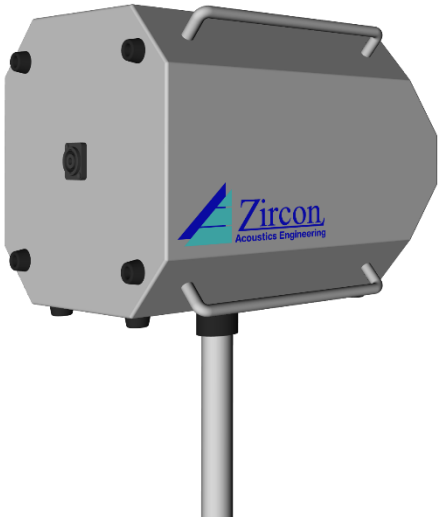
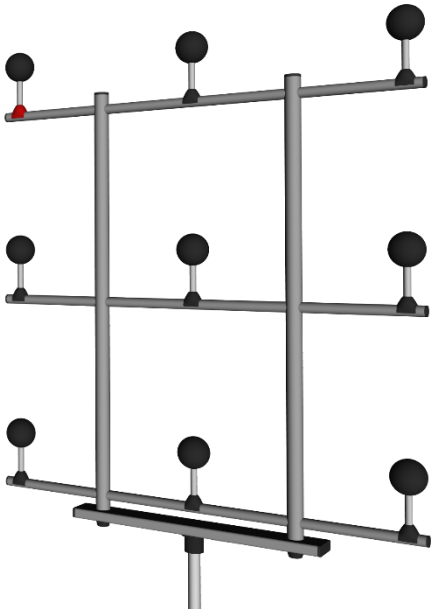
Product Data

ZIRCON V2

EN 1793 In Situ Noise Barrier Measurement System





1 Description

The Zircon V2 is a complete measurement system for road traffic noise reducing devices in accordance with EN 1793-3:1997 [1], EN 1793-5:2016 [2] and EN 1793-6:2018 [3]. Compared to earlier versions these updated standards[1] have been improved by implementing a microphone grid.

The Zircon V2 comprises a loudspeaker unit (*source*), a 3x3-microphone array (*measurement grid*), a control interface, PC software DIRAC 7 or higher and optionally a power bank for off-grid operation.

[1] Hereafter, body texts printed in italics refer to the terminology as used in these standards.

2 Features

- Complete system for EN 1793 compliant in situ measurements
- Easy setup with few cables
- Loudspeaker unit and 3x3-microphone array fitted with standard screw threads
- Compact CI24 Control Interface contains multi-channel sound device and power amplifier
- Included tripods suitable for difficult terrain
- Includes protective flight-cases for Microphone array and Control Interface transport
- DIRAC software running on a PC (not included) performs impulse response measurements, provides all data to adjust the setup (INR, R_{sub}, time delays and C_{gain}), applies *Adrienne temporal windowing*, using the *signal subtraction technique* [5] to extend the frequency range and calculates the noise barrier parameters (RI, DL_{RI}, SI, DL_{SI}).
- Included spreadsheets calculate the final noise barrier parameters, taking into account the *geometrical divergence of the sound* C_{geo}, LS24 *sound source directivity* C_{dir}, the acoustic channel gain changes C_{gain} and the *normalized traffic noise spectrum* as defined in EN 1793-3.

3 Application Information

3.1 Summary

Dirac generates sound through the loudspeaker unit, which is emitted towards the *noise reducing device NRD* and records the reflected or transmitted sound, picked up by the microphone array. From the NRD measurements and the corresponding *free-field measurements* (away from the NRD), the intrinsic acoustic characteristics of the NRD are determined.

For detailed instructions on the use of the software for Zircon measurements, please refer to the Zircon V2 User Manual.

3.2 Measuring in situ sound reflection

Figure 1 depicts a basic test arrangement for EN 1793-5 measurements, schematically showing a side view of the sound source, the microphone array and the noise reducing device NRD under test. Measurements are carried out in front of the NRD. Similarly, free-field measurements are carried out with the same arrangement, but not in front of the NRD.

