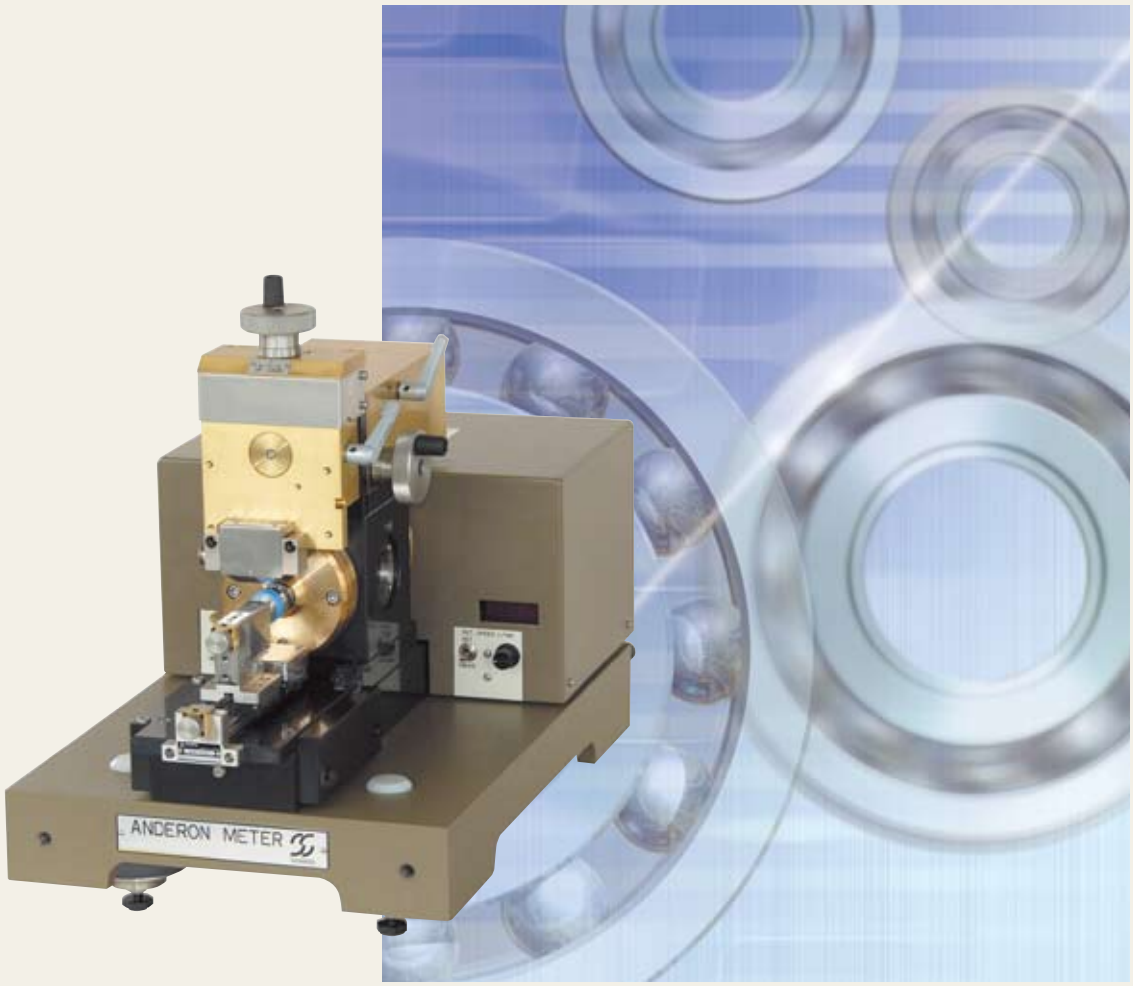
SUGAWARA

Bearing inspection systems



Anderon meter, wavimeter, roundness measurement device,
bearing life testing machine, pusher-type torque sensor, and calibrator

SUGAWARA Laboratories Inc.

Anderon meter

ADM-101 and ADA-15

Performs high-precision measurements of ball bearing vibrations.

Rotating the inner ring of the bearing at 1,800 rpm, the Anderon meter measures the radial vibrations of the outer ring with the velocity sensor. The measurement result is divided into three frequency bands: low band (50 to 300 Hz), medium band (300 to 1,800 Hz), and high band (1,800 to 10,000 Hz) and indicated in units of Anderons for each band. The meter is also used to detect flaws and dust on bearings by monitoring audio output from the velocity sensor through speakers or headphones.

Features

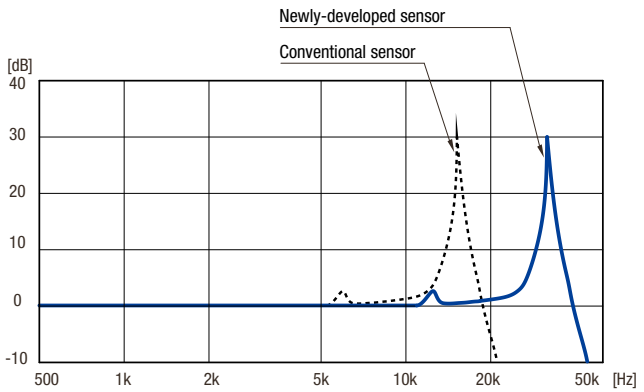
- Sugawara's precision fluid dynamic bearing achieves display resolutions as fine as 0.001 Anderons, enabling measurements of small-diameter and other high-performance bearings.
- Vibrations are measured using Sugawara's compact velocity sensor, which features flat characteristics. The sensor has approximately 10 times the sensitivity of a laser Doppler vibrometer.
- The meter can be adjusted (by changing arbors) to measure various bearing sizes.
  (Bearing sizes: Bore diameter of 1 mm to external diameter of 50 mm)
- The meter can be combined with an automation unit to create an automatic measurement and acceptability inspection system.
- Achieves compact, small-footprint form factor.

