Instruction Manual

Analyzer A30 / Tester T30

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Measuring with A30 / T30

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Measuring techniques and other features	Tester T30 Basic	Tester T30 Logger	Tester T30 Expert	Analyzer A30 Basic	Analyzer A30 Logger	Analyzer A30 Expert
Shock pulse, dBm/dBc	●	●	●			
Shock pulse, HR/LR				●	●	●
Vibration severity, ISO 10816	●	●	●	●	●	●
Temperature measurement	●	●	●	●	●	●
Speed, contact and optical	●	●	●	●	●	●
Continuous reading	●	●	●	●	●	●
Data logging with Condmaster®Pro		●	●		●	●
Free value recording		●	●		●	●
Comment recording (Logger)		●	●		●	●
Check point record		●	●		●	●
Continuous recording		●	●		●	●
Vibration spectrum			●			●
Evaluated vibration analysis (Expert)			●			●

Basic, Logger and Expert versions

Both T30 and A30 are available in three different versions: Basic, Logger and Expert.

As before, the difference between T30 and A30 lies in the application of the Shock pulse Method for bearing condition monitoring: all T instrument versions use the dBc/dBc technique, and all A instrument versions use the LR/HR technique.

"Basic" measures vibration severity, shock pulses, speed and temperature. It has no data logging functions – measuring results are recorded manually. It can be set to continuous measurement but does not record the results shown on the display.

"Logger" measures the same quantities. In connection with the SPM software Condmaster®Pro, it gets its measuring instructions from a PC and uploads measuring results via cable to the PC. Thus, this version can also be loaded with comments and checkpoints as well as instructions for continuous recording of vibration, shock pulses, speed and temperature.

"Expert" has all the logger features. In addition, it uses the EVAM® method for vibration spectrum display and vibration analysis.

A "Basic" version can be upgraded to "Logger" and "Expert".

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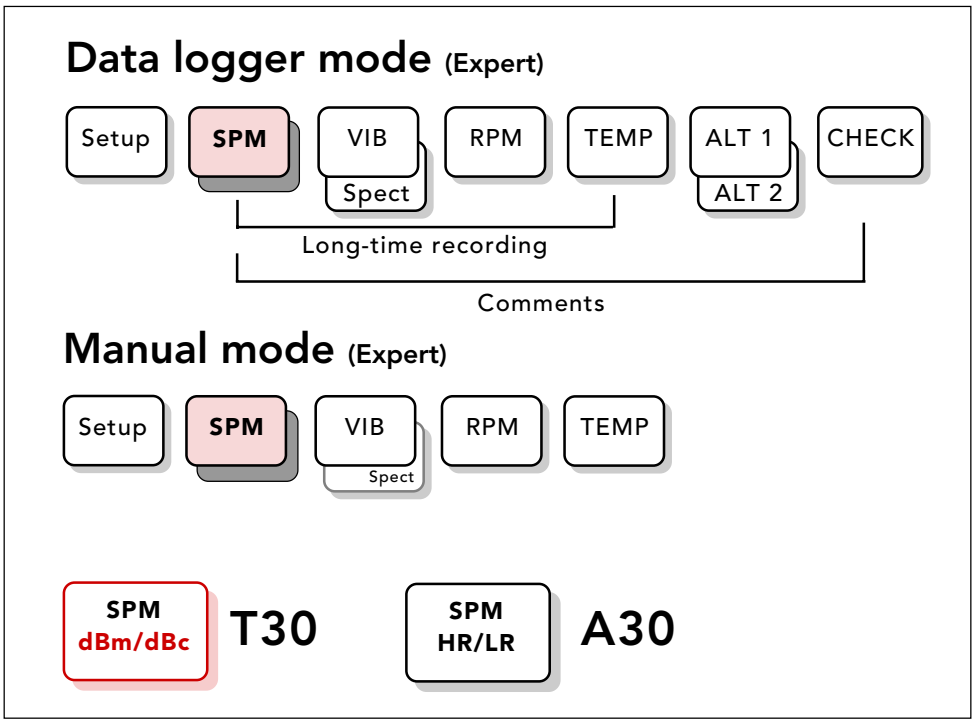


Functions in manual and data logger mode

The full potential of the measuring instruments is realized in the data logger versions. For some of the functions, the basic data cannot be input via the keypad but are saved in CONDMASTER ®Pro and downloaded from the PC.

Setup — General instrument settings such as time and display brightness. Selection of communication mode. Battery test. Instrument version.

SPM — Shock pulse measurement. **This is the function where T30 and A30 differ**. T30 uses the **dBm/dBc** technique, A30 the **LR/HR** technique.

VIB — Vibration measurement. The Expert versions have in addition to vibration severity (according to ISO), spectrum recording. The instrument displays the RMS velocity value for the selected range (3 – 200, 500, 1000, 2000, and 5000 Hz) and the 15 lines, in Hz or cpm, with the highest values. It transfers up to 200 lines to CONDMASTER®Pro, where you have graphical and evaluation functions.

RPM — Speed measurement. In manual mode, the display for this function is only shown when the speed probe is connected.

TEMP — Temperature measurement. In manual mode, the display for this function is only shown when the speed probe is connected.

ALT — Alternative measurement (Logger/Expert), which means recording, by manual input, a value (e. g. read from a dial or gauge) for a user defined quantity such as flow or pressure. Two input menus are available. In CONDMASTER®Pro, the temperature measurement, if used, occupies one of the input forms for an alternative measurement.

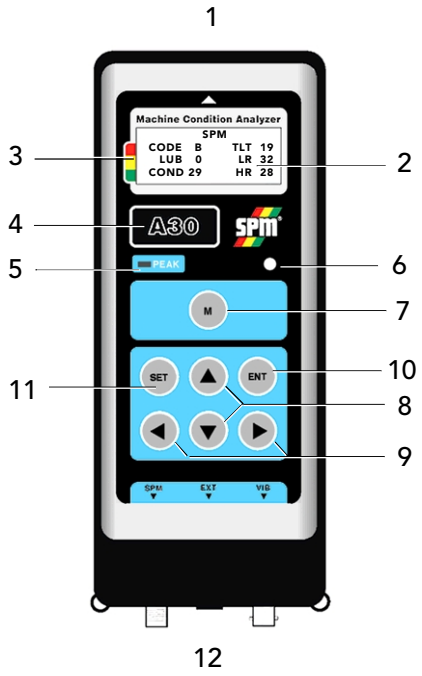
CHECK — Check point (Logger/Expert). A text from CONDMASTER®Pro saying what to check.

A list of comments and parameters for continuous recording can be downloaded to the Logger and Expert instrument versions.

Instrument layout

1 Proximity reader
2 Display 4x16 char.
3 Condition scale
4 Instrument type
5 Peak indicator
6 Light sensor
7 Measuring key
8 Up/down keys
9 Left/right keys
10 Enter key
11 Set key
12 Input connectors

ENT + M
Continuous read



Instrument layout, screen and keys

Holding down any key for a second switches on the instrument at the function last used. The display, 4 lines of 16 characters each, shows the active menu. Measuring techniques are selected with the RIGHT/LEFT arrows, measuring points (if loaded in logger mode) with UP/DOWN. Menus for RPM and temperature measurement appear when the respective probe is connected.

The green-yellow-red marking beside the display is the condition scale. After a normalized SPM or a VIB measurement with machine class input, an arrow points at one of the colours.

PEAK is a light indicator active during SPM measurements. The round window opposite to the right is a light sensor controlling the LED backlight of the display. At the top, an arrow marks the position of the proximity reader receiving the ID data from coded measuring points.

The functions of the keypad vary, depending the active menu. The instruments now contain too many functions to limit each key to a single action. The exception is the M key, used exclusively to start measurements.

Pressing the keys M and ENT simultaneously starts **continuous reading**. The measuring results are being updated until any key but M is pressed and held down to interrupt this mode.

The ENT key confirms selections, saves values and settings, and leaves functions. The other keys are mainly used to move between or within displays. UP/DOWN increases/decreases marked values.

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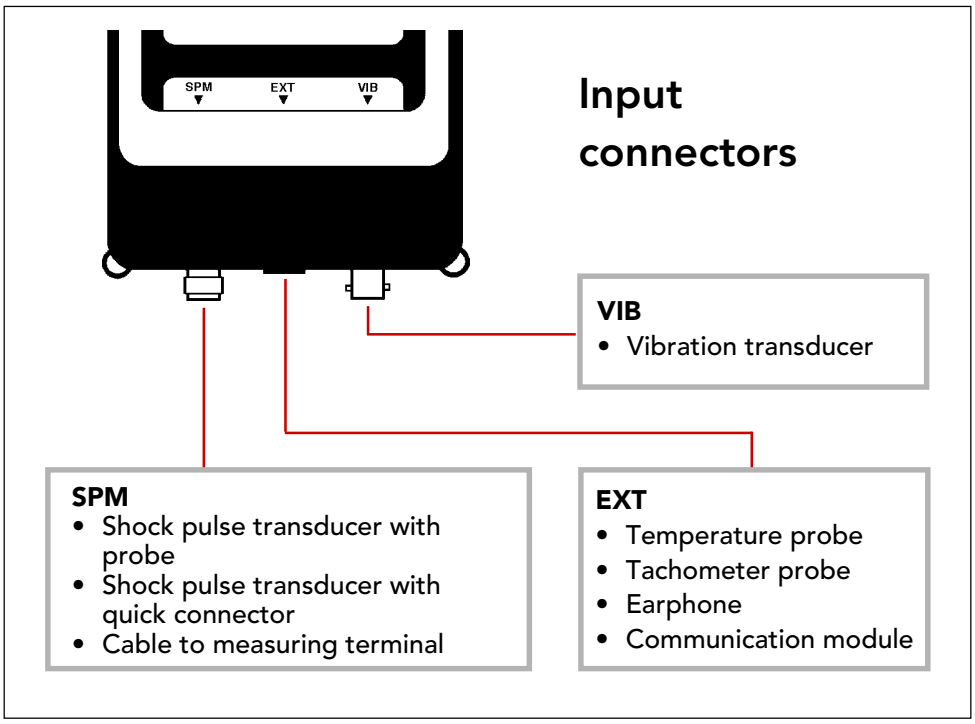


Instrument layout, inputs

The instruments have three different input connectors:

SPM A TNC connector receiving a shock pulse transducer (probe, quick connect transducer, or a cable to a measuring terminal.

EXT A modular jack receiving temperature probe, tachometer probe, earphone, and the cable to the communication module for data transfer.