The loudspeaker and microphone array are usually placed on tripods and must be carefully aligned, mutually as well as with the NRD. This may be challenging on irregular terrain or with non-flat complex devices for which the *reference plane* does not coincide with the NRD. The tripods included with the Zircon provide bubble levels and (direct-gear) cranks to adjust the height, which can be used as first order alignment tools.

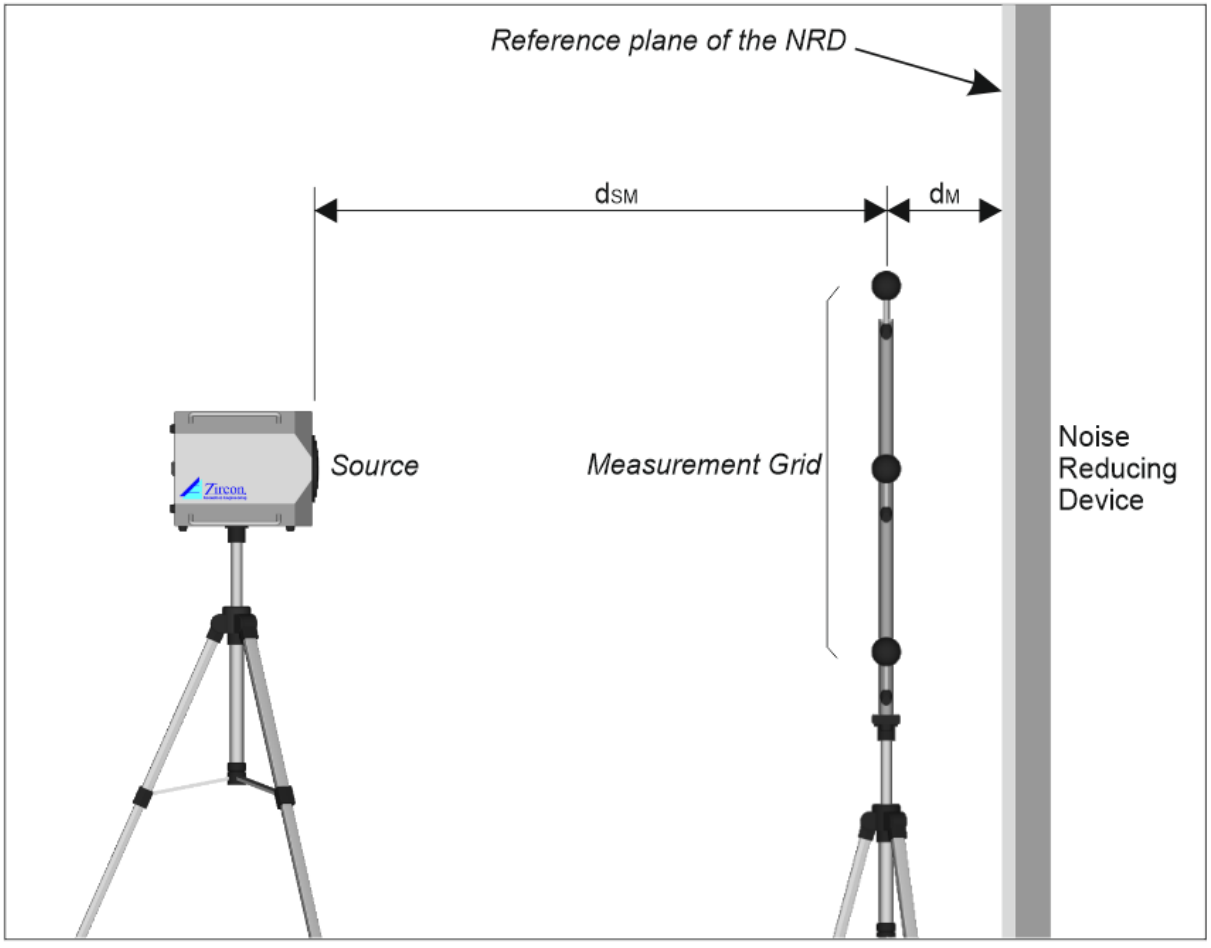


Figure 1. Test arrangement for EN 1793-5 measurements.

