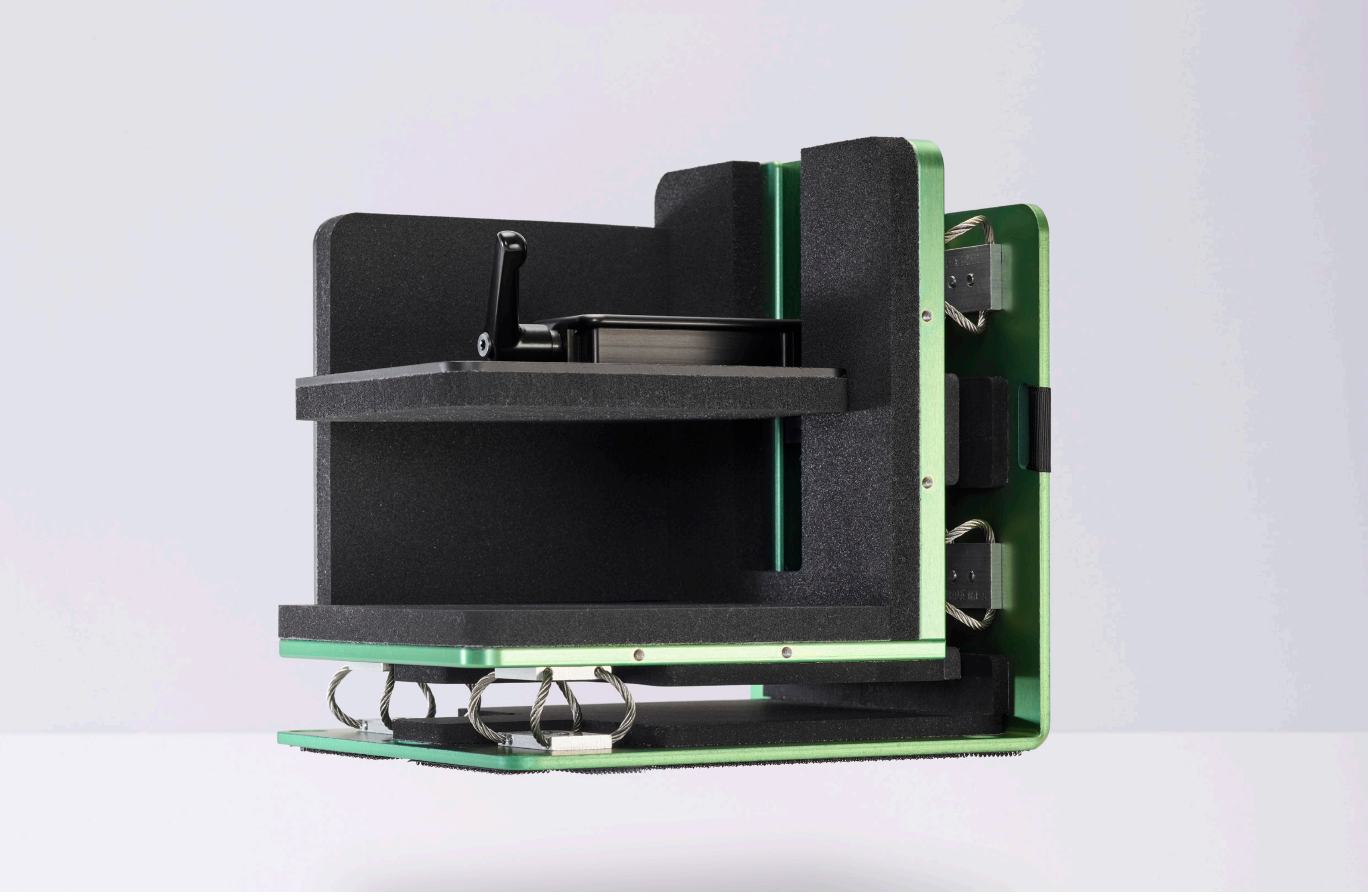
Literature review wire rope isolator

Numerous studies concern the impact of shock and vibration and consequently the damage caused on canvas during the transportation of valuable artworks. Despite the innovations in art packaging solutions, art pieces still show damage and deterioration when packed in crates and foam. Experts, among which the Georgia O'Keeffe Innovation (GOKI) group, noticed that cracks emerged on the surface of canvas' without any exposure to drops or shocks during transportation. Here from can be concluded that the damage must have occurred due to another phenomenon, namely vibrations. The effects are hardly detectable in the first instance, however reducing the exposure to vibrations is of significant relevance. (Cerkanowicz et al., 2017)