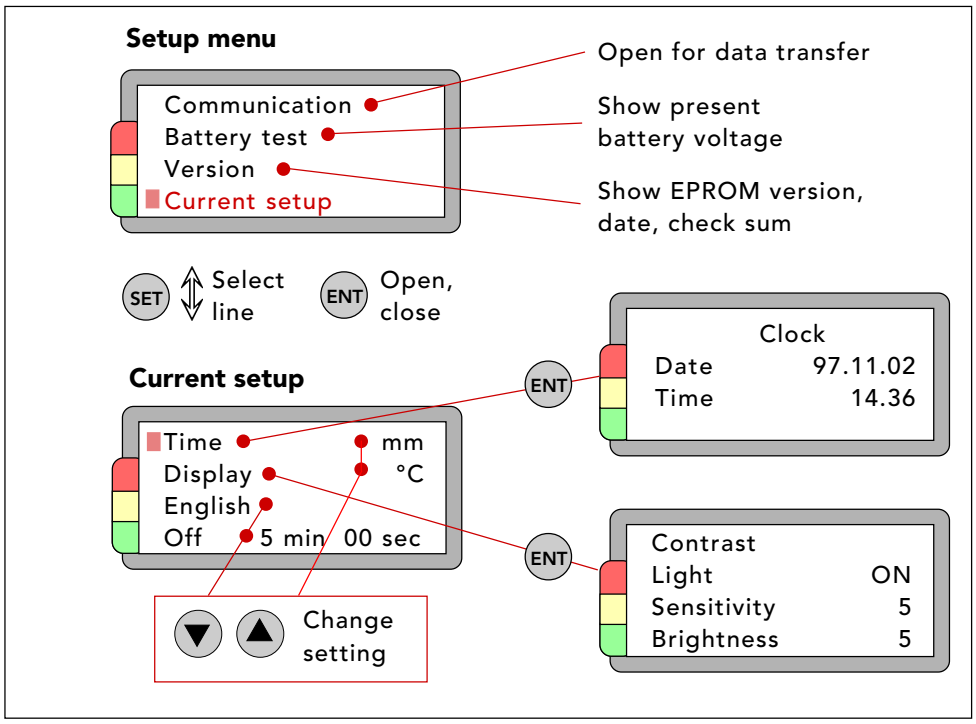
VIB A BNC connector receiving vibration transducer.

The instruments can monitor the connected SPM transducer type, e. g. a shock pulse transducer with or without transducer matching unit TMU, and react accordingly.

In data logger mode and for long-time recording, three transducers can be simultaneously connected: SPM, VIB, and either temperature or tachometer probe. The display shows measuring points and measuring techniques in the order they are downloaded, and you can scroll through the list without disconnecting a transducer.

In manual mode, you can have both a shock pulse and a vibration transducer connected all the time. The display switches to the respective function when a temperature or tachometer probe is connected. To leave the function, disconnect the probe.

During SPM measurements you can connect the earphone and switch between SPM measuring and earphone mode.



General setup

General instrument functions are available under the setup menu, selected with the LEFT/RIGHT arrow keys. Use the SET key to mark the desired function, the ENT key to open, save, and close.

Battery test and **Version** show data, there is nothing to adjust.

A number of display **languages** are permanently stored. Mark the language line and use UP/DOWN to scroll through the available languages and display the language you want.

The line **Off** shows the time which elapses between pressing any key and automatic power off. When the line is marked, UP/DOWN changes the time in 10 second intervals.

Bearing diameters can be displayed in either **mm** or **inch**, and vibration velocity in mm/s or inch/second. Use SET to go past the Off line to the length measuring unit and change with UP or DOWN. At the following position, you can toggle between the temperature units **°C** and **°F**.

The settings under Current setup are saved when you press ENT to leave the menu.

The menus for communication, time and date setting, and display adjustment are described separately.

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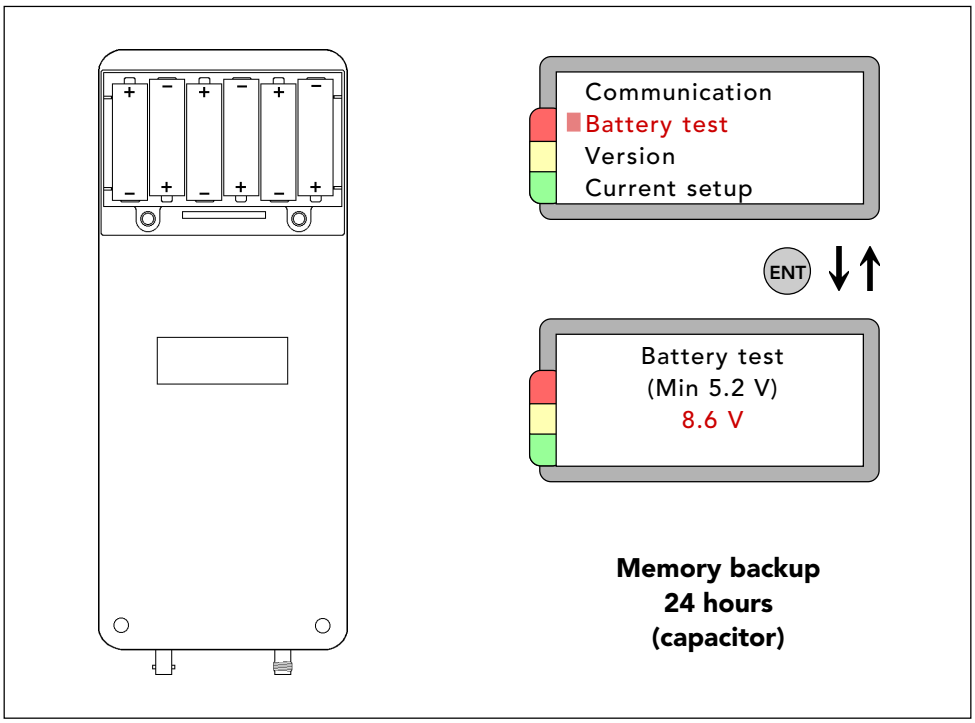


Batteries

The instruments are powered by 6 batteries type MN 1500 LR6, 1.5 V. The battery compartment is located at the back and fastened by two screws. Pull off the protective cover to reach the screws.

The Battery test on the setup menu shows the present battery voltage. A low battery warning is given at 5.1 V. At this stage, only ongoing data transmission works, while the display shows "Battery low".

Memory and clock are protected for approx. 24 hours by a capacitor. If you replace the batteries within that time, you will not lose any data.

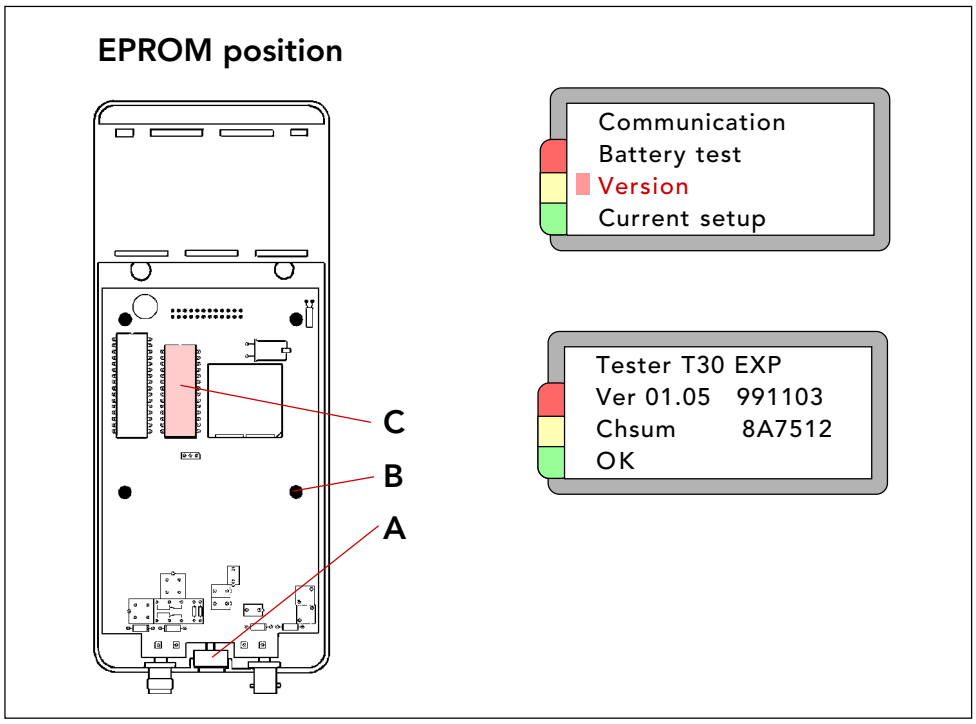
The battery life depends on how the instrument is used. Full power is only consumed while a reading is in progress: from pressing the M key until a measured value is displayed.

Battery life (with high effect cells , backlight off) is about 1 year with power off, else specified as follows:

Typical readings: 5000 measuring points, using several techniques/point. This is based on an average measuring time of 1 min./point, without backlight. A single measurement takes approx. 2 - 10 s, here the calculation is based on 10 seconds/measurement.

Continuous read: At least 50 hours.

Before long-time storage, keep in mind to remove the batteries.



EPROM and memory

The instrument program is contained in an EPROM on the lower circuit board. **Version** on the **setup** menu shows instrument type plus EPROM version and date.

To exchange the EPROM (in case of an update), the instrument casing is opened by removing two screws at the input connector end, rear side, and lifting off the lower part of the casing. The connector (A) is pulled off and the upper circuit board unscrewed (B). The EPROM (C) is carefully levered out of its socket with a small, flat screwdriver and carefully replaced with the new version.

The memory capacity is 128 kbyte. How this translates into the number of measuring points and measuring results that can be stored in a data logger depends mainly on two factors:

- length of measuring point number and name
- number and kind of measuring techniques used per point.

The upper limit is 999 measuring points, because the running number of the point in the round is 3 digits long. Using 6 measuring techniques per point, the typical number is 500 measuring points. At a measuring time of one minute per point, that is more than enough for a working day. In practice, measuring rounds are normally much smaller.