3.3 Measuring in situ sound insulation

Figure 2 depicts a basic test arrangement for EN 1793-6 measurements, schematically showing a side view of the sound source, the microphone array and the noise reducing device under test. Measurements are carried out with this test arrangement around the NRD. Similarly, free-field measurements are carried out with the same arrangement, but not around the NRD.

The EN 1793-6 measurements are similar to the EN 1793-5 measurements, but the setup, calibration and calculation techniques are less comprehensive.

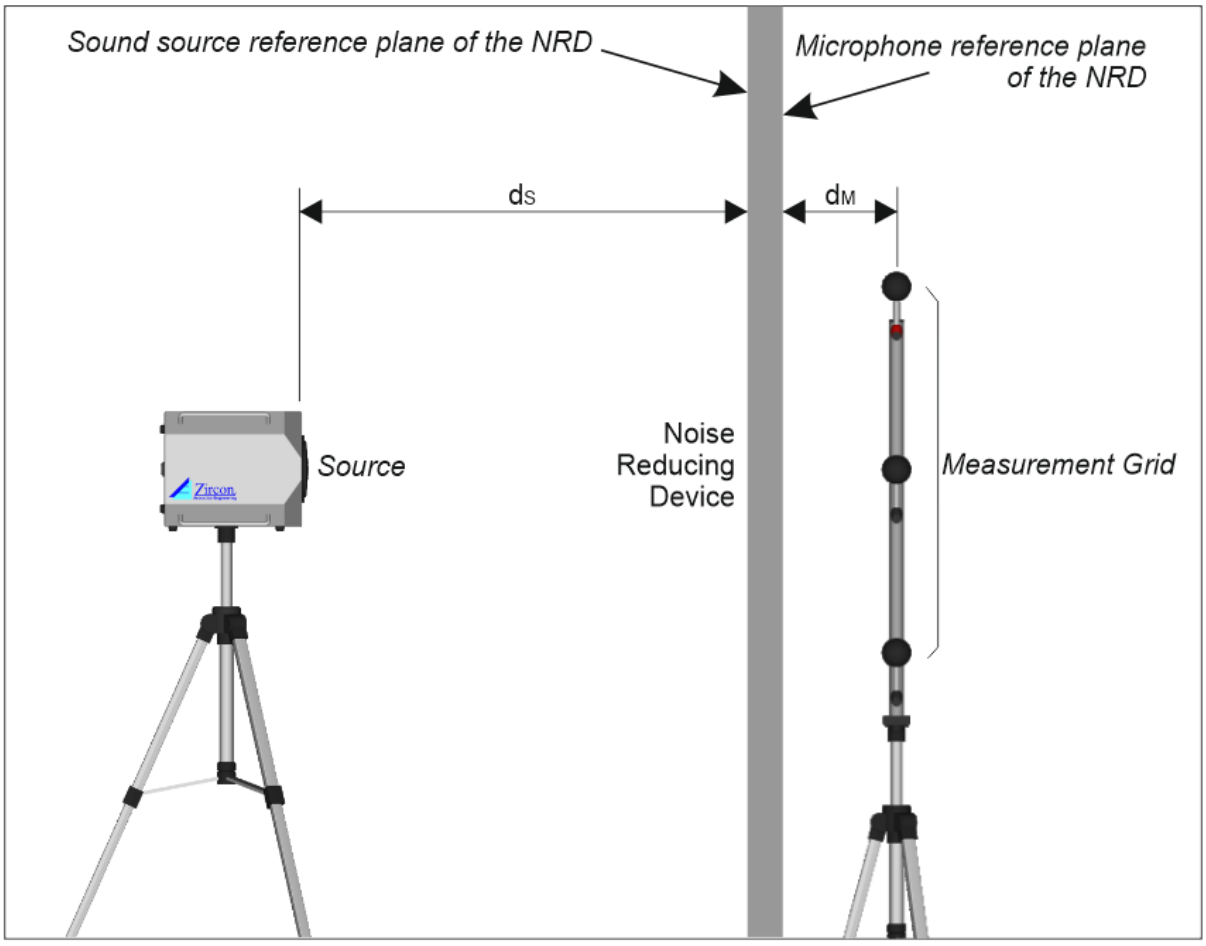


Figure 2. Test arrangement for EN 1793-6 measurements.