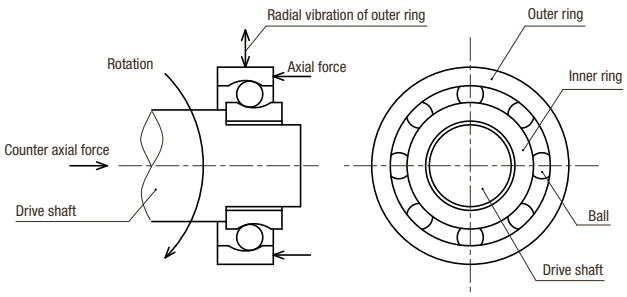
Vibration measurement method

When a bearing is mounted on a shaft that rotates stably with sufficient load capabilities, if the outer ring is restrained so that the ring does not rotate and is pressed along the axis, the inner ring rotates with the shaft. As rolling elements, the balls roll between the inner and the outer rings.
The arbor and the spindle shaft serve as a stable axis of rotation. The pusher force presses the outer ring of the bearing along the axis, while the probe presses the outer ring along a radial axis with force adequately below the pusher force, thereby measuring radial vibrations.

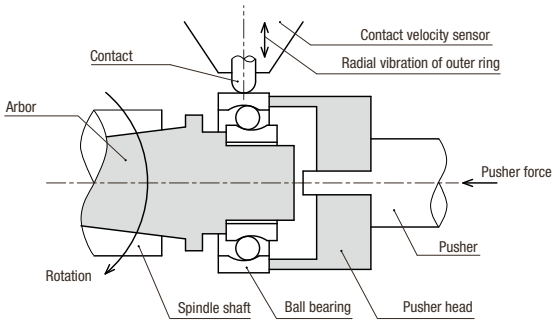
Contact velocity sensor featuring flat characteristics

Due to characteristic vibrations above 5,000 Hz, many conventional velocity sensors encounter difficulties in measuring high band frequencies. Sugawara's ADS-12 velocity sensor maintains flat characteristics up to 10 kHz.





Model of drive shaft rotating the inner ring of a ball bearing



Structure of vibration detecting portion of the Anderon meter

Assesses ball bearing quality.

Specifications

Anderon meter drive unit	ADM-101
Spindle rotation speed:	300 to 2,100 rpm, continuously variable
Spindle drive system:	Direct drive
Vibration of mounted arbor:	3 μmpp or less during no-load rotation
Lubrication:	Circulating oil bath lubrication
Overall background vibration: (1,800 rpm)	0.1 Anderons or less in any of L, M, and H bands
Arbor mounting system:	ABT3-*** series, Taper B & S #3
Supply power:	Single phase AC (2 power wires and 1 FG wire)
Supply voltage:	100 ± 10 VAC, 50/60 Hz
Current consumption:	Approx. 1 A
Dimensions and weight:	300 (W) x 420 (H) x 474 (D) mm, 80 kg

Pusher	ADP-20NT
Pusher force:	20 N or less
Bearing size:	Maximum external diameter of 50 mm and maximum width of 20 mm

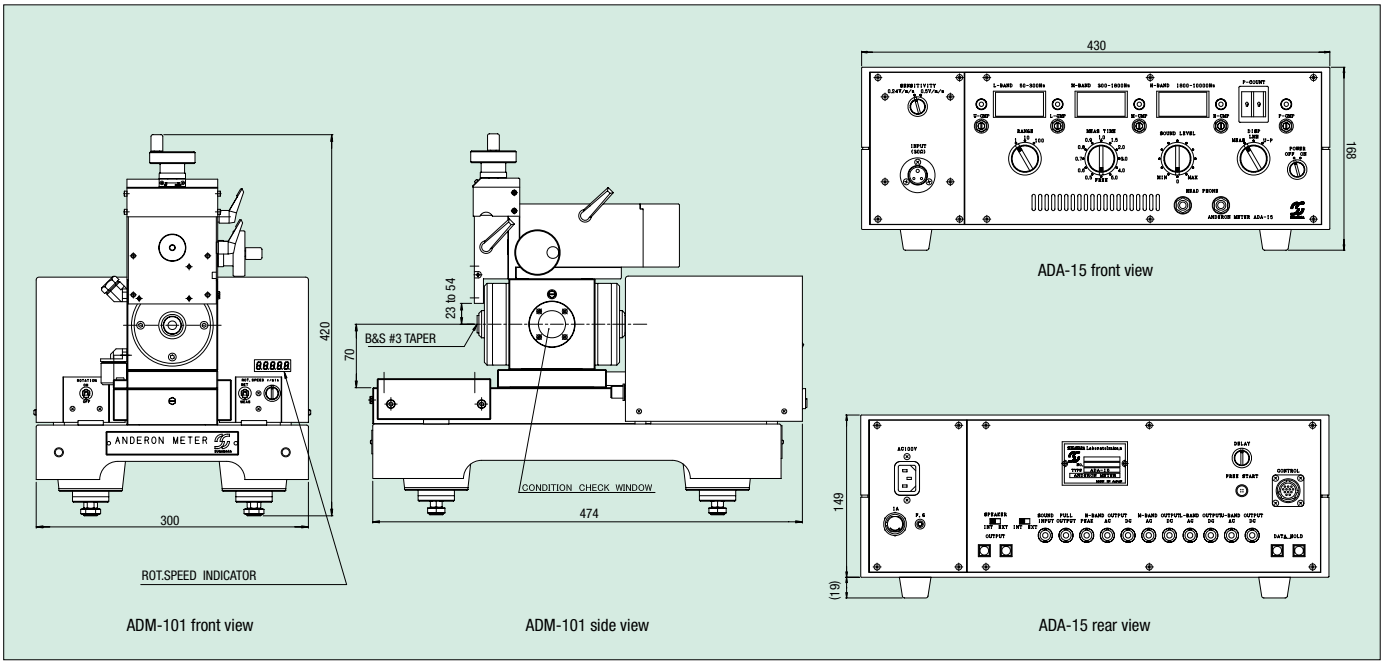
Contact velocity sensor	ADS-12
Sensitivity:	3 ± 0.2 mV/usp under a load of 30 Ω
Frequency characteristics:	±1 dB 50 to 10,000 Hz
Resonance frequency:	20 kHz or more when pressed into the bearing by 0.1 mm
Probe force:	0.40 N ± 0.05 when pressed into the bearing by 0.1 mm