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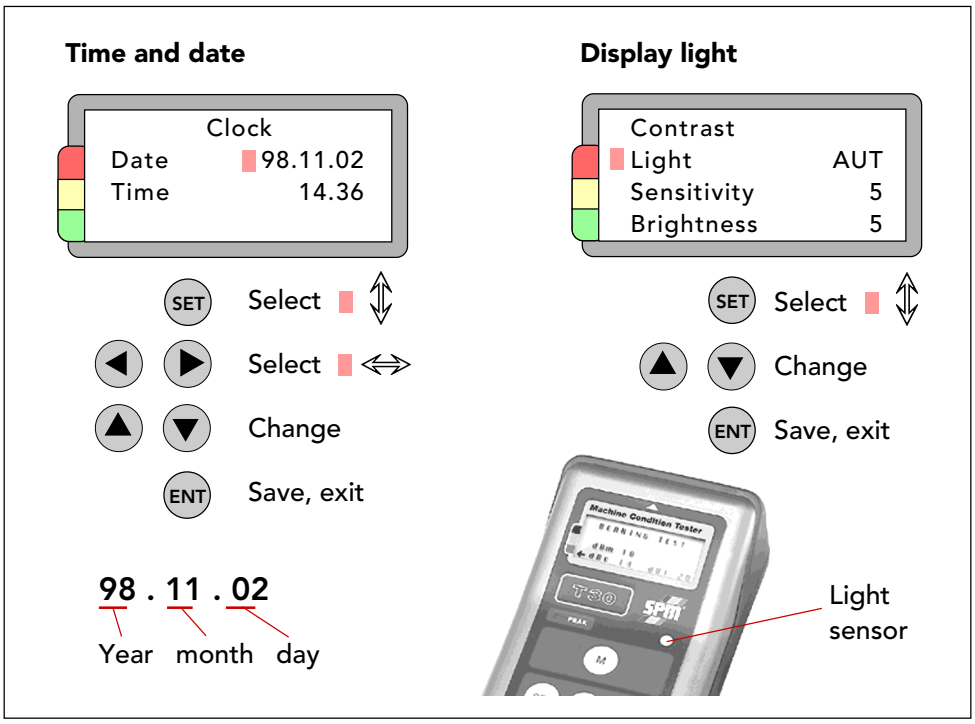


Time and display light

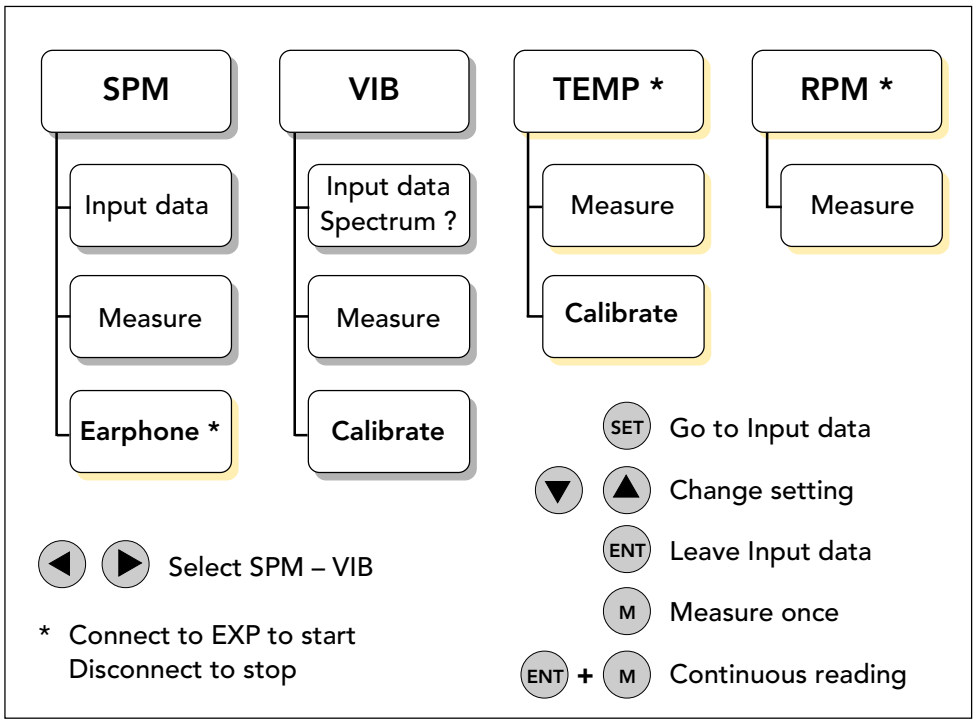
The date format is fixed and cannot be adjusted to the format used in COND-MASTER. It is YY.MM.DD, i. e. the last two digits of the year followed by month and day. The time display is from 00.00 to 23.59. Pressing and holding down one of the UP/DOWN keys changes the marked number. The clock is year 2000 compliant.

For data loggers, the time of the instrument must be adjusted within 5 minutes of the PC's time.

On the menu for display adjustment, the line **Contrast** controls the appearance of the normal instrument display, without backlight. Use the UP/DOWN keys to adjust the setting in normal light.

The line **Light** controls the backlight. You can toggle between AUT (automatic) and OFF. On automatic, the backlight is switched on by the action of the light sensor above the keypad. The **Sensitivity** of this sensor is set on the third line, on a scale of 1 to 9. In the same way, the brightness of the backlight is set on the fourth line. For fine adjustment, you make the settings in bad light.

Please note: With the backlight on, the instrument draws approx. 30% more power. Do not cover the sensor when measuring – if on automatic, that will switch on the backlight.



Manual measuring mode

In manual mode, you can measure shock pulses (SPM), vibration severity (VIB) including a spectrum, temperature, and speed. The shock pulse and vibration transducers can be connected simultaneously, and you do not have to disconnect them to use the input EXT. You select either method with the LEFT/RIGHT arrows.

When measuring shock pulses, you can connect the earphone to EXT. Connecting the temperature or tachometer probe to EXT automatically changes the display to the respective measuring mode. To leave this mode, disconnect the probe.

For SPM and VIB, you have to input basic data. For this, you press the SET key and move the cursor with RIGHT/LEFT to the number you want to change. UP/DOWN changes the number, ENT saves and allows you to start a reading with the M key.

For continuous reading, first press and hold down ENT, the press M. To stop, hold down any key (except the M key) for about half a second.

Beneath the VIB display, you have two more displays where you can define a spectrum measurement and calibrate the vibration transducer.

Beneath the TEMP display, you have a displays where you can calibrate the temperature probe tip.

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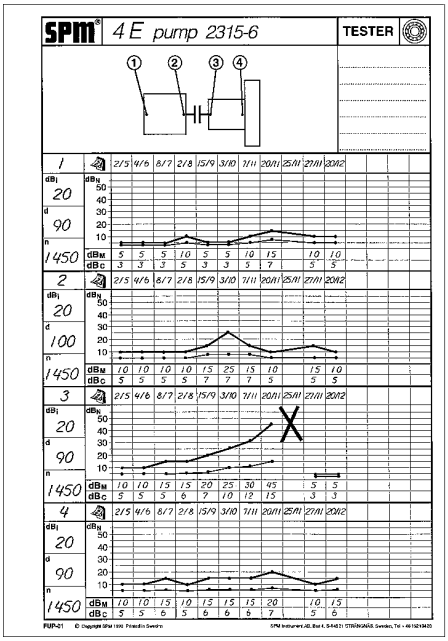
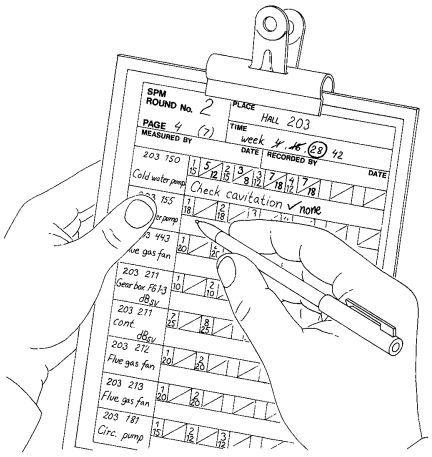


Follow-up form for condition monitoring in manual mode



Record keeping and measuring intervals

In manual mode, you cannot save more than one measuring result (always the last reading taken) for each measuring technique.

For systematic condition monitoring, you have to keep records. The development of measured values over a period of time is a much better basis for the planning of repairs and maintenance than the result from a single reading.

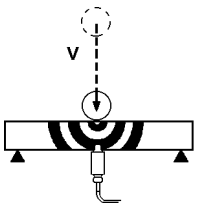
If you do not have CONDMASTER®Pro, you can use an SPM follow-up form for recording shock pulse and vibration readings. There is one form for the data from a T30, and another for the A30.

Bearing and vibration condition should be measured at regular intervals of 1 to 3 months while machine condition is normal.

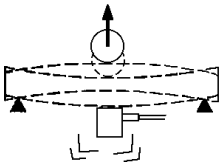
If you see that the results from a measuring point are getting higher, you check for the causes and also shorten the measuring intervals. It is difficult to recommend exact times, because all depends on how important the machine is and how fast its condition deteriorates. Bearings with high but stable shock values can last for a long time.

A slow increase of vibration severity is often a sign of wear and no cause for immediate worry. However, especially on fans you can expect a sudden dangerous unbalance (e. g. rotor blade breaking or shedding a layer of dirt/soot). Machines with such problems need a permanent surveillance and often an automatic shutdown device. Read more details in the chapters on the monitoring methods.

Results of an impact:

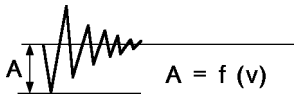


Event 1: a shock wave spreds through the material

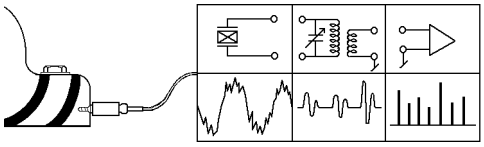


Event 2: the body vibrates

Shock pulse measurement:



1. Shock waves converted to electric pulses



2. Pulse magnitude is measured, vibration filtered out

SPM - shock pulse measurement

The Shock Pulse Method for bearing condition monitoring (SPM) is described in its own chapter. This is a short and simplified summary of some important facts needed to understand the basic input data for bearing monitoring as well as the nature and use of the shock pulse transducers.