4 Zircon V2 Components

The standard Zircon V2 system is based on an NRD height of 4 m maximum and 10 m of source and microphone array cable lengths. In case of sound insulation measurements, where the source and microphone array are placed on both sides of the NRD, the Speakon cable may have to be extended.

Should a particular measurement environment require special tripods or other means to mount the source or microphone array with respect to the NRD, please contact Acoustics Engineering.

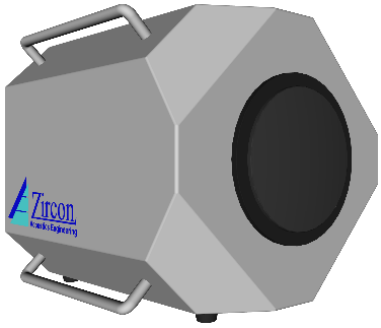
4.1 Zircon V2 LS24

This loudspeaker unit combines a good frequency response and a high sound level in a compact and lightweight enclosure. Although the introduction of a microphone grid in the updated standards has reduced the impact of the source directivity on the reliability of the measurement results, the low directivity of the Zircon LS24 minimizes first order errors [4], thereby improving system robustness.

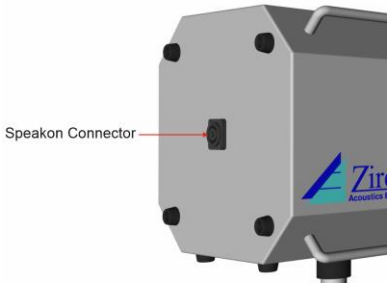
The Zircon LS24 can safely be placed on rough surfaces due to protective rubber feet at the back and the bottom, and has a central 5/8-11 UNC threaded hole in the bottom for fixation on a tripod.

Standard LS24 Loudspeaker Unit
Tripod for 2.1 m speaker height
Speakon cable 10 m
Carrying bag for LS24