Anderon meter indication unit	ADA-15
Measurement range:	1-, 10-, and 100-Anderon ranges
Measurement band	
L band:	50 to 300 Hz
M band:	300 to 1,800 Hz
H band:	1,800 to 10,000 Hz
Measurement display: (common to all bands)	Digital, 3.3 digits (0000 to 1999)
Residual noise (1-Anderon range)	
Sensitivity 0.24 V/m/s:	0.1 Anderons or less
Sensitivity 0.5 V/m/s:	0.05 Anderons or less
Comparison function:	After the START signal is input and the measurement time has elapsed, measurements are compared against each upper limit and acceptability determined.
Measurement time setting:	0.5/0.6/0.7/0.8/0.9/1.0/1.5/2.0/3.0/4.0/5.0 [sec.]
Upper limit setting:	Anderon values in U, L, M, and H bands, Anderon-equivalent of H band waveform peak and number of peaks.
Result output:	Results of U, L, M, and H bands and PEAK COUNT; items exceeding upper limit settings during measurement.
Audio output:	Monitoring sounds are output from the built-in speaker.
Electric output for sound:	For external speaker/headphones Output band of 50 to 10,000 Hz
Dimensions and weight:	430(W) x 168(H) x 427(D) mm,16 kg

Common specifications

Temperature:	0°C to 40°C
Humidity:	90% RH or less (no condensation)

Dimensional diagram



Anderon meter for medium-/large-diameter bearings

ADM-512
ADM-701

The ADM-512 Anderon meter drive unit is used for medium-diameter ball bearings (bore diameter of 3 mm to external diameter of 100 mm), while the ADM-701 is used for large-diameter ball bearings (external diameters ranging from 20 mm to 190 mm). The ADM-512 applies axial loads of up to 100 N, while the ADM-701 applies axial loads of up to 1,500 N.

Specifications

Drive unit	ADM-512	ADM-701
Indication unit:	ADA-15	
Contact velocity sensor:	ADS-12	
Pusher:	ADP-100NK	One-piece design integrated with main body.
Arbor mounting system:	ABT7-*** series, Taper B & S #7	
Spindle load capacity		
Thrust:	Max. 100 N	Max. 1,500 N
Radial:	Max. 100 N	Max. 100 N
Overall background vibration (1,800 rpm)		
L band:	0.1 Anderons or less	
M band:	0.1 Anderons or less	
H band:	0.1 Anderons or less	
Workpiece permissible torque:	—	200 mN·m or less
Supply air pressure:	—	0.4 to 0.7 MPa
Dimensions (W x H x D):	700 x 1,300 x 830 mm	700 x 1,340 x 830 mm
Weight:	300 kg	430 kg

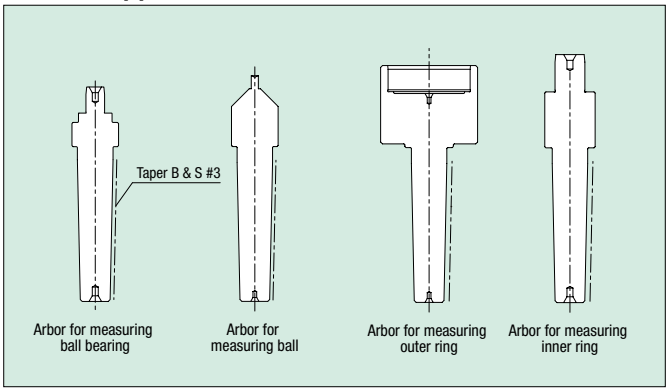
Product components

Desktop Anderon meter	
Anderon meter drive unit	ADM-101
Pusher	ADP-20NT
(Pusher)	(ADP-50NK)
Connection cable*	8CP-802-152
Contact velocity sensor*	ADS-12
(Contact velocity sensor)	(ADS-22)
Connection cable*	8CP-601-102
Anderon meter indication unit*	ADA-15
Headphones*	ATH-AD700
Oscilloscope*	CO-1305
Signal cable*	8CJ-401-152
Amplifier stand	PR-21
Anderon oscillator*	ADC-10
Arbor	ABT3-****
Pusher head*	H*X-***
Step down transformer*	CD220-15S
Power tap*	WCH2334B
Floor-standing Anderon meter	
Anderon meter drive unit	ADM-512
Pusher	ADP-100NK
(Pusher)	(ADP-20NT)
Amplifier stand	LD4-SPP6
Arbor	ABT7-***
Common components indicated by *	
Anderon meter drive unit	ADM-701
Anderon meter calibrator	ADC-100/VVU-100
Contact velocity sensor	AD-H-S

Bearing list

Bearing number (d: bore diameter, D: external diameter, B: width)	Arbor for ADM-101	Arbor for ADM-512	Arbor for ADM-701
681X (d:1.5, D:4, B:2)	ABT3-105	—	—
682 (d:2, D:5, B:2.3)	ABT3-204	—	—
693 (d:3, D:8, B:3)	ABT3-302	ABT7-03-1	—
695 (d:5, D:13, B:4)	ABT3-504	ABT7-05-1	—
696 (d:6, D:15, B:5)	ABT3-606	ABT7-06-1	—
608 (d:8, D:22, B:7)	ABT3-804	ABT7-08-1	ABT7-08-1
6000 (d:10, D:26, B:8)	ABT3-A03	ABT7-10-2	ABT7-10-2
6201 (d:12, D:32, B:10)	ABT3-C04	ABT7-12-1	ABT7-12-1
6906 (d:30, D:47, B:9)	ABT3-U01	ABT7-30-2	ABT7-30-2
6307 (d:35, D:80, B:21)	—	ABT7-35-1	ABT7-35-1
6308 (d:40, D:90, B:23)	—	ABT7-40-1	ABT7-40-1
6309 (d:45, D:100, B:25)	—	ABT7-45-1	ABT7-45-1
6310 (d:50, D:110, B:27)	—	—	ABT7-50-1
6315 (d:75, D:160, B:37)	—	—	ABT7-75-1
6024 (d:120, D:180, B:28)	—	—	ABT7-120-1

Arbor appearances



Anderon meter automation unit

Single-spindle type

The ADP-20NA1 pusher together with the Anderon meter drive unit forms an automatic high-precision measurement system.