- Shock pulses are caused by impacts. An impact is a single event: one body hitting another body once. It is not a constant force. It can be repeated at regular intervals in time, but is often not. In a bearing, typically the impacts occur at random (and extremely short) intervals.
- The impact sends a shock wave through the material of both bodies. Vibration comes as a second stage. In the SPM transducer, vibration is filtered out.
- The shock pulse transducer reacts to the amplitude of the wave front at its own resonance frequency. This magnifies the low energy signal. Only the wave front is measured, causing one shock pulse from the transducer.
- The amplitude of the wave front is a function of impact velocity. This means, bearing and operating condition being equal, the higher the rpm, the higher the shock level. Because the rotational speed of the bearing depends on both its size and the rpm, both are needed as input data.
- Shock pulses are transient signals. They lose their energy on the way through the material of the machine. Also, they are reflected from surfaces and severely dampened by interfaces in the material. That is why we need defined measuring points.
- All impacts cause shock pulses. You must make sure that you are measuring a signal from the bearing.

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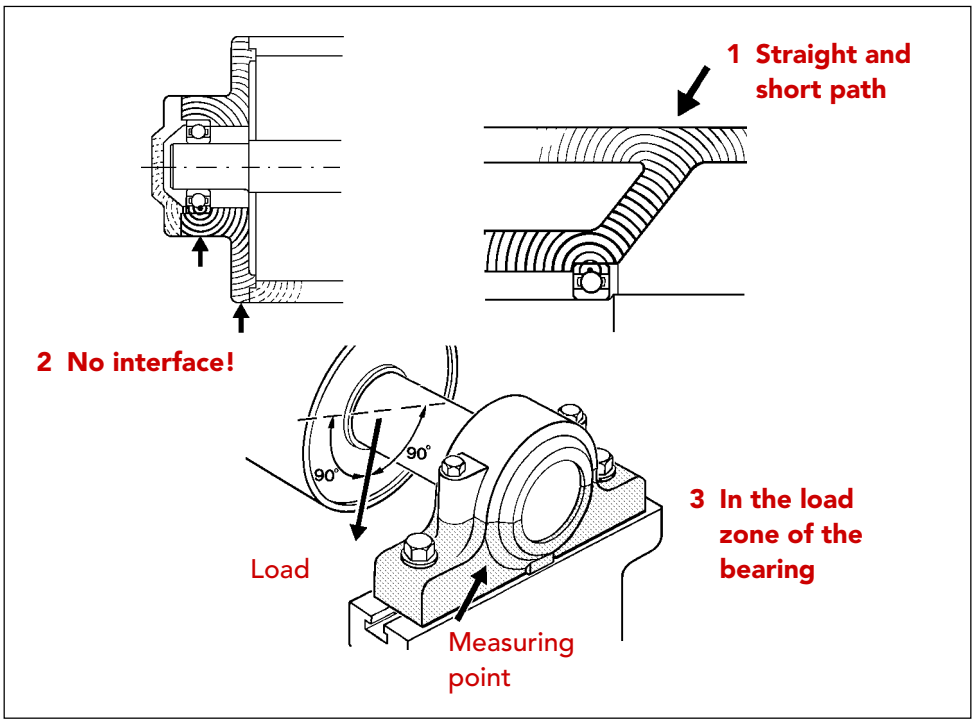


SPM measuring points

The rules for the selection of SPM measuring points have a very practical purpose. We are trying to catch low energy signals which are getting weaker the farther they travel and the more they are bounced about inside a piece of metal. We know that they lose strength when they cross over from one piece of metal to another (oil between the pieces helps). We cannot know, for all bearing applications, how much of the strength of the signal emitted by the bearing will reach the measuring point. However, of necessity we try to apply general evaluation rules, i. e. treat all measured signals as if they were of the same quality.

The rules for SPM measuring points try to assure that most of them are, with sufficient accuracy, and that the green-yellow-red condition zones are valid:

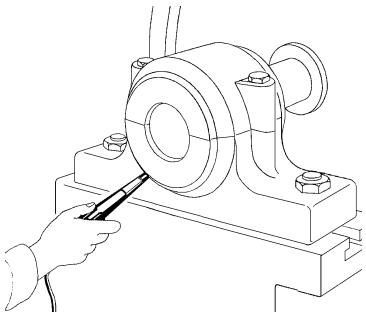
1 **The signal path between bearing and measuring point shall be as short and straight as possible.**

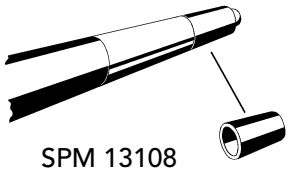
2 **The signal path must contain only one mechanical interface, that between bearing and bearing housing.**

3 **The measuring point shall be located in the load zone of the bearing.**

Short means up to 75 mm (3 in.), but that depends also on how straight the path is: bends cause re- and deflections whose effect is hard to judge. The load zone is the load carrying half of the bearing housing, normally the lower one. Allow for the pull of belts or other forces which can shift the load to one side. Use the probe to find the spot yielding the strongest signal. When a measuring point cannot conform to the rules (because an ideal spot cannot be reached), make allowance for a weaker signal. If you measure with a A30, you have the COMP no. to compensate for weak signals, but must still try to find a good point.

Transducer with probe



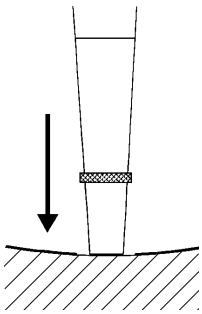


SPM 13108

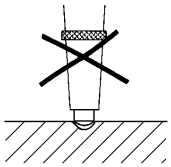
Neoprene, 110° C (230° F)

Rubber sleeve in contact with the surface

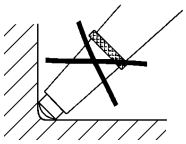
Point at the bearing



Hold steady



Avoid small cavities and fillets



Shock pulse transducer with probe

All three types of shock pulse transducers are connected to the TNC connector marked SPM. The choice of transducer type depends on how the measuring point is prepared. For systematic shock pulse monitoring, SPM recommends the use of installed adapters and quick connect transducer wherever possible.

Measuring points for the hand-held probe should be clearly marked. Always measure in the same spot. In addition, the probe is used to measure elsewhere on the machine, in case it is necessary to search for other shock pulse sources such as pump cavitation or rubbing parts.

The probe tip is spring loaded and moves within a sleeve of hard rubber. To maintain a steady pressure on the tip, press the probe tip against the measuring point until the rubber sleeve is in contact with the surface.

Hold the probe steady to avoid rubbing between probe tip and surface.

The probe is directionally sensitive. It has to be pointed straight at the bearing.

The centre of the probe tip should touch the surface. Avoid pressing the probe tip against cavities and fillets which are smaller than the probe tip.

The only part likely to wear out is the rubber sleeve for the probe tip. It is made of chloroprene rubber (neoprene) and tolerates 110° C (230° F). Spare sleeves have the part number 13108.

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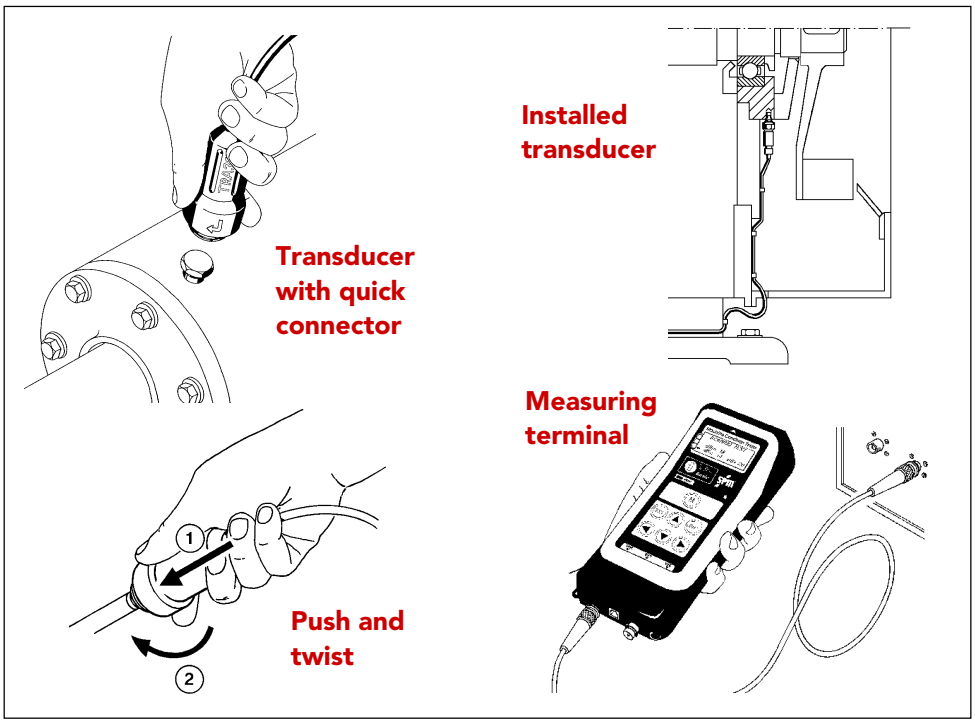


Transducer with quick connector, terminal

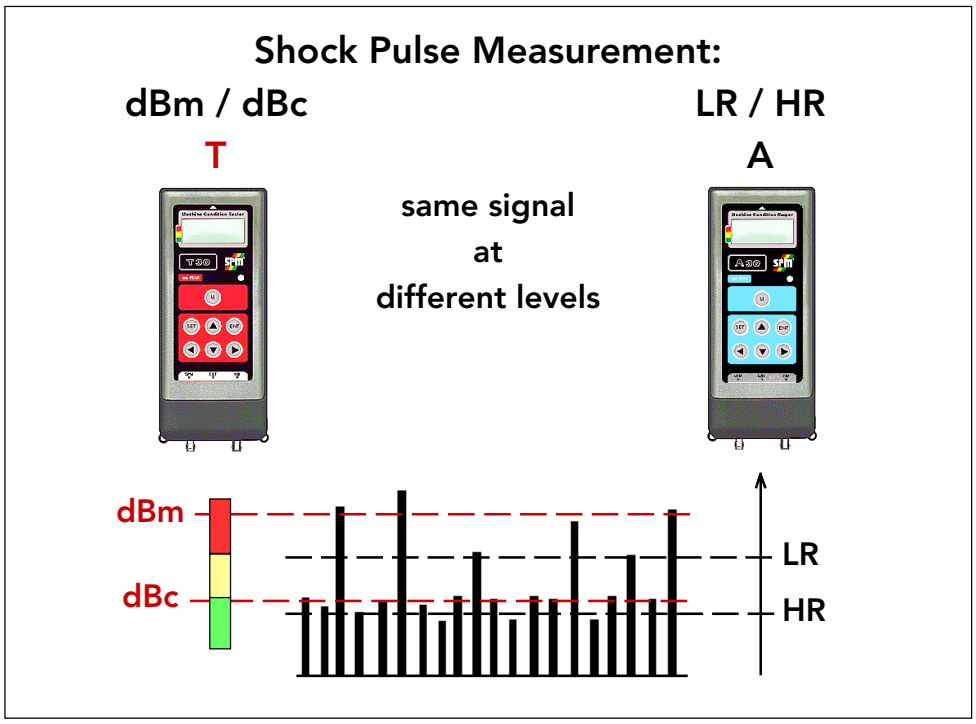
For systematic shock pulse monitoring, the installation of shock pulse adapters is recommended. Adapters are solid metal bolts of different length and thread sizes, tuned for correct signal transmission. They are installed in threaded, countersunk mounting holes on the bearing housings. Glue-on adapters are available.