Optional Speakon extension cable



Zircon LS24

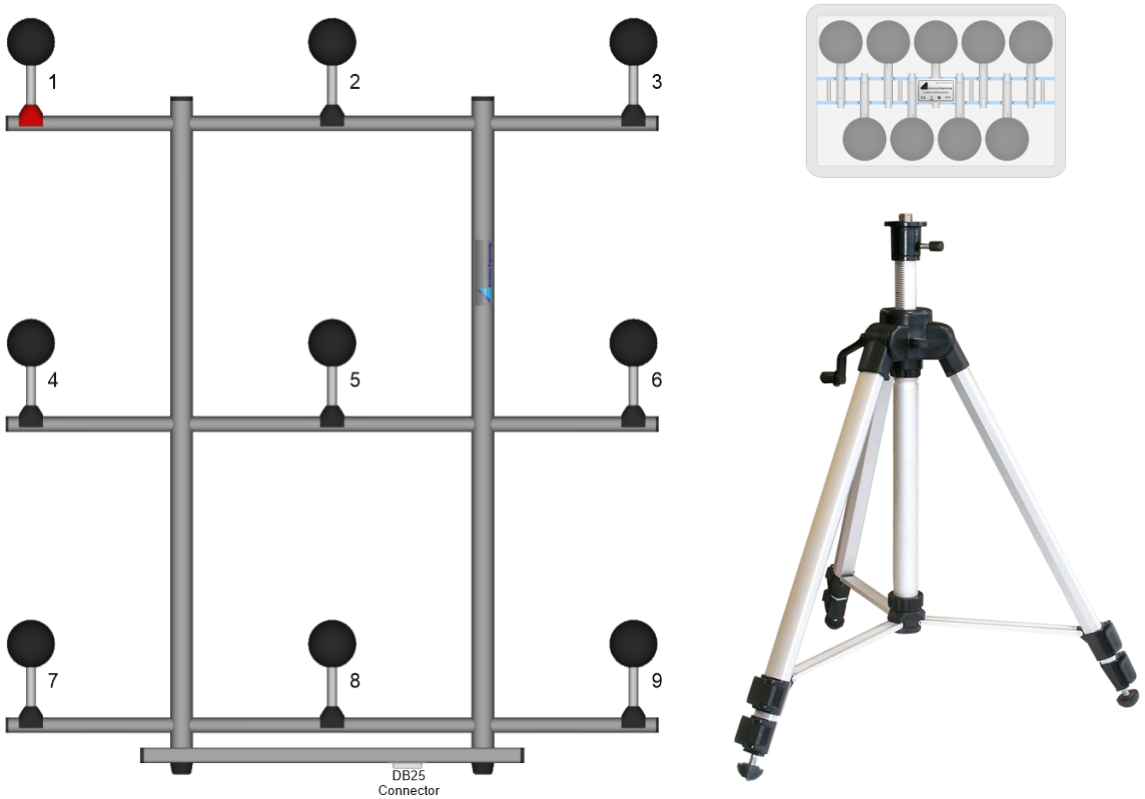


4.2 Zircon V2 MA24

The microphone array accepts ½" IEPE microphones (included) and is connected to the Zircon CI24 Control Interface by means of a single DB25 multi-cable with a male D-sub 25 connector at each end. The microphone numbering corresponds to the grid numbering depicted in the standards and the recording channel numbers in DIRAC 7.

The Zircon MA24 has a central 5/8-11 UNC threaded hole in the bottom for fixation on a tripod.

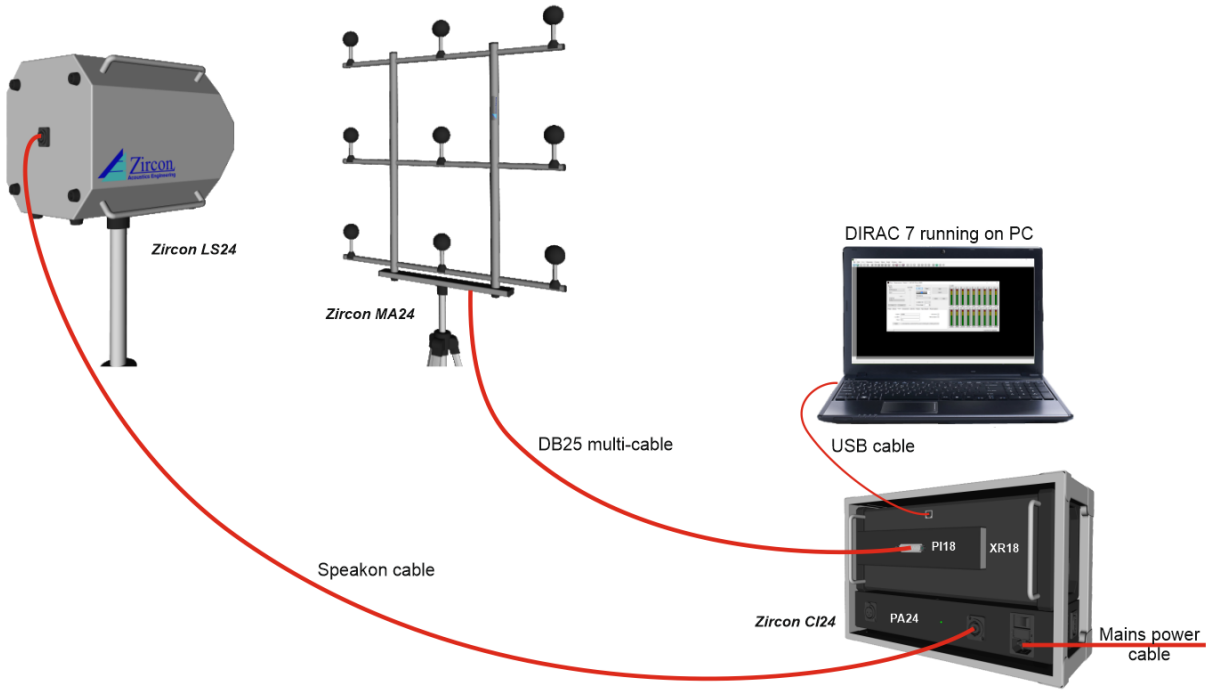
Standard	**MA24 Microphone Array** incl. - 9 x AEM-01 ½" IEPE mic - 9 x windshield for ½" mic Tripod for 2.1 m center mic height DB25 multi-cable 10 m Flight case for MA24 Box for 9 x AEM-01 + windshield	**Optional**	Extension cable Spare AEM-01 microphone Spare windshield