Features

- The automatic system is capable of high precision measurements equal to the manual Anderon meter.
- Simply mounting the standard ADM-101 manual meter creates a low-cost automated system.
- Both sides of a bearing are automatically measured to ensure reliable inspections and screening.
- The total tact time required is approximately 6 seconds to measure both sides. The system can inspect 15,000 workpieces a day.
- Achieves compact, small-footprint form factor.

Spare parts

Replacement parts	Bearing number (d: bore diameter, D: external diameter, B: width)		
	623 (d3D10B4)	695 (d5D13B4)	6800 (d10D19B5)
Arbor	ABT3-303	ABT3-504	ABT3-A03
Pusher head	HYZ-8811A	HYZ-8814A	HUZ-A801A
Bearing releaser	JBS-Z1040	JBS-Z1340	JBS-Z1950
Guide block	JRS-Z1040	JRS-Z1340	JRS-Z1950
Slide block	JUS-Z1040	JUS-Z1340	JUS-Z1950
Carrier claw	JPS-Z1040	JPS-Z1340	JPS-Z1950
Reversing table	HZS-Z1040	HZS-Z1340	HZS-Z1950

Specifications

Pusher	ADP-20NA1
Supply voltage:	12 VDC
Supply air pressure:	0.4 MPa
Pusher force:	20 N or less
Dimensions and weight:	340 (W) x 265 (H) x 260 (D) mm, 21 kg

Parts feeder	ADF-001
DC output:	12 VDC
Dimensions and weight:	322 (W) x 295 (H) x 225 (D) mm, 38.5 kg

Anderon meter indication unit	ADA-15
Measurement range:	1-, 10- and 100-Anderon ranges
Measurement band	
L band:	50 to 300 Hz
M band:	300 to 1,800 Hz
H band:	1,800 to 10,000 Hz
Residual noise (1-Anderon range)	
Sensitivity 0.24 V/m/s:	0.1 Anderons or less
Sensitivity 0.5 V/m/s:	0.05 Anderons or less
Result output:	Results of U, L, M, and H bands, and PEAK COUNT; and items exceeding upper limit settings during measurement.
Audio output:	Monitoring sounds are output by the built-in speaker.
Dimensions and weight:	430 (W) x 168 (H) x 427 (D) mm, 16 kg

Anderon meter drive unit	ADM-101
Spindle rotation speed:	300 to 2,100 rpm, continuously variable
Spindle drive system:	Direct drive
Vibration of mounted arbor:	3 µmpp or less during no-load rotation
Lubrication:	Circulating oil bath lubrication
Overall background vibration: (1,800 rpm)	0.1 Anderons or less in any of L, M, and H bands
Arbor mounting system:	ABT3-*** series, Taper B & S #3
Dimensions and weight:	300 (W) x 420 (H) x 474 (D) mm, 80 kg

Contact velocity sensor	ADS-12
Sensitivity:	3 ± 0.2 mV/usp under a load of 30 Ω
Frequency characteristics:	±1 dB, 50 to 10,000 Hz
Resonance frequency:	20 kHz or more when pressed into the bearing by 0.1 mm

Common Specifications

Temperature:	0°C to 40°C
Humidity:	90% RH or less (no condensation)
Supply power:	Single phase AC
Supply voltage:	100 ± 10 VAC, 50/60 Hz

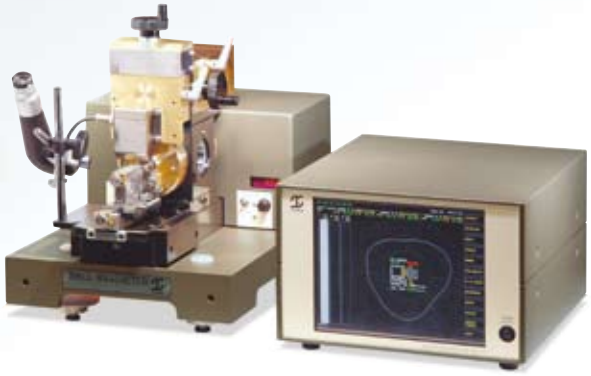
*This specification does not apply to the ADP-20NA1 pusher or ADS-12 velocity sensor.

Ball wavimeter

Roundness measurement device BWM-102 and SWA-31

Makes high-speed, high-precision measurements of the surface waviness of a rotating ball.

The ball wavimeter measures surface waviness and the roundness of a ball bearing in the manner required for practical applications. A ball is mounted on the front end of the spindle and the velocity sensor is pressed against the ball to measure vibration velocity. Waviness is obtained as a value for vibrations per rotation. Roundness is evaluated by removing the spindle's vibration component from the value obtained for waviness.



Features

Ball and race wavimeters

- High-precision measurements
  - Practical measurement accuracy: 10 nm
  - Spindle vibration: 3 μm or less (at 450 rpm)
  - Sensor sensitivity: Approximately 10 times the sensitivity of a laser Doppler vibrometer
  - Uses low-vibration spindle direct drive system.
- High-speed measurements: Measurement results are displayed in real-time.

*Excludes time required to mount workpiece.

- The built-in printer outputs a hard copy of the screen display.
- Incorporates large, color LCD for clarity and legibility.
- Achieves compact design.
- These wavimeters are highly cost-effective compared to comparable meters.
- The meters are calibrated using the SWC-10.

Ball wavimeter

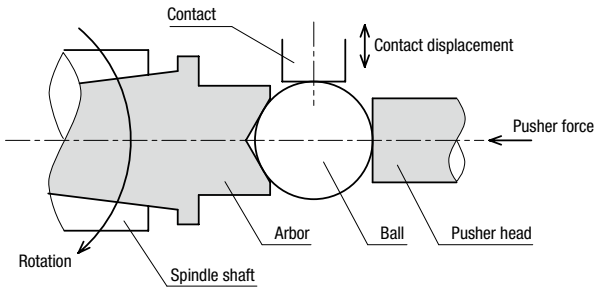
- The meter is capable of measuring extremely small miniature bearings. Measurable ball diameter : 0.3 mm to 12 mm.
- The dedicated pusher ensures reliable measurements.