To attach the transducer with quick connector, press it against the adapter and twist clockwise. Twist counter-clockwise to remove it.

Adapter surfaces must be clean and plane. Use an adapter cap to protect them.

A permanently installed transducer and a measuring terminal (BNC or TNC connector) are used when the bearing cannot be reached directly. Use a measuring cable to connect instrument and terminal.

Check that installed transducers and adapters are properly mounted (see the chapter on SPM installations) and in good condition. You cannot expect a useful signal by attaching the quick connect transducer to a rusty lump of metal, or from a transducer that is rolling on the floor on the other side of a partition.



The difference between T and A

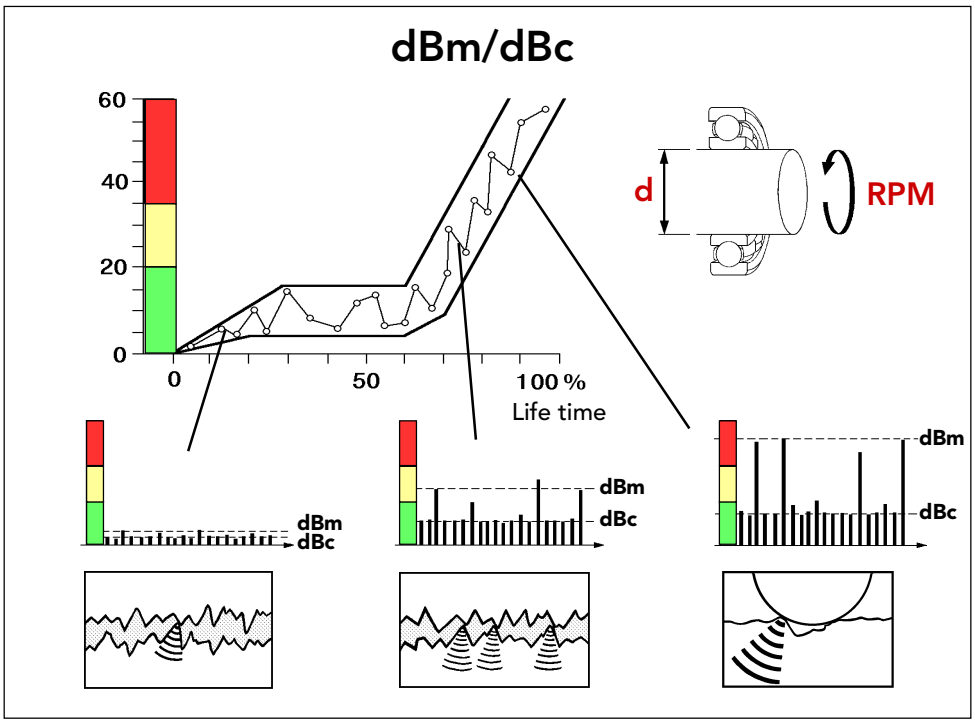
The difference between Tester and Analyzer lies in the parameters used to describe and evaluate the signal from a shock pulse transducer. If you are using a Tester, read the next pages. The description of shock pulse measurement with the Analyzer A30 starts on page 23.

The signal you measure consists of a train of stronger and weaker electric pulses, analog to the shock pulses emitted by the source. SPM has developed two quantifying techniques for this shock pulse pattern.

The Testers (T) use the dBm/dBc technique. The dBm is a maximum value defining the strongest pulse in the time window. It is the indicator for bearing damage. The dBc or carpet value is read at the level where about 200 pulses/second are registered. It is the indicator for lubrication condition. Both values are measured on a normalized decibel scale. Normalized means that the scale is adjusted with regard to the basic bearing data: shaft diameter and rpm. Thus, measured with a Tester, dBm and dBc are already evaluated and express bearing condition.

The Analyzers (A) uses the LR/HR technique. LR (from "low rate of occurrence") is an average value of the stronger pulse in the measuring window. It corresponds to but is not equal with the maximum value. HR (from "high rate of occurrence") is read at the level where about 1000 pulses/second are registered. It corresponds to but is not equal with the carpet value. Both are "raw data", measured on an unnormalized decibel scale. The evaluation produces three results:

CODE A-D (describing condition), the LUB no. (for lubrication condition), and the COND no. (indicating damage severity). You can also get different error codes.



The dBm/dBc technique [Tester T30]

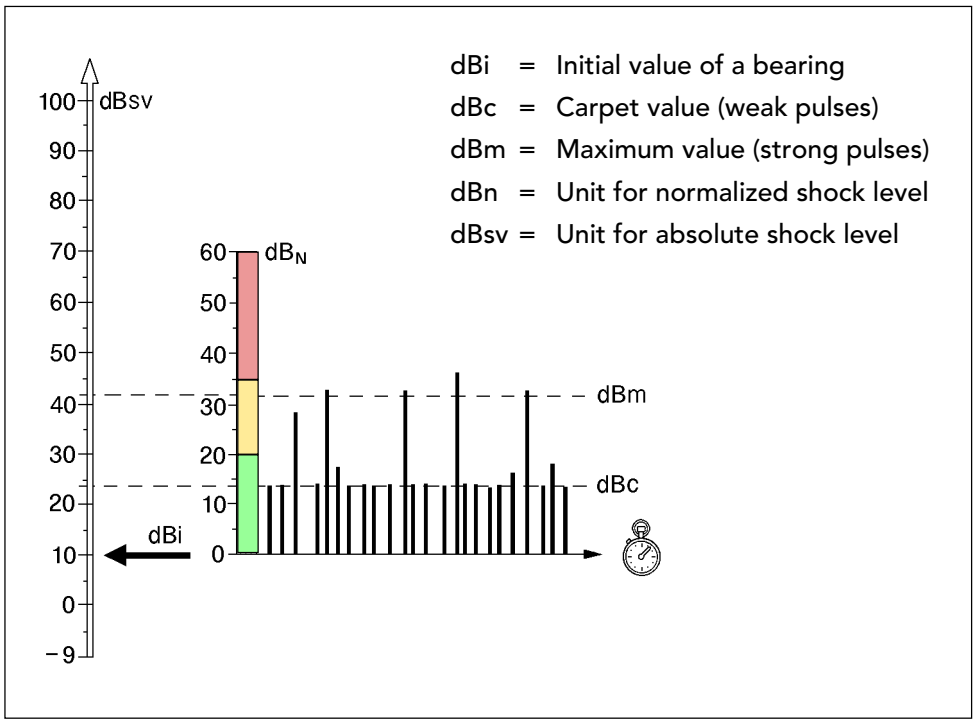
The dBm/dBc technique has been successfully applied for more than 30 years (instruments 43A, T2000, T2001) and continues to be widely used. It is well suited for industrial condition monitoring, because it works with few, easy to understand in- and output data and with "reasonable accuracy".

Even on a logarithmic scale, there is normally a large, distinct difference between the maximum values from good and bad bearings. Thus, minor inaccuracies in the input data (rpm and shaft diameter) have little effect on the evaluated measuring result.

Lubrication condition is indicated by the delta value, i.e. the difference between dBm and dBc. High readings and a small delta value indicate poor lubrication or dry running. This is sufficient for maintenance purposes.

dBm and dBc are now measured in a fixed time window and automatically displayed. After that, the instrument continues to measure while the transducer is connected. The peak indicator blinks when pulses stronger than the displayed level are detected.

The earphone is used to listen to the shock pulse pattern in case of suspect or high readings. This, and the possibility to search for shock pulse sources with the probe transducer, is a means to verify the measuring result and its cause.



Normalized and unnormalized readings [T30]

The absolute shock pulse level of a bearing, measured in dBsv (decibel shock value), is both a function of rolling velocity and of bearing condition. To neutralize the effect of rolling velocity on the measured value, the T30 has to be programmed with shaft diameter (in millimetre or inch) and rotational speed (in rpm).

The T30 will then calculate the **initial value dBi**, the starting point of the condition scale for a particular bearing. You can also input the dBi directly. The condition scale is graded in **normalized** shock values, dBn.

The T30 takes a sample count of the shock pulses occurring over a period of time and displays:

- the **maximum value dBm** for the small number of strong shock pulses.
- the **carpet value dBc** for the large number of weaker shock pulses.
- an arrow against a field on the condition scale: green for dBm up to 20 dBn = good condition, yellow for 21-34 dBn = caution, red for 35 dBn and more = bad condition.

The maximum value dBm defines the bearing's position on the condition scale. The difference between dBm and dBc is used for a finer analysis of the causes for reduced or bad condition.

When you set the dBi to "--" (below -9), the T30 will take an **unnormalized** reading, in dBsv (absolute shock values). The condition zones do not apply. This method is used for comparative reading on different bearings and/ or other shock pulse sources.