Zircon MA24

4.3 Zircon V2 CI24

The Control Interface is built around the Behringer XR18 multi-channel USB/Audio interface. The CI24 has 4 connections, as depicted below.



The XR18 has been set up with the proper configuration and signal level settings and is mains-powered via the PA24. The user must only connect the PA24 to the mains power and turn it on to get the Zircon CI24 operational. Measurements and analysis are carried out from within DIRAC 7 running on the PC.

The Zircon CI24 can be placed safely on rough surfaces due to protective rubber feet at the back and the bottom.

Standard	**CI24 Control Interface** (between LS24/MA24 and computer), including: - Behringer XR18 multi-channel USB/audio interface (pre-configured) - PI18 9-channel P48/IEPE input converter (connected to MA24 array) - PA24 power amplifier (connected to LS24 source) - Interconnection cables (XLR audio and mains power) - Flight case USB cable Mains power cable
Optional	Power bank, 230 VAC, Pure Sine, 200 Wh (3 h full power / 5 h standby) Inverter, Pure Sine, powered from external (e.g. car) battery

4.4 Software

DIRAC 7 is a multi-channel acoustic measurement and analysis software. It is based on impulse response measurements, from which many acoustical parameters are calculated, depicted graphically and/or exported for further processing. From the very first version of the EN 1793 standards, the related Zircon functions and parameters have been implemented and developed.

DIRAC has many users worldwide who contribute to improving and refining the software.

DIRAC is distributed worldwide exclusively by HBK. For commercial information on DIRAC, please contact your local HBK representative. For technical information you can always contact support@acoustics-engineering.com directly.

5 Compliance with Standards

CE Complies with the requirement of the 1999/5/EC directive

Safety	EN/IEC 61010-1 and ANSI/UL 61010-1: Safety requirements for electrical equipment for measurement, control and laboratory use.
EMC Emission	EN/IEC 61000-6-4: Generic emission standard for industrial environments.
	CISPR 22: Radio disturbance characteristics of information technology equipment. Class A Limits.
	FCC Rules, Part 15: Complies with the limits for a Class A digital device.
EMC Immunity	EN/IEC 61000-6-1: Generic standards - Immunity for residential, commercial and light industrial environments.
	EN/IEC 61000-6-2: Generic standards - Immunity for industrial environments.
	EN/IEC 61326-1: Electrical equipment for measurement, control and laboratory use - EMC requirements
Functional	EN 1793-3:1997: Road traffic noise reducing devices - Test method for determining the acoustic performance - Part 3: Normalized traffic noise spectrum
	EN 1793-5:2016: Road traffic noise reducing devices - Test method for determining the acoustic performance - Part 5: Intrinsic characteristics - In situ values of sound reflection under direct sound field conditions
	EN 1793-6:2018: Road traffic noise reducing devices - Test method for determining the acoustic performance - Part 6: Intrinsic characteristics - In situ values of airborne sound insulation under direct sound field conditions

Note

The above is only guaranteed using the standard Zircon V2 components in this document.