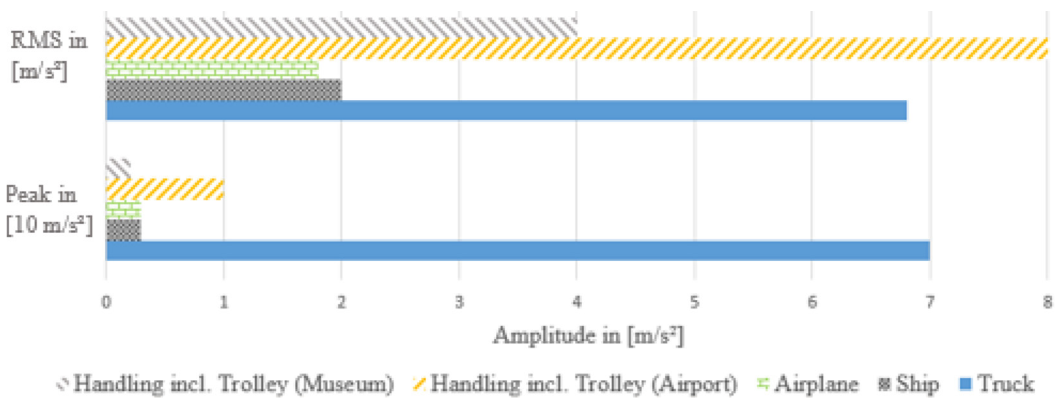
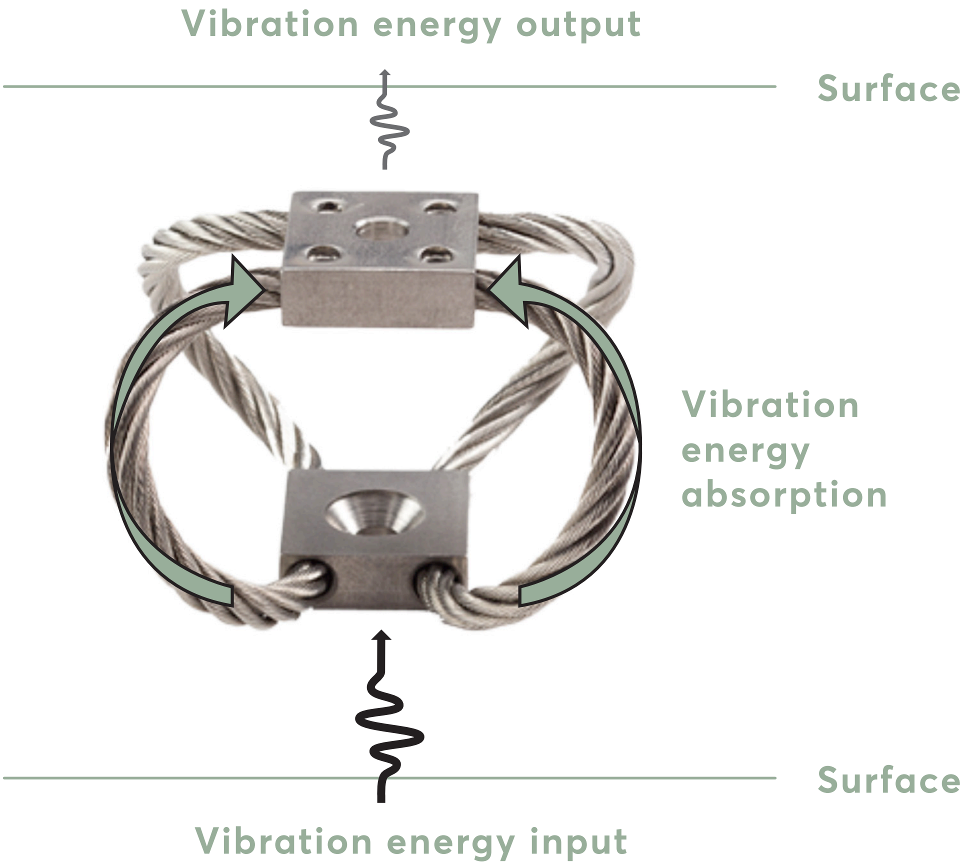


Figure 1: Emission levels and frequency ranges of different vehicles (Läuchli and Bäschlin, 2014).

