Vacuum Measurement Kit A7

Accessories of the KLIPPEL ANALYZER SYSTEM (Document Revision1.3)

Features	
• Separate mechanical system from acoustical system • Get precise mechanical parameters • Investigate impact of radiation impedance and air load • Scanning of mechanical vibration	

Electro-acoustical transducers such as loudspeaker drivers, micro-speakers, headphones, microphones are measured in vacuum to identify properties and the parameters of the electro-mechanical system directly while the effect of air is eliminated. The vacuum measurement kit satisfies the special requirements in the loudspeaker application such as a flat vessel to accommodate loudspeaker drive units of large diameter, air sealed terminals to feed the electrical stimulus and a planar glass plate for laser scanning.

Article Numbers:	2600-010

CONTENT:

1 Components of the Vacuum Measurement Kit

VACUUM CHAMBER		A cylindrical vessel made of low magnetic stainless steel can be loaded by most kind of transducers such as woofers, tweeters, horn compression drivers, headphones and micro-speakers. The low magnetic material used will not affect the magnetic properties of the transducer. Only transducers with very strong outer B-field should be isolated from the chamber by some millimeters of air distance.
PRESSURE MANOMETER		A pressure manometer shows the pressure difference between the interior of the vacuum chamber and the ambience in bar. (1 Bar = 100 kPa = 750 Torr) Measurements should be performed between -0.8 and -1.0 Bar.
TAP WITH HOSE COUPLER		The air in the vacuum chamber is exhausted via a tap on the bottom of the vacuum chamber. The hose connected with the vacuum pump can be easily removed by using a fast coupler system.
ELECTRICAL INTERFACE	 	The DUT will be connected with standard laboratory 4 mm connectors, which are fed inside the chamber through vacuum tight 4-pin LEMO couplers. The outer cable is equipped with four isolated 4 mm female laboratory connectors. They are mechanically coded to be correctly connected to Klippel provided speaker cables with separate FORCE and SENSE wires (4-wire Kelvin technique).

	 	The inner cable is equipped with two 4 mm male laboratory connectors with removable shells. The FORCE and SENSE wires are connected inside the laboratory connectors, as close as possible to the DUT. *<u>Alternative application:</u>* *With modified inner cables it is possible to use the available 4 pins for other application e.g. mic self-noise measurements.* *A modified version of the vacuum chamber with two cable feed-through couplers is available on request.*
GASKET		A rubber gasket is provided to seal the gap between vessel and glass plate.
TRANSPARENT GLASS PLATE	 	A plane plate made of acrylic glass allows laser scanning of the cone vibration of a transducer in vacuum. The plate can be easily replaced if the transparency is impaired by scratches.
AIR FILTER AND VACUUM HOSES		A special air filter is provided to protect the vacuum pump against any kinds of particles which may damage the vacuum pump.

VACUUM PUMP		Klippel offers an oil free diaphragm vacuum pump for laboratory use. The oil free diaphragm technique requires no maintenance. Typical evacuation time to reach -0.9 bar in the Klippel 7 liter vessel is about 100 s. Ultimate vacuum: 15 mBar absolute Delivery: 16 l/min at atm. pressure LxHxW: 361/141/90mm, weight: 3.95 kg 230 V / 50 Hz or 110 V / 60 Hz – 100 W Klippel Part-Nr.: 2600-030 *(An alternative stronger pump needing less than the half time is available on request.)*

2 Safety Requirements

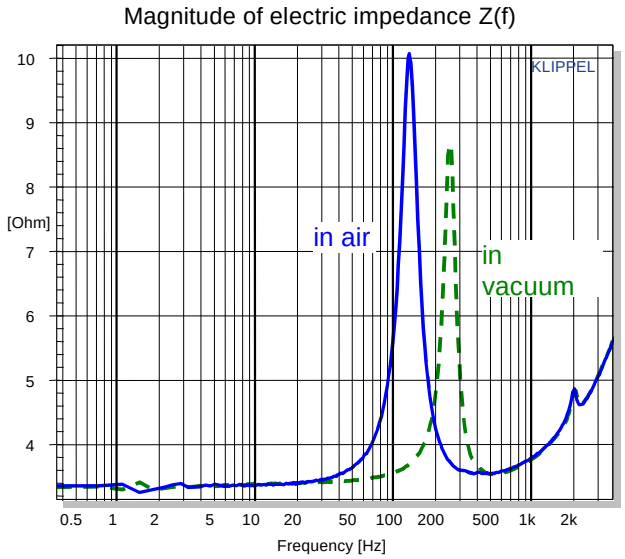
WEAR EYEGLASSES AND GLOVES	The user of the vacuum chamber shall follow safety regulations as used for equipment under vacuum. Always wear goggles and gloves to protect eyes and other human surfaces to avoid any bodily damage when the glass plate breaks. Handle the glass plate with care and replace it if shows any indications of damages (scratches). KLIPPEL GmbH takes no responsibility for any kind of damage caused by the Vacuum Measurement Kit and improper use.