6 Specifications

6.1 Hardware

Parameter	Condition	Min	Typ	Max	Unit
Zircon LS24 loudspeaker unit					
Operating frequency range	Third octave frequency bands, -10 dB	100		8000	Hz
Nominal impedance			8		Ω
Power handling	Continuous Peak			25 50	W W
Sound Pressure Level	At 1 m distance in front, at 25 W		101		dB
Mounting hole thread	At bottom centre		5/8“ (5/8-11 UNC)		
Weight			2.5		kg
Cable					
Connector type			4p Speakon (2x)		
Length	Standard		10		m
Tripod					
Effective LS24 height	Stable position, loudspeaker centre			2.1	m
Weight			5.3		kg
Length	Retracted		1.06		m
Mounting screw thread			5/8“ (5/8-11 UNC)		
Other features	Quick Clamp, Circular Bubble Level, Direct-gear Height Adjustment				
Zircon MA24 microphone array					
Frame					
Grid pitch	3 x 3 microphones		40		cm
Relative position error	Any microphone, any direction	-2		2	mm
Accepted microphone type	BNC connector		½” IEPE		
Main connector	Female		D-Sub 25		
Mounting hole thread	At bottom centre		5/8“ (5/8-11 UNC)		
Flight-case	L x W x H		98 x 98 x 8		cm
Weight	Including 9 AEM-01 microphones In flight case (without microphones)		3.4 20		kg
Microphones	Standard		AEM-01		
Operating frequency range	Third octave bands, ±3 dB	50		12500	Hz
Sensitivity	1 kHz		40		mV/Pa
SNR	@ 94 dB SPL, 1 kHz, A-weighted		80		dB
Cable					
Connector type			D-Sub 25 male (2x)		
Length	Standard		10		m
Tripod					
Weight			1.85		kg
Length	Retracted		0.60		m
Mounting screw			5/8“ (5/8-11 UNC)		
Other features	Quick Clamp, Circular Bubble Level, Direct-gear Height Adjustment				

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Zircon V2 In Situ Noise Barrier Measurement System

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Parameter	Condition	Min	Typ	Max	Unit
Zircon CI24 controller interface					
Behringer XR18 USB/Audio I/F	Pre-configured[2]				
Microphone input voltage	XLR Input 1…9, 1 kHz, Full Scale			100	mV_{rms}
Maximum input SPL	Using AEM-01 microphones, 1 kHz		98		dB
Line output voltage	Aux1, p2/p3, 1 kHz, Full Scale			2.3	V_{rms}
Input phantom power voltage	XLR Input 1…9, On Other XLR inputs, Off		48 0		V
Mains power voltage	50 – 60 Hz	100		240	V_{AC}
Power consumption	Mains power, specified		30		W
Weight	Specified		3.2		kg
PI18 P48/IEPE input converter					
Input IEPE current	Each of 9 inputs		4.5		mA
Input connector	9 inputs	D-Sub 25 (DB25) female			
PA24 power amplifier					
Output power	At 1% THD+N, into 8 Ω		25	65	W
Nominal input voltage	At typical output power		2.3		V_{rms}
Mains power voltage	230 V setting[3] (45 – 65 Hz)	170	230	264	V_{AC}
Power consumption	Standby At typical output power		10 35		W
Input connector	p.1: GND, p.2: input signal	3p XLR female			
Output connector	p.1-: GND, p.1+: output signal	4p Speakon			
Weight			1.5		kg
Overall					
Power consumption	Standby @ typical output power		40 65		W
Weight	Including flight case		8		kg
Cables	Mains power cord USB cable	Schuko male to IEC female USB-A to USB-B			
Power bank					
Output voltage	Standard, Pure Sine		230		V_{AC}
Capacity	Standard		200		Wh

Alterations reserved

Acoustics Engineering reserves the right to change specification and accessories without notice.

[2] Other configurations available on demand. Backup of default Zircon configuration file available on AE website.
[3] 115 V setting available on demand.

6.2 Software: DIRAC 7 - Zircon V2 related functions

At HBK, DIRAC is known as DIRAC Room Acoustics Software Type 7841. Below only the Zircon V2 related specifications are given. A complete product datasheet can be downloaded from our website.

