MÜLLER-BBM

Müller-BBM GmbH
Helmut-A.-Müller-Straße 1 - 5
82152 Planegg bei München

Telephone +49(89)85602 0
Telefax +49(89)85602 111

www.MuellerBBM.de

Dipl.-Ing. (FH) Andreas Haager
Telephone +49(89)85602 3019
Andreas.Haager@mbbm.com

2022-03-04
M145014/11 Version 1 HAAG/SCHJ

Measurement of the velocity level difference according to the Tonpilz method and DIN EN ISO 10846-4

Hilti MP-U-G 63

Report No. M145014/11

Client:	Hilti Corporation Feldkircherstrasse 100 P.O. Box 333 9494 Schaan Liechtenstein
Consultant:	Dipl.-Ing. (FH) Andreas Haager
Total number of pages:	8 pages, thereof 6 pages of Text and 2 pages of Appendix

Table of contents

1 Task

In order to identify the velocity level difference as a measure for the noise mitigation capability of pipe clamps equipped with rubber inlays, measurements according to the Tonpilz method and the DIN EN ISO 10846-4 [1] standard were conducted. The boundary conditions are defined and correspond to the usual mounting conditions. The vibration transmission factors in the form of velocity level differences measured with this method can be used as product information for manufacturers, suppliers and users.

2 Documents and references

[1] DIN EN ISO 10846-4: Acoustics and vibration – Laboratory measurement of the vibro-acoustic transfer properties of resilient elements – Part 4: Dynamic stiffness of elements other than elastic supports for translatory motion. 2004-02.

[2] DIN ISO 5348: Mechanical vibration and shock – Mechanical mounting of accelerometers. 1999-07.

[3] Müller-BBM Report M145014/09 “Measurement of the velocity level difference according to the Tonpilz method and DIN EN ISO 10846-4 – Hilti MP-U-G Hilti MIP-H/M/T” dated 2022-02-10.

3 Test procedure

The measurements were performed according to the Tonpilz method in conjunction with the indirect method according to the DIN EN ISO 10846-4 [1] standard.

According to the ISO 10846 standard, the vibration transmission factor was measured in the form of the velocity level difference. This measurement’s objective is to demonstrate the relative vibrational insulation characteristics of the pipe clamp at the given boundary conditions for the chosen test situation and can therefore only be used for comparison purposes, tested under the same systemic conditions as described below.

The measured components shall be mounted between two masses of 30 kg each. An adapter is used to fix the test component between the two masses. The mass on the shaker side is excited in the longitudinal direction with a discretely increasing sinusoidal signal of constant velocity amplitude. Vibrations are transmitted through the test object to the blocking mass (receiver side). The acceleration levels are measured in the axial (excitation) direction on both masses. The measured acceleration was integrated into velocity and the difference between the excitation and receiver side was calculated.

In order to obtain a relative evaluation of the effectivity of the pipe clamps, they were tested with the resilient layer and referenced to a test where the resilient layer was removed (respectively a larger pipe dummy diameter was used in that case). After that, both transfer curves can be compared, and the relative insulation capability can be calculated.

To eliminate disturbances during the measurements, the vibration system was suspended on ropes as shown in Figure 1.

The measurement method is limited to the measuring range up to 1600 Hz. Above this limit, the difference between useful and interfering signal on the receiving side is insignificantly small and the clear evaluation of the signal is not possible.