3 Specifications

Parameter	Symbol	Min	Typ	Max	Unit
Diameter of inner space in vessel	D_{inner}		280		mm
Height of inner space in vessel	h_{inner}		130		mm
Size of glass plate	Ø		320		mm
Thickness of glass plate	t		15		mm
Total height (vessel + glass plate)	h_{total}		200		mm
Inner diameter of hoses	D_{hose}		9		mm
Length of the hoses	L_{hose}		3		m

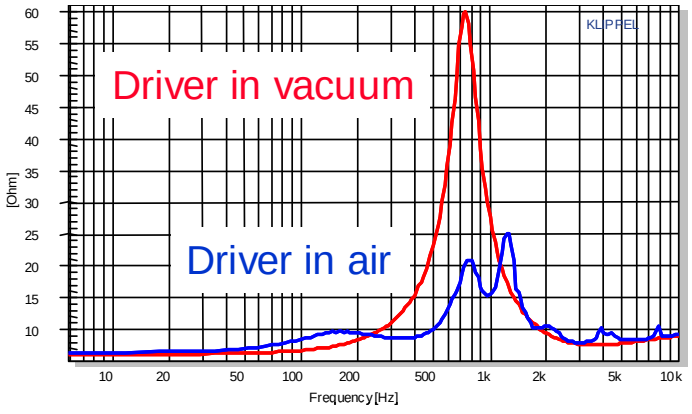
4 Applications

SEPARATION OF MECHANICAL AND ACOUSTICAL PARAMETERS

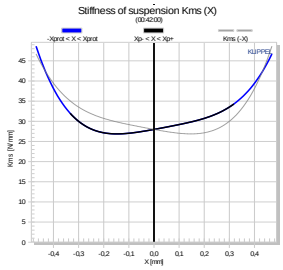


The lumped parameters of the mechanical system (moving mass M_{ms}, stiffness K_{ms} and mechanical resistance R_{ms}) can be measured more accurately by performing the measurement in vacuum. Comparing the pure mechanical parameters with the parameters measured in air allows to separate the contribution of the air to the measurement in free air.

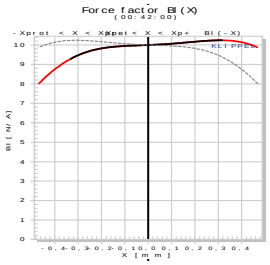
SUPPRESSION OF ACOUSTICAL RESONANCES



Some transducers such as horn compression drivers, tweeters, headphones, micro-speakers and microphones cannot be represented by a 2nd-order mechanical resonator comprising a single mass, spring and resistance only. Cavities, small ports and additional acoustical damping material may cause a higher-order impedance function when the transducer is operated in free air. The acoustical resonances can be sufficiently suppressed when the driver is operated in vacuum and standard techniques for measuring the linear Thiele-Small parameter (LPM module) and the nonlinear parameters (LSI module) can be applied.

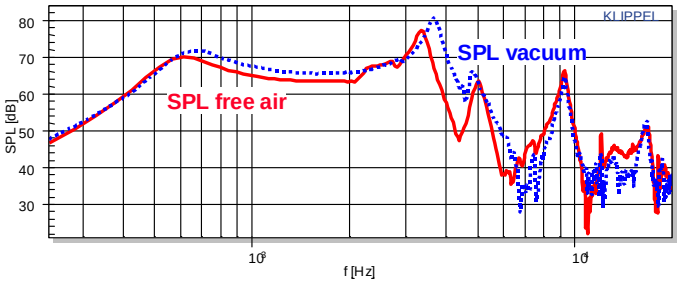


Nonlinear stiffness $K_{ms}(x)$ of a horn compression driver measured in vacuum

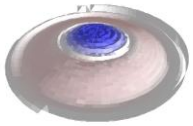


Nonlinear force factor characteristic Bl(x) of a horn compression driver measured in vacuum

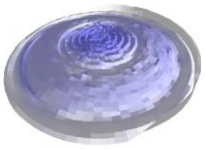
INFLUENCE OF THE AIR ON THE CONE VIBRATION



SPL response of a headphone predicted by using cone vibration measured in free air (solid line) and in vacuum (dotted line). Note that the moving mass of the air load shifts the natural frequency of the first bending mode from 3.8 kHz found in vacuum down to 3.4 kHz in air and causes a different vibration pattern as shown below.