STANDARDS
Conforms with the following:
IEC 61260: 1/1-octave and 1/3-octave Bands Class 0
ISO 18233: Application of new measurement methods in building and room acoustics
ISO/DIS 13472-1: Acoustics – Measurement of sound absorption properties of road surfaces in situ – Part 1: Extended surface method
EN 1793-5:2016: Road traffic noise reducing devices - Test method for determining the acoustic performance - Part 5: Intrinsic characteristics - In situ values of sound reflection under direct sound field conditions
EN 1793-6:2018: Road traffic noise reducing devices - Test method for determining the acoustic performance - Part 6: Intrinsic characteristics - In situ values of airborne sound insulation under direct sound field conditions
And more

OPERATION
The software is a native 32-bit Windows® program, operated using buttons and/or menus and shortcut keys

HELP AND USER LANGUAGE
Extensive context-sensitive help is available throughout the program in English

MEASURING METHODS
MLS, Pink MLS, e-Sweep (125Hz-4kHz)[4] and more
Signal measurements
Stimulus lengths: 0.34 - 350 s
Pre-average: 1 – 999 times
Measurements can be executed automatically

FREQUENCY RANGE
10 1/1-octave bands from 31.5 Hz to 16 kHz
30 1/3-octave bands from 25 Hz to 20 kHz

CALCULATED 1793 RELATED PARAMETERS
• Reflection Index, RI (partial values)
• Sound Insulation Index, SI (partial values)
• Sound Power Reflection Factor, Qw (partial values)
• Reduction factor, Rsub
• Gain correction factor, Cgain
• Impulse response-to-Noise Ratio, INR
• Source-Receiver Distance, SRDIST
• Many more other parameters

POST-PROCESSING
All parameters can be viewed in table and/or graph format
Parameters are graphed versus frequency or source-receiver distance
Measurements can be grouped, and over each group the average, standard deviation, minimum and maximum can be calculated
The calculated results of multiple groups can be displayed in a single graph or table
Groups can be saved in project files

IMPULSE RESPONSE VIEWS AND PLOTS
Impulse Response, Energy-Time Curve, magnitude frequency spectrum and more.
Overlay view of second impulse response. Directivity plot

PRINT AND EXPORT
Graphs and tables can be exported via the clipboard, or printed. All results can be printed or exported in ASCII (text) format for further processing in other programs.
Calculated results of multiple parameters can be saved for an entire project

SUPPORTED FILE FORMATS
Wave (.WAV) 8-/16-/24-/32-bit integer. 32-/64-bit float. 1 - 2 channels
Raw (.PCM) 8-/16-bit integer, 32-bit float. 1 - 2 channels
Text (.TXT) 32-bit float. 1 - 2 channels
.WAV files generated by HBK instruments
and more

COMPUTER SYSTEM REQUIREMENTS
Operating Systems: Windows® 10

[4] Frequencies refer to centre frequencies of full octave bands covered by the sweep

References

[1] EN 1793-3:1997: Road traffic noise reducing devices - Test method for determining the acoustic performance - Part 3: Normalized traffic noise spectrum

[2] EN 1793-5:2016: Road traffic noise reducing devices - Test method for determining the acoustic performance - Part 5: Intrinsic characteristics - In situ values of sound reflection under direct sound field conditions

[3] EN 1793-6:2018: Road traffic noise reducing devices - Test method for determining the acoustic performance - Part 6: Intrinsic characteristics - In situ values of airborne sound insulation under direct sound field conditions

[4] M. Garai, P. Guidorzi, “Reflection index measurement on noise barriers with the Adrienne method: source directivity investigation and microphone grid implementation” (invited paper), Proc. Inter-Noise 2011, Osaka, Japan, Paper 427100, 1-6 (2011)

[5] Mommertz E., Angle-dependent in-situ measurements of reflection coefficients using a subtraction technique. Applied Acoustics, 46, 1995, pp. 251-263

[6] Adrienne Research Team, Test methods for the acoustic performance of road traffic noise reducing devices – Final report - European Commission – DGXII – SMT Project MAT1-CT94049, 1998

Acoustics Engineering develops systems for the prediction and measurement of acoustical parameters, resulting in user-friendly tools that enable you to perform fast and accurate acoustical measurements and calculations.

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