Race wavimeter

- Measurable outer ring external diameter : 5.0 mm to 22 mm

Vibration measurement method

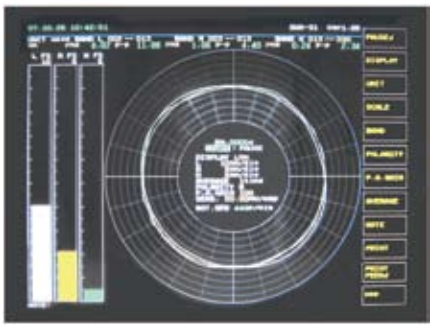
With the arbor attached to the end of the spindle rotating at constant speed, the pusher presses the ball against the arbor. The ball begins to rotate together with the arbor and spindle. Applying the minimum force needed, the probe of the velocity sensor is pressed against the surface of the rotating ball in the direction perpendicular to the axis of rotation. The probe is displaced by the arbor vibrations and by the spindle combined with the surface waviness of the ball. The probe's displacement is detected as a voltage signal proportional to vibration velocity, on the basis of which roundness and waviness are calculated.



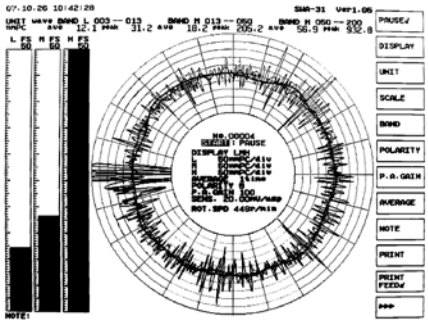
Structure of the vibration detecting component of the ball wavimeter

Example of graphic data display

▲ **Example in which nm/rad is selected as the unit of waviness**



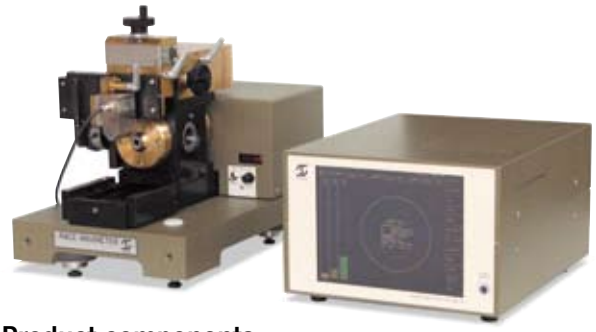
▲ **The chart shows the p-p value in a band with two waves of the lower limit for the measurement unit of nm or μm and roundness.**



▲ **The built-in printer outputs a hard copy of the screen display**

Race wavimeter

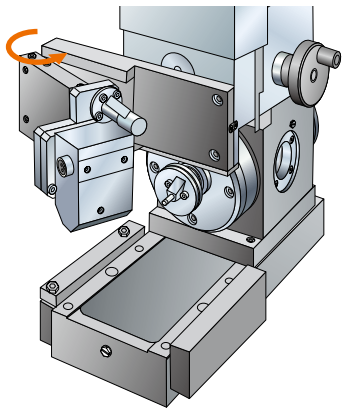
LWM-102 and SWA-31



Rotates the outer and inner rings of a ball bearing to perform high-speed, high-precision measurements of surface waviness of a race.

Vibration measurement method

A bearing is mounted on the arbor fitted in the spindle rotating at constant speed. As shown in the illustration, the velocity sensor probe is pressed against the surface of the race of the outer or inner ring. The displacement is detected and the waviness calculated.



Mechanism for guiding and pressing the velocity sensor against a workpiece

Product components

Ball wavimeter/roundness measurement device	
Ball wavimeter drive unit	BWM-102
Ball pusher	BWP-20NT
Contact velocity sensor	BWS-10M
Connection cable*	8CP-601-102
Synchro wave analyzer*	SWA-31
Signal cable*	8CT-401-102
Headphones*	ATH-AD700
Amplifier stand	PR-21
Synchro wave oscillator	SWC-10
Microscope set	SDC-LJJ1
Ball arbor	ABW3-***
Recording paper (10 rolls)	1A2-001
Step down transformer	CD220-15S
Power tap	WCH2334B
Desktop race wavimeter	
Race wavimeter drive unit	LWM-102
Contact velocity sensor	LWS-10
Arbor for inner ring	ABL3-***
Arbor for outer ring	ABR3-***
Common components marked with *	
Floor-standing race wavimeter	
Race wavimeter drive unit	LWM-508
Synchro wave analyzer	SWA-31
Contact velocity sensor	LWS-M17
Amplifier stand	LD4-SPP3
Arbor for inner ring	ABL7-***
Arbor for outer ring	ABR7-***
Other	

Specifications

Drive unit	BWM-102	LWM-102
Workpiece dimensions		
Ball:	Ball diameter of 12 mm or less	—
Inner ring bore diameter:	—	1.0 mm to 10 mm
Inner ring external diameter:	—	1.5 mm to 15 mm
Outer ring bore diameter:	—	3.5 mm to 18 mm
Outer ring external diameter:	—	5.0 mm to 22 mm
Spindle rotation speed:	300 to 2,100 rpm ± 2% or less	
Display of set rotation speed:	7-segment LED: 4 digits	
Arbor mounting system:	Taper B & S #3, inserted into the taper hole	
Vibration of mounted arbor:	3 µmpp or less	
Dimensions:	300 (W) x 420 (H) x 474 (D) mm	
Weight:	80 kg	82 kg
Pusher force:	20 N or less	—
Overall background vibration	0.1-µPC range	0.3-µPC range
L band:	0.02 µPC or less	0.03 µPC or less
M band:	0.03 µPC or less	0.04 µPC or less
H band:	0.04 µPC or less	0.06 µPC or less
*Spindle rotation speed: 450 rpm		

Velocity sensor	BWS-10M	LWS-10
Sensitivity:	20 ± 1 mV/usp under a load of 30 Ω	
Frequency characteristics:	50 to 3,000 Hz	50 to 1,000 Hz