Figure 1, showcases the average of measurements results according to transportation processes data collected by Palmbach (2013), Kracht (2011), Braun (2013) and Läuchli and Bäschlin (2014). From these results, it has become evident that the main generator of continuous vibrations during transportation are trucks. The vibrations transmit easily through packing materials where the vibration amplitude directly translates into the extent the surface of the canvas will bend. Thus, a higher amplitude relates to an increased chance of cracks forming (Lasyk, 2008).



During the design process of current packaging solutions, the main focus of consideration has been on shocks, neglecting the impact of vibration, specifically continuous vibration (Kracht and Kletschkowski, 2017). It has become evident that continuous vibrations are enhanced rather than eliminated through the use of foam materials, despite their characteristics to successfully dampen severe shocks (Läuchli and Bäschlin, 2014). Thus, development of an art packaging solution with the aim of eliminating the damage caused during transportation should consider reducing both continuous vibration and shock emission.

Passive vibration isolation refers to the use of passive techniques (non-electrical) for the isolation of vibration, such as rubber pads or mechanical springs (Balaji et al., 2015). Wire rope isolator (WRI), a type of non-linear passive isolator, is used in circumstances when both vibration and shock protection are required (Hussain and Balaji, 2018; Chaudhuri and Bharat, 2008). According to Balaji et al., (2015), the WRI provides better isolation than the conventional passive isolators. The damping characteristics of the WRI are resultant to friction damping (Coulomb damping) between the individual wire strands of which the larger wires are composed. This frictional contact results to the diminution of vibrational energy (Hussain and Balaji, 2018), and thus the impact on valuable art pieces during transportation. Complementary to vibration and shock protection, WRI are insensitive to aging, and thermal influences. According to vibration control expert van der Vliert (2021), the performance of WRIs is stable and constant regardless of the intensity of use. Thus, when applied properly, the use of WRI complementing developments in packaging solutions for safe art transportation is highly recommended.

References:

Balaji, P., Rahman, M.E., Leblouba, M. and Ho Lau, H., 2015 Wire rope isolators for vibration isolation of equipment and structures. *A review. IOP Conference Series: Materials Science and Engineering.*, 78, p.10.

Braun, N., 2013 *Transport von Gemälden – Grundlegende Aspekte und Vibrationsmessungen während eines Kunsttransports*. Master-thesis, München, TU München.

Cerkanowicz, D., Henry, J., Kaplan, J. and Walwik, M., 2017 *Protecting Art and Incresing Awareness of Transportation Risks*. Worcester Polytechnic Institute.

Chaudhuri, S. and Bharat, K., 2008 Wire Rope Based Vibration Isolation Fixture For Road Transportation Of Heavy Defence Cargo. In: *Vibration Problems ICOVP-2007*. pp. 61–67.

Hussain, A. and Balaji, P., 2018 Stiffness characteristics of a polycal wire rope isolators. *IOP Conference Series: Materials Science and Engineering*, 402, p.8.

Kracht, K., 2011 *The investigation of the vibration behavior of canvas dependent on weathering,*. PhD Thesis, Berlin, TU Berlin.

Kracht, K. and Kletschkowski, T., 2017 From art to engineering: *A technical review on the problem of vibrating canvas part I: excitation and efforts of vibration reduction. Facta universitatis*, 15(1), pp.163–182.

Lasyk, L., 2008 Vibration as a hazard during the transportation of canvas paintings. *Studies in Conservation*. Studies in Conservation, 53(sup1), pp.65–68.

Läuchli, M. and Bäschlin, N., 2014 Packing systems for paintings: Damping capacity in relation to transport-induced shock and vibration. 15 September 2014 Paris: *Interational Council of Museums*, J. Bridgland, art., p. 9 pp.

Palmbach, C., 2013 Transportmonitoring bei Gemäldetransporten - *Neue Datensammlung zur Charakterisierung der Schock- und Vibrationsimmisionen*.

Van der Vliert, R., 2021 *The prestation of Wire Rope Isolators over time*.