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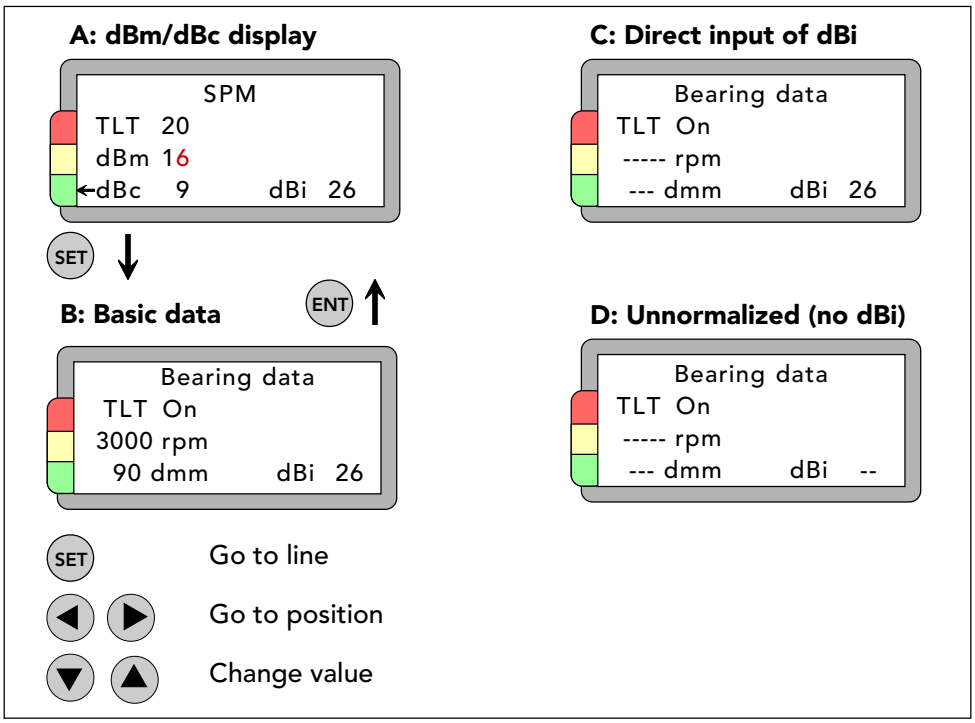


Input data [Tester T30]

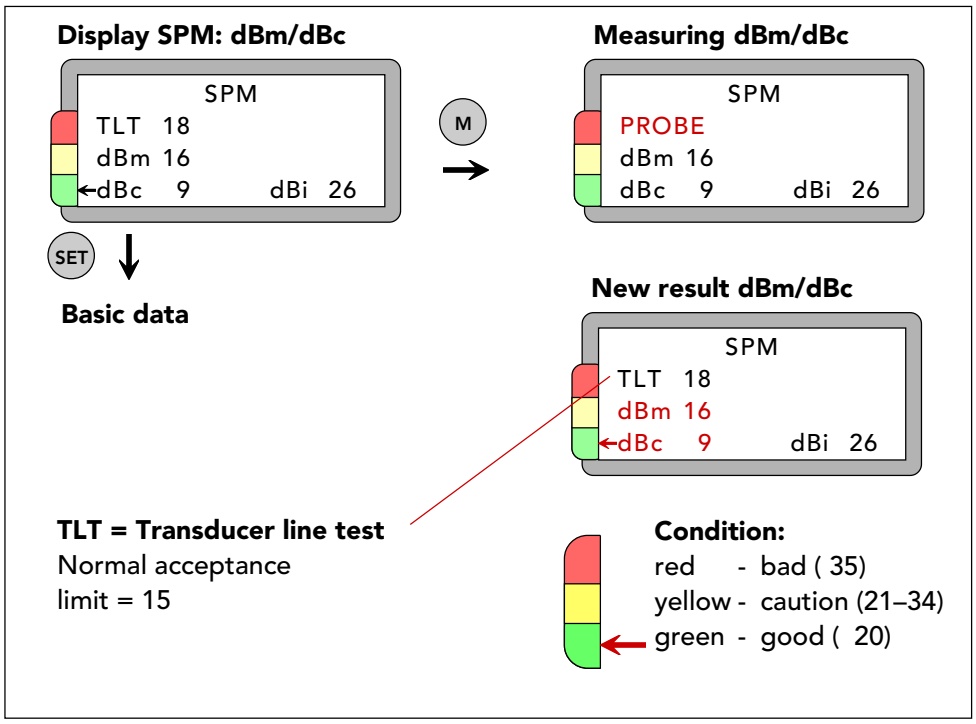
For shock pulse measurement, you go to the SPM menu (A) with RIGHT/LEFT. The SET key takes you to the display of the basic data for the bearing (B).

For a normalized reading of bearing condition with a T30, you need the initial value dBi. Given the rotational speed (rpm) and the shaft diameter d, the T30 will calculate and display the dBi. The figure under (B) shows the setting when you input the rpm and the shaft diameter (here in mm). If you change the dBi directly, which is faster when you know it from your records, you see the display shown under (C).

For unnormalized readings, you scroll the dBi down past -9 to "--", as shown under (D). You will then measure in dBsv (absolute shock values) and get no condition indication.

To change the setting, you step to the line with SET. RIGHT/LEFT moves the cursor to individual numbers, UP/DOWN scrolls the number and toggles TLT on/off. SET brings you to the next line, and ENT back to the SPM menu.

When TLT test is on, the instrument will display the result of a transducer line test on the display for data input, so you can check the quality of signal transmission between transducer and instrument. This is used when you measure with permanently installed transducers. Values below 15 are not acceptable and you have to check cables and connectors for bad connections and moisture. When values deteriorate from a previously higher level you should also check the tranducer line.



SPM measurement [Tester T30]

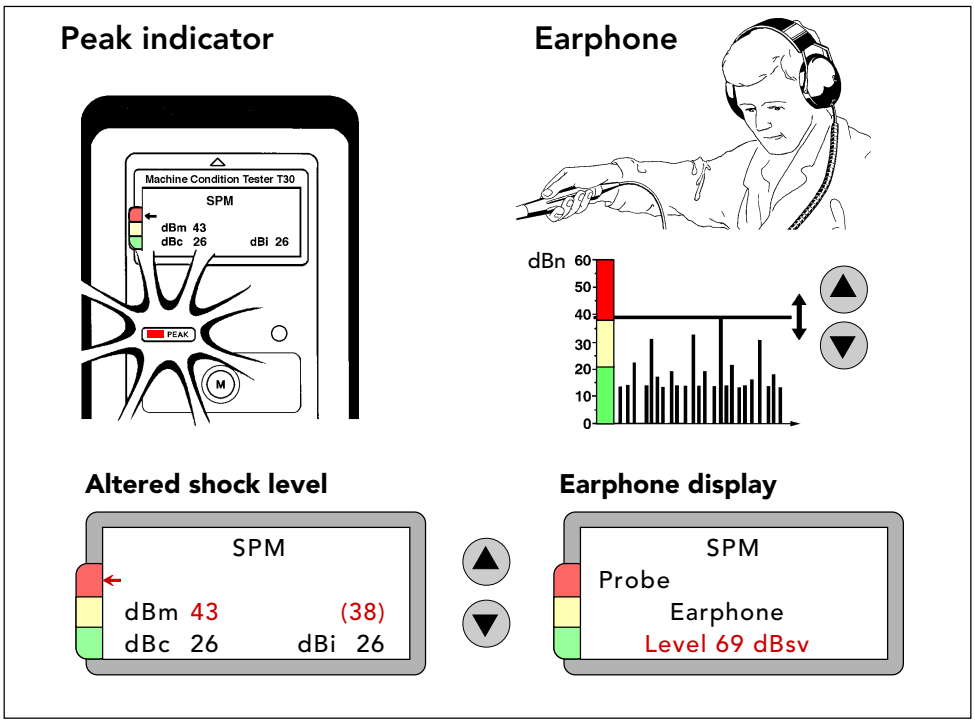
Back in the SPM menu, you can connect the transducer to the measuring point and press the M key to start a measurement. It takes approx. 2 - 10 seconds, during which the connected transducer type is displayed: PROBE for hand-held probe, TRA for the quick connect transducer and the standard 40000 transducer, TMU for a transducer matching unit in the transducer line.

The two measuring results are the maximum value dBm and the carpet value dBc. Depending on the dBm value, an arrow will point at the green, yellow or red field of the condition scale.

When TLT test is on, the instrument will also display the result of a transducer line test. At TLT-values from 15 upward, there is normally no signal loss due to a faulty transmission between transducer and instrument. If the value is below 15, or if it is deteriorating from a previously higher value, you have to check cables and connectors for poor connections and moisture.

When you get high readings (yellow and red zone), you should immediately verify their nature and probable cause. Do not give the verdict "bearing damage" before making a further investigation. As a first measure:

- see if the peak indicator is blinking.
- use the earphone to identify the shock pulse pattern.
- use the probe transducer to measure on and outside of the bearing housing to identify the shock pulse source.



Peak indicator and earphone [Tester T30]

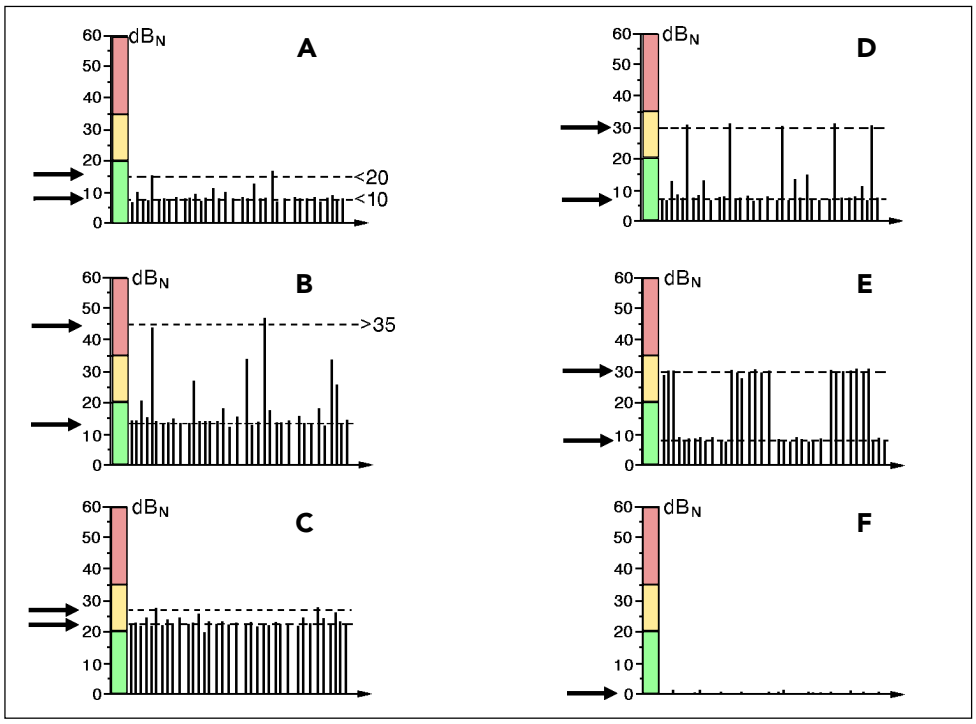
The stream of shock pulse from a rotating bearing is, of course, continuous. Their strength varies all the time, depending on the relative positions of rolling elements and raceways.