Display unit	SWA-31
Unit and measurement range:	5 to 10,000 nm, 50 to 50,000 ninch, 1 to 10,000 nmWCLA, 50 to 50,000 nm/rad, 100 to 50,000 nmPC
Measurement band	
L band:	Na to Nb wave/r, 1 ≤ Na ≤ Nb ≤ 500,Nb < 10 x Na
M band:	Nc to Nd wave/r, 1 ≤ Nc ≤ Nd ≤ 500,Nd < 10 x Nc
H band:	Ne to Nf wave/r, 1 ≤ Ne ≤ Nf ≤ 500,Nf < 10 x Ne
*The effective range depends on spindle rotation speed and other conditions.	
Headphone output:	Output level of approx. 24.3 mV RMS
Averaging function:	Displays results of averaging 1, 2, 3, 4, 5, 6, 7, 8, 10, 12, and 16 times.
Display screen:	10.4-inch color LCD
Built-in printer:	Thermal roll paper (112 mm wide)
Dimensions:	315 (W) x 216 (H) x 400 (D) mm
Weight:	15 kg

Common specifications

Temperature:	0°C to 40°C
Humidity:	90% RH or less (no condensation)
Supply voltage:	100 ± 10 VAC, 50/60 Hz

Measuring the bearing torque

Pusher-type torque sensor ATP-1MN

Measuring the loss torque of a ball bearing rotating at high speed, this device is capable of measuring miniscule torque values that could be affected by the performance of the grease incorporated into a bearing. The pusher-type torque sensor unit is mounted on the Anderon meter drive unit and applies axial loads against a bearing to perform measurements.

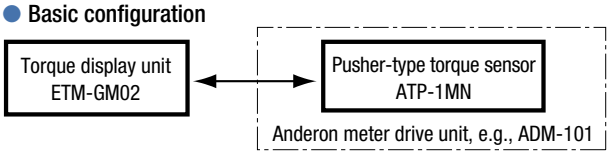
Specifications

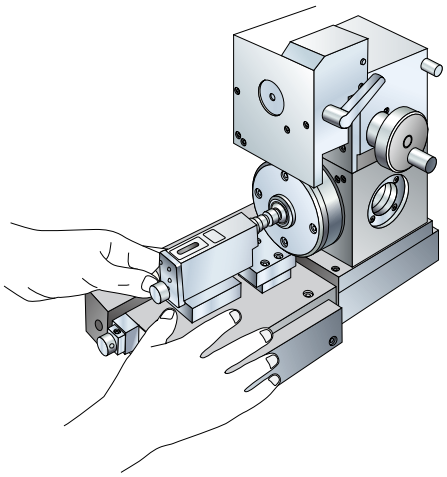
Pusher-type torque sensor	ATP-1MN
Rated torque:	1 mN·m
Measurement accuracy:	Rated torque ± 5%
Pusher force:	2 N or less
Bearing size:	Maximum external diameter of 14 mm; maximum width of 20 mm
Dimensions and weight:	100 (W) x 82 (H) x 195 (D) mm, 2.8 kg
Torque display unit	**ETM-GM02**
Supply voltage:	100 ± 10 VAC, 50/60 Hz
Residual noise:	Digital, 3.3 digits (0.000 to 1.999)
Dimensions and weight:	215 (W) x 109 (H) x 250 (D) mm, 4 kg

Common specifications

Temperature: 0°C to 40°C
Humidity: 90% RH or less (no condensation)

Basic configuration





The pusher-type torque sensor is mounted on an Anderon meter drive unit.

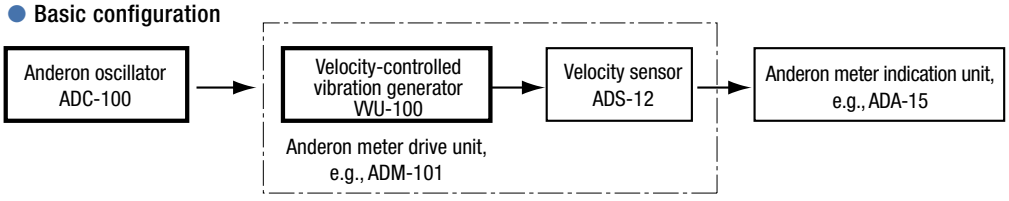
Velocity sensor calibrator ADC-100 and VVU-100

The calibrator produces oscillations equivalent to 0.1, 1, and 10 Anderons for the low, medium, and high bands to calibrate the velocity sensor and indication unit (e.g., ADA-15), enabling management of velocity sensor accuracy during operations or the accuracy of several velocity sensors with no special skills. The calibrator outputs an arbitrary oscillation frequency based on a sine wave input from an external device.

Specifications

Anderon oscillator/ Velocity-controlled vibration generator	ADC-100 and VVU-100
Output level:	0.1 Anderon ≈ 0.7698 µm/s 1 Anderon ≈ 7.698 µm/s 10 Anderon ≈ 76.98 µm/s
Level accuracy:	0.1 Anderon ± 15% 1 Anderon ± 10% 10 Anderon ± 5% Varies, depending on combination with ADC-100 and VVU-100.
External input:	Enabled when FREQ. switch is set to EXT. Oscillation equivalent to output level is output by input of a sine wave of 1 Vrms, 50 Hz to 10,000 Hz.
Temperature:	0°C to 40°C
Humidity:	90% RH or less (no condensation)
Supply voltage:	100 ± 10 VAC, 50/60 Hz

Basic configuration

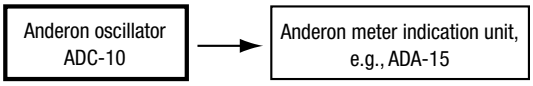


Calibrator

Anderon oscillator ADC-10

The oscillator calibrates an Anderon meter indication unit (e.g., ADA-15) by generating reference signals equivalent to 1, 10, and 100 Anderons for the low, medium, and high bands and outputting pseudo sine-wave signals at oscillating frequencies. The ADC-10 can be used with velocity sensors with differing sensitivities, including the ADS-12 and ADS-22, simply by switching the sensitivity.