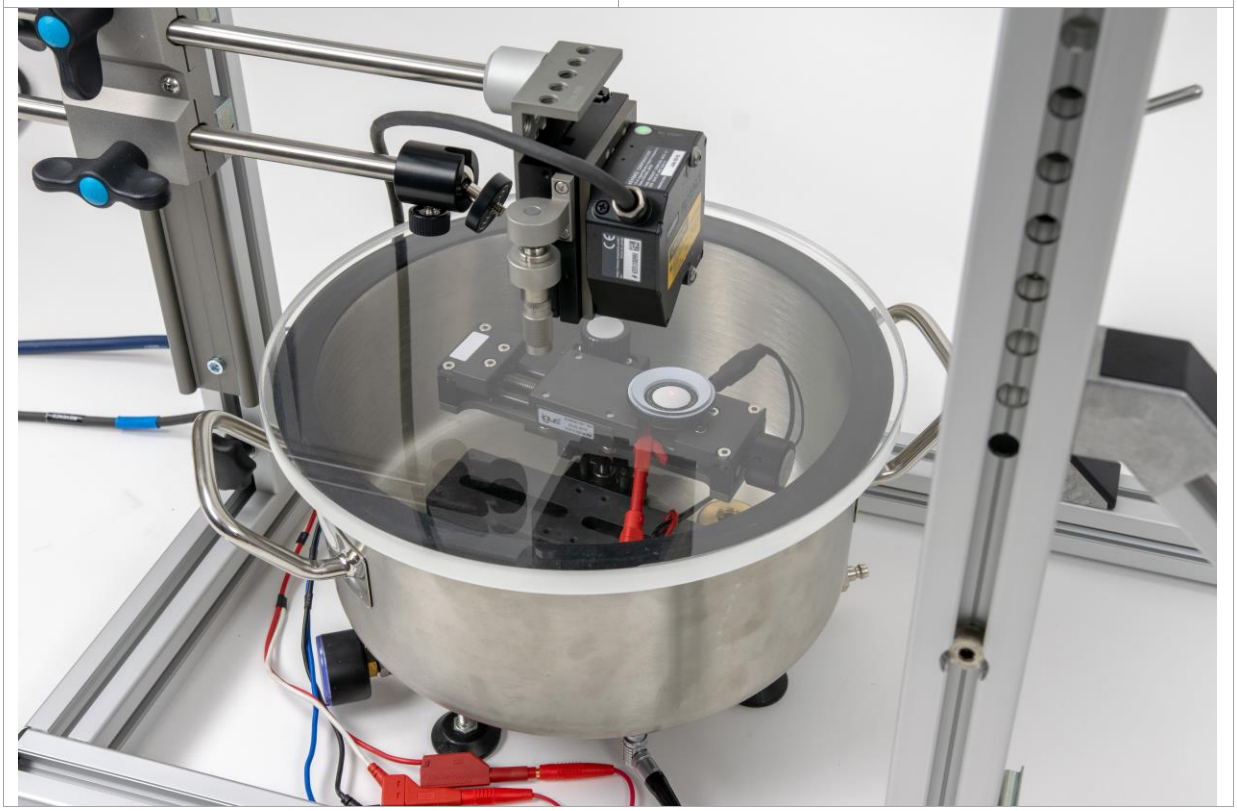
Measured at 3.8 kHz in air



Measured 3.8 kHz in vacuum.

5 Hardware Setup Examples

Vacuum Measurement Kit with Pro Driver Stand	
Included and shown products:	Article Numbers:
• Vacuum Measurement Kit	2600-010
• Pro Driver Stand	2211-002
• Vacuum Stand	2211-004
• Laser Set LK-H052 (all purpose)	2103-200
• Translation stage (incl. Micrometer)	2300-001



Vacuum Measurement Kit with Scanning Vibrometer	
Included products:	Article Numbers:
• Vacuum Measurement Kit	2600-010
• SCN Vibrometer Set	2510-004
• Vacuum Stand	2211-004
• Laser Set LK-H052 (for SCN only)	2103-210

Find explanations for symbols at:
http://www.klippel.de/know-how/literature.html
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