A spot of surface damage causing a strong shock pulse will only register, if a roller hits it during the measuring interval. Especially at low rotational speeds, the instrument can miss the strongest pulse, simply because it does not occur during the measuring interval. The **peak indicator** helps you to catch it.

While the transducer is connected, the instrument continues to measure after displaying a result. The peak indicator blinks each time it registers a pulse stronger than the displayed value. With a T30, you can change the measuring threshold with the UP/DOWN keys to a level where the indicator stops blinking. The level is shown in dBm position (as normalized shock value in dBn). The measured dBm is shown in brackets.

The **earphone** is a means to verify and trace shock pulse sources. The earphones allows you to listen to the shock pulse pattern. When you connect the earphone to the EXT input, you get the earphone display, showing shock level in dBsv (unnormalized). With the UP/DOWN keys you can manipulate the measuring level. To go back to normal measuring mode, disconnect the earphone.

In the earphone, the noise carpet is represented by a continuous tone. The dBc level is approximately where you can start to distinguish between an even sound and individual pulses. Do not worry about getting this setting exactly right – you cannot fail distinguishing between a high and a low noise carpet.



Different shock pulse patterns

The **earphone** is a means to verify and trace shock pulse sources. The signal from a bearing should be highest on the bearing housing. If you get a higher signal outside of the bearing housing (across an interface in the material), you are most likely measuring shock pulses from another bearing or some other source. Typical for a bearing signals is that the stronger shock pulses, best heard a few dB below the peak level, appear at random intervals.

A For a good bearing , the dBm is within the green zone. dBm and dBc are not close together.

B The shock pulse pattern from a damaged bearing contains strong pulses in the red zone, a random sequence, and a large difference between dBm and dBc. When you grease lubricate the bearing, the values should drop but rise again.

C A dry running bearing has a high carpet value very close to the dBm. When you grease lubricate the bearing, the values should drop and stay low. A similar pattern is caused by pump cavitation, in which case readings on the pump housing are stronger than those taken on the bearing housing, and are not influenced by lubricating the bearing.

D A regular pattern, containing burst of strong pulses in a rhythmic sequence, is caused by e.g. scraping parts.

E Individual pulses in a regular sequence are cause by clicking valves, knocking parts, regular load shocks.

F A sudden drop in the shock pulse level is suspicious. Check your measuring equipment. If the reading is correct, you may have a slipping bearing ring.

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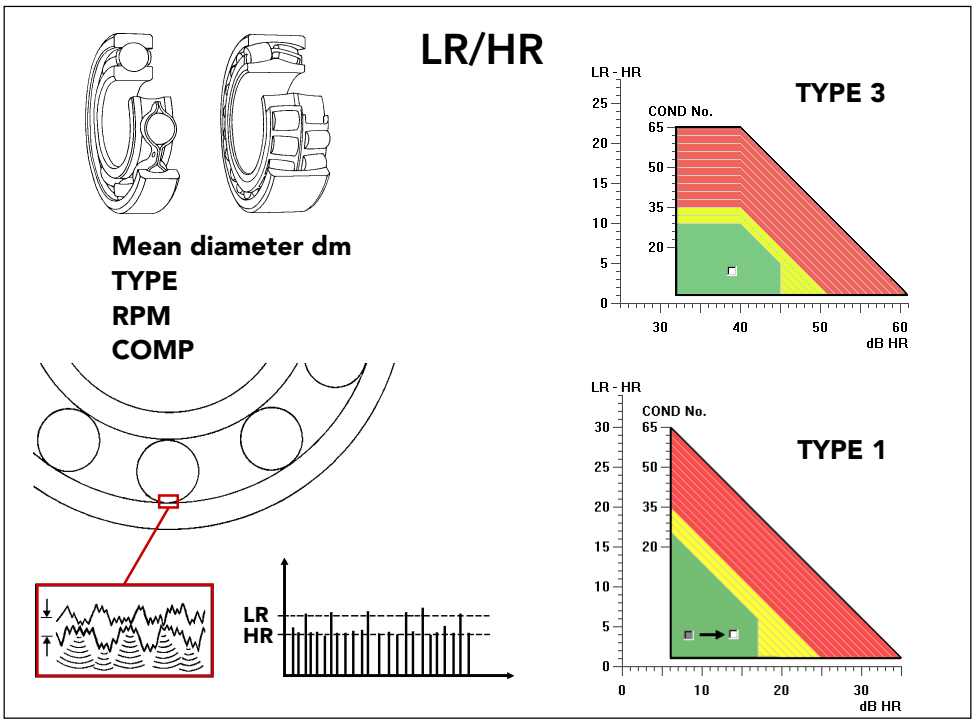
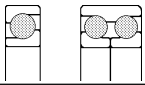
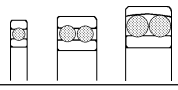
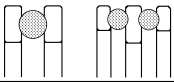
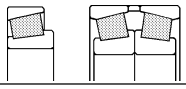
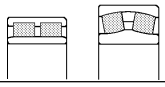
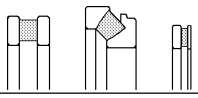


The LR/HR technique [Analyzer A30]

The LR/HR technique was originally developed for a continuous, automatic monitoring system (CMS). An automatic system can not, like a human operator, vary measuring time, use earphones or make "further tests" to verify suspect readings. It works with fixed settings and is dependent on accurate input data. This, together with new research results, programmable chips, and the desire to get more detailed information from the shock pulse signal, lead to a change in the threshold values, plus a more diverse and detailed output.

The value for the noise carpet (HR) is read at an occurrence rate of approx. 1000 pulses/second, the value for the strong shock pulses (LR) at approx. 40 pulses/second. This makes LR an average value of the strong pulses, lower than the maximum, and thus reduces the dynamic range. To increase accuracy, the mean diameter of the bearing is used, the SPM TYPE no. is input to define bearing geometry, and the COMP no. to calibrate the individual measuring points.

The extra output information concerns mainly lubrication condition, allowing the user to attack a mayor maintenance problem (most bearings fail too soon because of inadequate lubrication) at the root. With SPM's LUBMASTER® (part of CONDMASTER®Pro versions for this technique) and LR/HR readings, it is possible to accurately measure lubrication condition, calculate the resulting L_{10a} life, and work out feasible improvements by simulating changes in the lubricant parameters.

	1 Deep groove ball bearings, series 62, 63, 64
	2 Angular contact bearings, all series
	3 Deep groove ball series 60, 160, 618, double row and self-aligning ball bearings
	4 Thrust ball bearings, all types
	5 Cylindrical roller bearings, single row
	6 Taper roller bearings, all radial types
	7 Spherical roller bearings Double row cylindrical roller bearings
	8 Thrust roller bearings

Basic data for SPM [Analyzer A30]

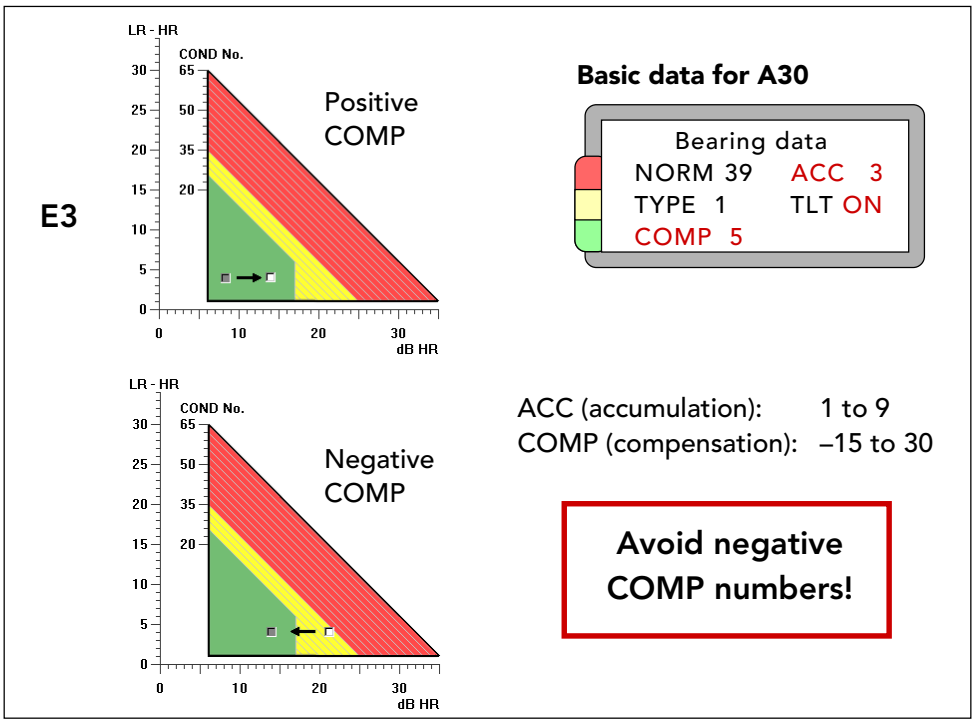
One part of the input data, the rpm and the size of the bearing, is needed to allow for the effect of bearing speed on the shock level when evaluating bearing condition. The mean diameter Dm is more exact than the shaft diameter, because the height of bearings with the same shaft diameter can vary considerably. Together, rpm and Dm are used to calculate the NORM no. of the bearing (range 10 to 58).

The HR level shock pulses vary with the shape and number of the rolling elements in the bearing. This becomes important when estimating the oil film thickness in the rolling interface. The largest influencing factor is the shape of the contact area. In ball bearings, the rolling element has point contact with the raceways. In roller bearings, there is line contact, which means that the area under pressure, where the shock pulses occur, is much larger.

For SPM purposes, bearings are grouped into 8 different types, each with a TYPE number 1 through 8. The types are described in the table above.

Bearing manufacturers, though not all, follow ISO standards when numbering their bearings. The number code contains the information on mean diameter and bearing type. Thus, when you use an ISO bearing number as input in CONDMASTER®Pro, the program will give you Dm and TYPE no. As manual input for the A30, you can use the last three digits of the ISO number, which will produce Dm but not the TYPE no. You therefore have three alternative inputs:

- NORM no. and TYPE no.
- RPM + TYPE no. + mean diameter Dm
- RPM + TYPE no. + ISO number (3 last digits).