Basic configuration



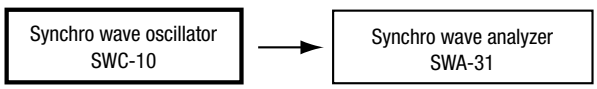
Specifications

Anderon oscillator	ADC-10
Sensitivity of contact velocity sensor:	Selectable from 3.0, 6.2, and 10.5 mV/usp.
Oscillating frequency	
L Band:	123 Hz ± 10%
MBand:	735 Hz ± 10%
H Band:	4,243 Hz ± 10%
Output level	
1 Anderon:	1 Anderon ± 10% or less
10 Anderons:	10 Anderons ± 5% or less
100 Anderons:	100 Anderons ± 3% or less
Signal input function:	Approx. 1 MΩ when 1 Vrms signal is input.
Oscillating monitor output	
L Band:	123 Hz, open terminal voltage 1 Vrms sine wave
M Band:	735 Hz, open terminal voltage 1 Vrms sine wave
H Band:	4,243 Hz, open terminal voltage 1 Vrms sine wave
Sensitivity monitor output	
3.0 mV/usp:	Open terminal voltage 1.10 Vrms ± 5%
6.2 mV/usp:	Open terminal voltage 2.27 Vrms ± 5%
10.5 mV/usp:	Open terminal voltage 3.85 Vrms ± 5%
Dimensions and weight:	215 (W) x 110 (H) x 276 (D) mm, 5 kg
Temperature:	0°C to 40°C
Humidity:	90% RH or less (no condensation)
Supply voltage:	100 ± 10 VAC, 50/60 Hz

Synchro wave oscillator SWC-10

The SWC-10 is used to calibrate the display sensitivity of the SWA-31 synchro wave analyzer of the display unit. Calibrations are performed using a rotation synchronization pulse from the drive unit and signal output from the SWC-10, which is equivalent to the signal from the velocity sensor. When used with another signal generator, the SWC-10 is also used to test the operations of the synchro wave analyzer for rotation speed and number of crests.

Basic configuration



Specifications

Synchro wave oscillator	SWC-10
Sensitivity of contact velocity sensor:	Selectable from 5.0, 10.5, and 20.0 mV/usp.
Signal selection by rotation speed	
450 rpm. L band:	52.5 Hz (7 crests)
M band:	195 Hz (26 crests)
H band:	750 Hz (100 crests)
900 rpm. L band:	52.5 Hz (7 crests)
M band:	195 Hz (26 crests)
H band:	750 Hz (100 crests)
Selection of output signal unit	
µPC:	0.1, 1, 10, 100 µPC
µWCLA:	0.001, 0.01, 0.1, 1µWCLA
Temperature:	0°C to 40°C
Humidity:	90% RH or less (no condensation)
Supply voltage:	100 ± 10 VAC, 50/60 Hz

Life test

Vibrometer VL-201GE and PL-201

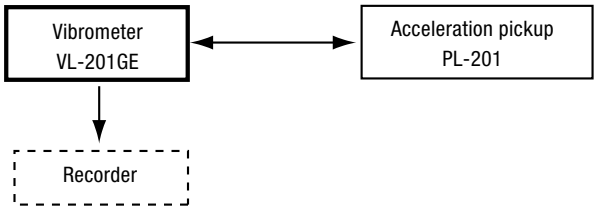
Acceleration vibrometer with automatic stop function used to assess bearings and to diagnose equipment

The vibrometer detects failures through comparisons with a set vibration. In the event of a detected failure, it switches on the alarm lamp and stops the tested equipment by activating the relay circuit. If combined with extended time recorder, the vibrometer can perform technical assessments of bearings by monitoring changes in vibration levels. Use of the charge amplifier input system means the system remains unaffected by extensions of the cable for the PL-201.

Specifications

Vibrometer	VL-201GE and PL-201
Measurement range:	0.1, 0.3, 1, 3, 10, 30, 100 G rms/FS, CAL
Frequency band:	10 Hz to 25 kHz ± 1 dB (filter OFF) 200 Hz to 15 kHz ± 1 dB (filter ON)
Level setting range:	25 to 100%/FS
Alarm display:	Alarm lamp ON and relay contact OPEN (2 circuits) Contact capacity: 250 VAC, 3 A
Monitor output voltage:	Approx. 1 VACrms/FS
Recorder output voltage:	Approx. 2 VDC/FS
Temperature:	0°C to 45°C (no condensation)
Supply voltage:	Single phase, 100 VAC, 50/60 Hz, approx. 20 W

● Basic configuration



Bearing monitor NB-4/4M and NB-P100/P101

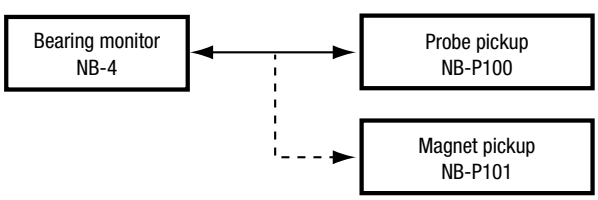
Handy palmtop bearing monitor quickly and easily diagnoses problems in bearings or other rotating components.

A bearing defect is identified based on vibration acceleration. General mechanical vibration problems are assessed by displacement or velocity based on JIS and other applicable standards. The monitor can be used with various devices, ranging from low-speed to high-speed rotation, simply by switching sensitivities. The pickup for the monitor is available in two types: the NB-P100 probe pickup or the NB-P101 magnet pickup.

