

Hardware qualities necessary

Number of channels

In most cases three (for X, Y, Z axis), or a multiple of three, if more than one measuring points are to be acquired in one measurement.

Scan rates

For whole body vibrations a scan rate of 1 kHz per channel is sufficient, for hand-arm vibrations 10 kHz are needed, for low-frequency whole-body vibrations 5 Hz.

With lower scan rates (up to a factor of 8) the DASYLab®-Addon-Modul ISO8041 interpolates the input signal. The accuracy for higher signal frequencies is reduced by interpolation.

If you are using data acquisition devices without simultaneous sample-and-hold which do not acquire the channels at the same time, the scan rates should be about a factor of two higher.

Sensors

Sensors with ICP®-supply are a reasonable possibility for hand-arm vibrations. For whole body vibrations the lower cutoff frequency of ICP® sensors and their supply is too high. In these cases sensors with charge outputs are necessary or sensors, which are not based on piezoelectric effects (e.g. piezoresistive, DMS or inductive). Please note, that as a rule such sensors cannot be connected directly to the acquisition device. Depending on the type of sensors, charge amplifiers, bridge amplifiers or others have to be used.

For the selection of sensors the strongest restrictions are the partly very low lower cut off frequencies needed and, particularly with hand-arm vibrations the very wide measuring range, which is specified in the standard ISO 8041 up to 50000 m/s² (see table below).

ICP® - sensors are served by a constant current source. This results in a DC-offset which has to be decoupled, resulting in a lower cut off frequency.

If ICP® sensors may be used, the acquisition device must have a built in ICP®-supply or a separate ICP® supply has to be used. In both cases please have a close look at the lower cut off frequency.

The following table gives a survey on the requirements concerning sensor properties. The specifications marked with a * come directly from the standard EN ISO 8041, appendix E, the others are derived from the tolerance tables of EN ISO 8041:

	Comment	Hand-Arm-vibrations (W _h)	Whole-body vibrations (W _b , W _c , W _d , W _e , W _j , W _k)	Whole-body vibrations in buildings (W _m)	Low frequency whole-body vibrations (W _f)
Maximum total mass of sensors and mounting system	< 10 % of the effective mass of the vibrating structure *	30 g	On seat: 450 g, elsewhere 50 g	1 kg	
Maximum sensor mass	*	5 g	50 g	200 g	
Maximum size of sensors and mounting system	No hampering, minimum restrictions on activity to be performed *	Cube with 25 mm edges	On seat: 300 mm diameter < 12 mm height (semi rigid disk) elsewhere: cube with 30 mm edges	200 mm x 200 mm x 50 mm height	

Acquisition devices for human response to vibrations



	Comment	Hand-Arm-vibrations (W_h)	Whole-body vibrations (W_b , W_c , W_d , W_e , W_j , W_k)	Whole-body vibrations in buildings (W_m)	Low frequency whole-body vibrations (W_i)
Maximum mounting height	As low as possible to prevent parts of rotational vibration from been amplified *	10 mm		25 mm	50 mm
Temperature range	*	- 10°C .. 50 °C			
EMV (30 mT at 50 or 60 Hz)	*	< 30 m/s²/T	< 5 m/s²/T	< 2 m/s²/T	
Acoustic sensitivity	*	< 0,05 m/s²/kPa	< 0,01 m/s²/kPa		
Transverse sensitivity	*	< 5 %			
Maximum unweightet shock acceleration	Measuring range of the sensor, not overload capability *	30000 m/s² (up to 50000 m/s² for pneumatic hammers)	1000 m/s²	500 m/s²	
Resonant frequency	Should be greater than approximately 10 times the nominal upper frequency limit	≥ 10 kHz	≥ 800 Hz		≥ 5 Hz
Lower cut off frequency	Including preamplifier and supply	- 2dB: 6,3 Hz - ∞: 5 Hz	- 2dB: 0,315 Hz - ∞: 0,25 Hz	- 2dB: 0,63 Hz - ∞: 0,5 Hz	- 2dB: 0,063 Hz - ∞: 0,05 Hz
Lower cut off frequency	Including preamplifier and supply	- 2dB: 1000 Hz - ∞: 1250 Hz	- 2dB: 125 Hz - ∞: 160 Hz		- 2dB: 0,8 Hz - ∞: 1 Hz
Enclosure specifications to prevent ingress of dust and water	Other specifications may be required in laboratory environment or measurements in explosive athmospheres	IP 55		Keine	IP 55
Recommendations on devices (we want to give you some help with these recommendations. We are not related or the companies below and we do not get a margin for these tips)					
Sensors / mounting systems	For sensors with charge outputs a charge amplifier is needed	PCB 356 B10, PCB 356 B20 (ICP®, 3 axes) SVANTEK SA 50, SV50	PCB 3701D1FA200G mit PCB 421A11 (charge, 1 axis), PCB 3703D1FD200G mit PCB 421A13 (charge, 3 axes) Dytran 5313A (Seat pad, 3 axes) SEIKA B3 (voltage, 1 axis)		
Data acquisition		RogaDAQ 16 (USB 2.0, ICP®, 16 channels)			

Further information and suppliers:

- Sensors and charge amplifiers of PCB Electronics Inc.: www.synotech.de, www.pcb.com
- Data acquisition devices of Roga Instruments and sensors of Seika : www.rogainstruments.com, www.seika.de
- Sensors and seat pads of Dytran and SVANTEK: www.repo-technik.de

If you are using other sensors, mounting adapters or data acquisition devices which meet the requirements above, please tell us. We will enlarge this list of recommendations if our customers have good experiences with other devices that they meet the requirements above.