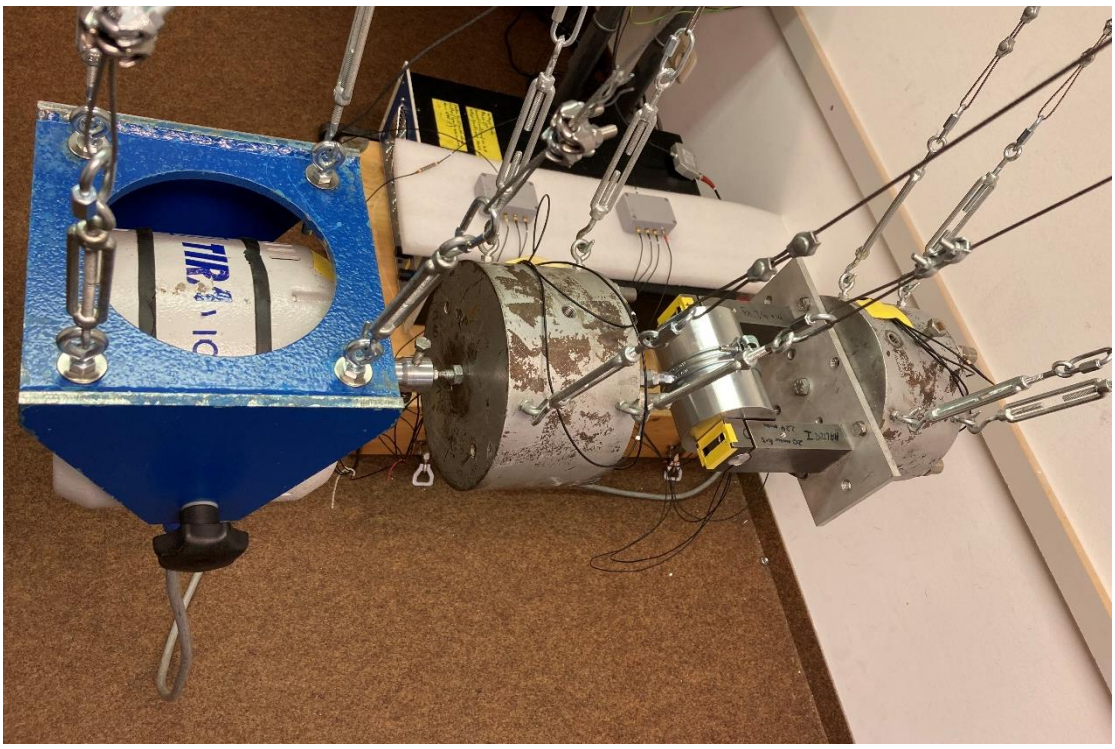

Figure 1. Test configuration.

4 Conduct of test

4.1 Time, place and involved personnel

The vibration measurements were carried out between 23rd November and 6th December 2021 at the test bench of Müller-BBM GmbH in Planegg by Andreas Haager from Müller-BBM.

4.2 Ambient conditions

Temperature:	approx. 21 °C
Relative humidity:	approx. 55 %

4.3 Test objects

Table 1. List of pipe clamps to be measured.

No.	Pipe Clamp	Dummy Size [mm]	Torque [Nm]	Croco [-]
1	MP-U 72-77	77	2	1
2	MP-U-G 63	63	2	1

The test objects are pipe clamps consisting of two steal bows which are connected by a snap mechanism on the one and a tightening screw on the other side. Both bows are equipped with an inlay of rubber material for insulation purposes. One bow is equipped with an internal M10 thread for connection purposes (photos of the MP-U and MP-U-G are shown in the Appendix).

4.4 Measurement equipment

The calibration of the measurement equipment used and listed below was checked and found to be fully operational. Within the scope of the quality management system, the measurement equipment is reviewed within regular intervals and calibrated according to national standards (DAkkS calibration laboratory). The accelerometers on the excitation and response side were applied on the two masses according to DIN ISO 5348 “Mechanical vibration and shock – Mechanical mounting of accelerometers” [2].

Table 2. Compilation of the used measurement equipment.

Measuring device	Type	Serial no.	Manufacturer	Date of calibration
MK2 measurement system	Controller PQ30	1111M7296	Mecalc	-
Electrodynamic shaker	54216/ LS-130	043/04	Tira	-
Amplifier	BAA 1000	B1000E01A03K0050	Tira	-
Charge amplifier excitation side	2647A	2708966	Brüel & Kjaer	28.03.2019
Charge amplifier response side	2635	1325795	Brüel & Kjaer	16.11.2021
Accelerometer excitation side	4371	958265	Brüel & Kjaer	22.10.2019
	4371	976137	Brüel & Kjaer	27.04.2020
	4371	916150	Brüel & Kjaer	27.04.2020
	4371	2296687	Brüel & Kjaer	22.10.2019
Accelerometer response side	4381	984902	Brüel & Kjaer	27.02.2020
	4381	985057	Brüel & Kjaer	27.02.2020
	4381	1354558	Brüel & Kjaer	27.02.2020
	4381	1354552	Brüel & Kjaer	27.02.2020

5 Results

The structure-borne sound insulation effect at 500 Hz of the pipe clamp can be read off by the difference between the two transfer functions of the reference measurement without the resilient inlay and the measurement with the inlay [3].

Table 3. MP-U-G results according to Müller-BBM report no. M145014/09 [3].

	Dummy size [mm]	**Torque on screw** [Nm]	**Used croco** [-]	**Sound reduction minimum (500 Hz)** [dB]
MP-U-G 63				
MP-U 72-77	77	2	1	-
MP-U-G 63	63	2	1	**> 22**

Dipl.-Ing. (FH) Andreas Haager

Appendix

Photo documentation

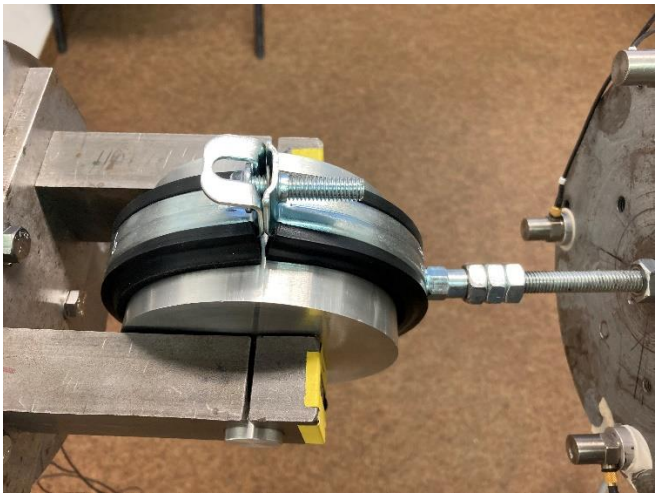

Figure 2. Measurement of MP-U-G (exemplary size of a pipe clamp).

Figure 3. Reference measurement of MP-U (exemplary size of a pipe clamp).