Specifications

Bearing monitor	NB-4/4M and NB-P100/P101
Measurement functions:	Switchable between displacement, velocity, and acceleration.
Measurement mode:	Switchable between RMS and peak value.
Frequency range:	Displacement/velocity: 10 Hz to 1 kHz, Acceleration: 1 to 15 kHz
Display range H range:	Displacement: 0.001 to 1.999 mm p-p
	Velocity: 0.001 to 1.999 S pk, RMS
	Acceleration: 0.001 to 1.999 G pk, RMS
L range:	Displacement: 0.01 to 19.99 mm p-p
	Velocity: 0.01 to 19.99 cm/S pk, RMS
	Acceleration:0.01 to 19.99 G pk, RMS
Output:	Oscillatory waveform signal, envelope signal, headphone output
Power supply:	Runs approximately 10 hours on one dry-cell battery 006P (9V).
Dimensions:	80 (W) x 150 (H) x 29 (D) mm
Weight:	400 g (excluding the pickup and the cable)

● Basic configuration



Glossary

Measurement units for bearing inspection systems

Anderon

The Anderon is a measure of bearing vibration devised by Lucian Chaney (U.S.) et al. in the 1940s. The word Anderon comes from the English terms referring to the angle derivation of radial displacement. Representing the radial vibration of the outer ring of a bearing measured when the inner ring rotates, an Anderon is calculated as follows:
Vibration displacement [µinch] is differentiated with respect to rotation angle [rad] and passed through a band-pass filter. The resulting RMS value [µinch] is then divided by the square root of the band octaves. This result is expressed in Anderons. Commonly, three bands are used: L (low), M (medium), and H (high).
In the past, MIL (Military Standard) specified the upper limit of bearing vibrations in Anderons. The current ABMA (American Bearing Manufacturers Association) standard does not specify Anderon as the unit.
When the radial vibration velocity of an outer ring [µm/sec.] is measured at an inner ring rotation speed of 1,800 rpm, we obtain the following relationship for each of the L, M, and H bands.

1 Anderon ≈ 7.698 µm/sec.

When the inner ring rotation speed is 1,800 rpm, each band ranges as follows:

L band: 50 to 300 Hz
M band: 300 to 1,800 Hz
H band: 1,800 to 10,000 Hz

Waviness

Waviness is a surface condition.
Vibrations in a rotating bearing are known to be closely linked to the waviness along the circumferential surfaces of bearing components, including the inner ring, outer ring, and ball/roller.
Waviness in a circumferential surface refers to fluctuations in the radii (radii from axis to surface). The amplitude of these fluctuations, however, has no correlation with absolute radii.
In the bearing component manufacturing process, waviness in circumferential surfaces must be measured and controlled to maintain adequate bearing quality.
Waviness is measured either by fixing the workpiece and rotating the sensor or by fixing the sensor and rotating the workpiece. We use the latter method.
Waviness is evaluated based on the value obtained after passing through a band-pass filter. The lower area of the band contains the evaluation of the shape, while the higher area contains evaluations of roughness. Various bands are used according to the intended bearing application.
The following units are used to quantify waviness:

µWcla: Micron Wcla
Mean value of waviness displacement in µm

µm: Micro meter
RMS value of waviness displacement in µm

µinch: Micro inch
RMS value of waviness displacement in µinch

µPC: Mu PC
Integrated absolute values of waviness displacement in µm

µm/rad: Micrometer per radian
RMS value for waviness displacement differentiated with respect to central angle

Roundness

Roundness is defined as the difference in radius between two concentric circles: The minimum circumscribed circle around and the maximum inscribed circle within the waviness or the surface of a sphere or ring. The following points are commonly used as centers of concentric circles.

LSC: Center of least squares circle: Center of the center circle of waviness
MZC: Center of minimum zone circle: Center of a circle that minimizes the waviness zone
MCC: Center of minimum circumscribed circle: Center of the smallest circle circumscribing waviness irregularities
MIC: Center of maximum inscribed circle: Center of the largest circle inscribed within the waviness irregularities

Our measuring systems display differences between the maximum and minimum values of waviness waveforms. This is the roundness obtained using the center of the least squares circle. The roundness curve is drawn based on the least squares circle, and roundness is measured by the same method as for waviness: The sensor is fixed, while the workpiece is rotated.
Our systems assess roundness by eliminating the eccentric component from actual measurements, including eccentric components based on the principle described above.

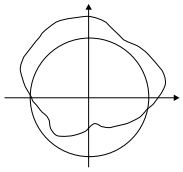


Figure 1: Graphic showing displacement including eccentric component

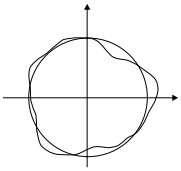


Figure 2: Graphic showing displacement without eccentric component

Displacement, velocity, acceleration, and crest factor

Our measurement systems uses a contact sensor and detects vibration and waviness as displacements of the sensor probe. The probe is connected directly to the coil in a magnetic circuit. A voltage proportional to the probe speed is generated between the coil terminals and is output by the sensor.
Velocity is obtained by differentiating displacement with respect to time. Acceleration is obtained by differentiating velocity with respect to time.
The following units are used to quantify vibration displacement.

µWcla, µm, µinch

Differential values of displacement with respect to angle are obtained by dividing velocity by rotation speed. In our measuring system, since a workpiece is rotated at constant speed, the differential value of vibration displacement with respect to the rotation angle is proportional to vibration velocity. A value expressed in any of the following units is proportional to vibration velocity:

Anderon, µPC, µm/rad

Mean value, RMS value, and peak-to-RMS ratio are used to express quantitative evaluations of vibration and waviness.

A mean value is obtained by folding up the waveform at an absolute value and dividing the area of the waveform by the length of the base. This value also indicates the mean amplitude of a waveform.

Mean values are expressed in the following units:

µWcla, µPC

An RMS value is the square root of a value obtained by dividing the squared waveform area by the length of the base. This value also indicates the mean amplitude of a waveform.

RMS values are expressed in the following units:

µm, µinch, µm/rad

The peak value is the maximum value in the waveform folded up at an absolute value. The crest factor is obtained by dividing the peak value by the RMS value.

SUGAWARA Laboratories Inc.

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SUGAWARA Laboratories Inc.

☐ Tokyo Sales Office: 8-2 Minami-Kurokawa, Asao-ku, Kawasaki, Kanagawa 215-0034, Japan
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For inquiries, please contact:

*Performance inspections of our Anderon meter

We assess performance by performing measurements with our sample workpiece at the client's site upon delivery. Please note that we will discuss workpiece and measurement conditions with the client before concluding the contract. If you would prefer to use your own workpiece, please have it prepared before the delivery date.

*We provide data measurement services based on our bearing inspection systems. For fees and other specifics, please visit our website.

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No.10NP0809

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