COMP and ACC [Analyzer A30]

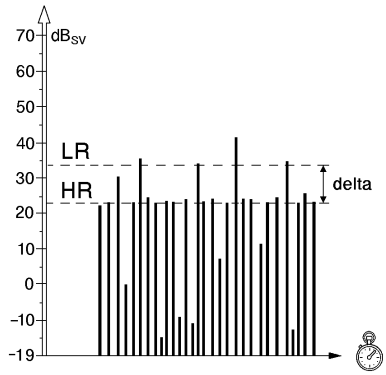
Above the basic input data, you can set a value for COMP and ACC before measuring with the A30.

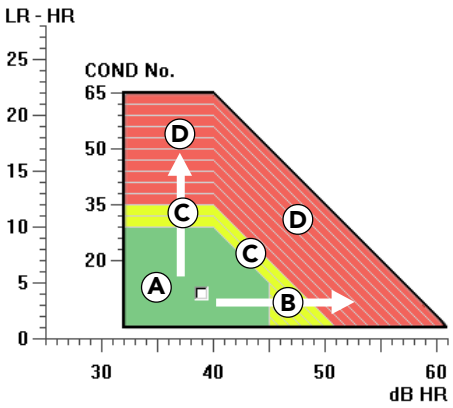
ACC (accumulation) determines the number of measuring cycles before the A30 displays the reading with the highest LR value as result. ACC can be set from 1 to 9. Especially on bearings with a low rpm, set ACC to at least 3.

The COMP no. (compensation number) is used to calibrate the measuring point, normally to compensate for a somewhat weaker signal from a measuring point that does not quite comply with the SPM rules. To find the correct COMP no., use the LUBMASTER®-function in CONDMASTER®Pro or the A30 itself (see page 29).

A normal signal from a good bearing should be near the centre of the green part of the evaluation frame. If it is far to the left, you can "push it forward" by setting a COMP no. If the signal is outside of the left side of evaluation frame, the A30 will display the error code E3 = signal too low. The COMP no. is added to the measuring result before it is evaluated. Thus, it will influence the evaluation results COND, LUB, and COND, but not the displayed values for HR and LR.

It is possible to set negative COMP nos., but you should avoid that. With a positive COMP no., you make the evaluation results worse than apparent from the measured LR/HR values. With a negative COND. no., you "improve" bearing condition, which can have unpleasant consequences if you are wrong in assuming that the signal from this bearing is stronger than normal. To avoid alarm from a stable bearing with high readings, it is better to change the alarm levels.





LR measured value for strong shock pulses

HR measured value for weak shock pulses

LR-HR delta value

dBsv unit for absolute shock pulse value

CODE A good condition

CODE B caution, dry running

CODE C caution, damage developing

CODE D bad condition

LR/HR values and CODE [Analyzer A30]

For LR/HR values, the measuring unit is dBsv, i.e. these values are measured on the absolute shock pulse scale and do not, by themselves, express operating condition. The term delta value simply means the difference between LR and HR. The operating conditon of the bearing is expressed by the CODE letter, the LUB no., and the COND. no., all of them not measuring but evaluation results.

CODE A means that the bearing is in good condition. There is no detectable damage to the surfaces of the load carrying parts, and no extreme lack of lubricant in the rolling interface.

CODE B indicates a dry running. The lubricant is not reaching the rolling interface, which can have several causes, e.g. lack of lubricant supply to the bearing, low temperature in a grease lubricated bearing, or a heavy overload due to misalignment, tight fit, deformed housing, etc.

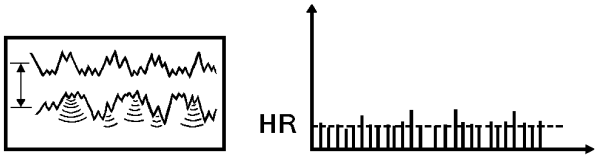
CODE C is displayed when the A30 detects an increased shock pulse level with a large delta value. This points to beginning surface damage.

CODE D is displayed when the signal is typical for bearing damage: a high shock level with a large delta value. A contamination of the lubricant by hard particles causes a similar signal.

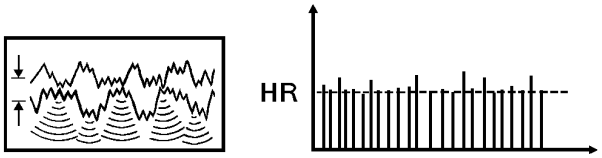
The message of the codes is supported by an arrow pointing at the green – yellow – red scale beside the display: green for CODE A, yellow for B and C, red for D.

LUB	Ball	Roller
0	Dry running	Dry running
1 to 2	Boundary lubrication	Boundary lubrication
3 to 4	Full lubrication	
> 4		Full lubrication

LUB no. for ball and roller bearings



Full lubrication



Boundery lubrication

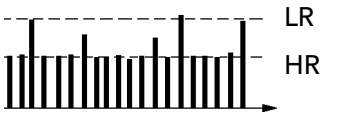
The LUB number [Analyzer A30]

The most important influence on the service life of a bearing is the lubricant film between the load carrying rolling elements and the raceway. By preventing or inhibiting metallic contact between the loaded bearing parts, the lubricant film reduces the local peak stress in the rolling interface. The greater the lubricant film thickness, the more even the load distribution in the contact area, and the better the fatigue life of the bearing.

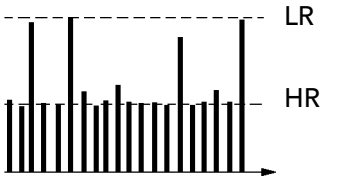
Irregularities in the bearing surfaces will always cause pressure variations in the contact area, and thus shock pulses, even when metallic contact is prevented by a separating lubricant film. A thinner film will result in an increase of the bearing's HR value.

The LUB No., displayed with CODE A and B, is directly proportional to oil film thickness. LUB No. 0 means dry running condition. The interpretation of LUB Nos. between 1 and 4 depends on the bearing type. For ball bearings, LUB Nos. greater than 2 mean full lubrication (a load carrying oil film). For roller bearings, a LUB No. greater than 4 indicates full lubrication.

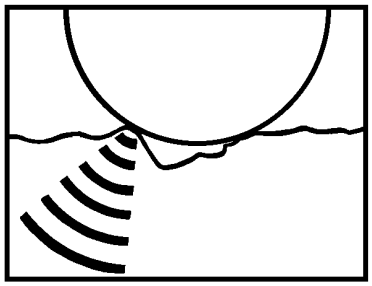
The term boundary lubrication implies that part of the load is carried by metal to metal contact. The amount of lubricant in or supplied to the bearing is only one of the many factors that determine lubricant film thickness. Lubricant type and the bearing's rpm are of great importance, but also the geometry of bearing parts and housing, as well as the load put on the bearing by alignment and fitting.



CODE C
COND 28 to 32
Beginning bearing damage



CODE C
COND >32
Minor to severe bearing damage



Error codes

E2 Disturbance
E3 Signal too low
E4 No signal
E5 NORM no. wrong
(lowest NORM for probe = 18)

The COND number and error codes [A30]

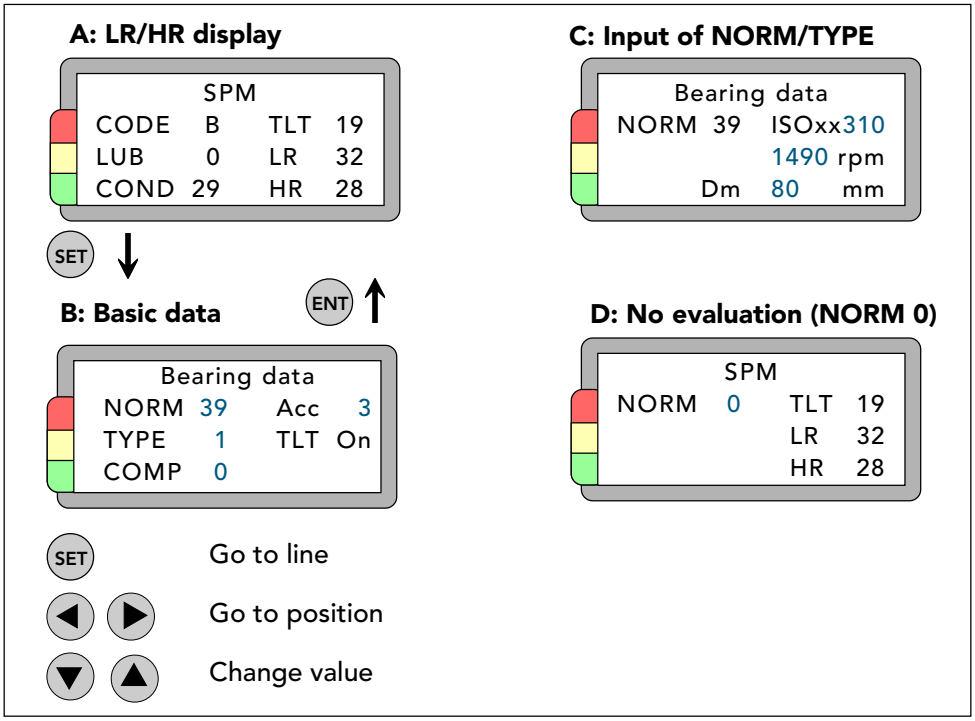
The COND No. (condition number) is displayed with CODE B, C, and D, i.e. for all bearings with reduced or bad condition. It indicates the degree of surface deterioration or damage in the rolling interface.

Large (visible) surface damage typically leads to a very marked increase in the bearing's LR readings and a high delta value. Thus, it is easily detected and will give Code D and high COND numbers.

When a COND number is displayed, the bearing should be watched very carefully. Once damage has started, it cannot be reversed. Temporary improvements of the COND No. only mean that the edges of fresh spallings or imprints have been rounded off. Soon, there will be new spallings. The time left to plan a bearing replacement depends on the trend of the COND No. As a rule, COND Nos. should be interpreted as follows:

COND No. < 30	Minor damage
COND No. 30 to 40	Increasing damage
COND No. > 40	Severe damage

When the measured signal is not within the evaluation frame, the A30 will display error codes. E2 is displayed when HR > LR, which normally means a high, even disturbance signal such as pump cavitation or a screaming steam box. E3 = signal too low can often be remedied by setting a COMP no. E4 comes up when there is no signal (transducer line interrupted). The NORM no. range is 0 (no evaluation) and 10 to 58. For the transducer with probe, the NORM no. is 18 to 58.



Input of basic data [Analyzer A30]

For shock pulse measurement, you go to the SPM display (A) with RIGHT/LEFT. The SET key takes you to the display of the basic data for the bearing (B).

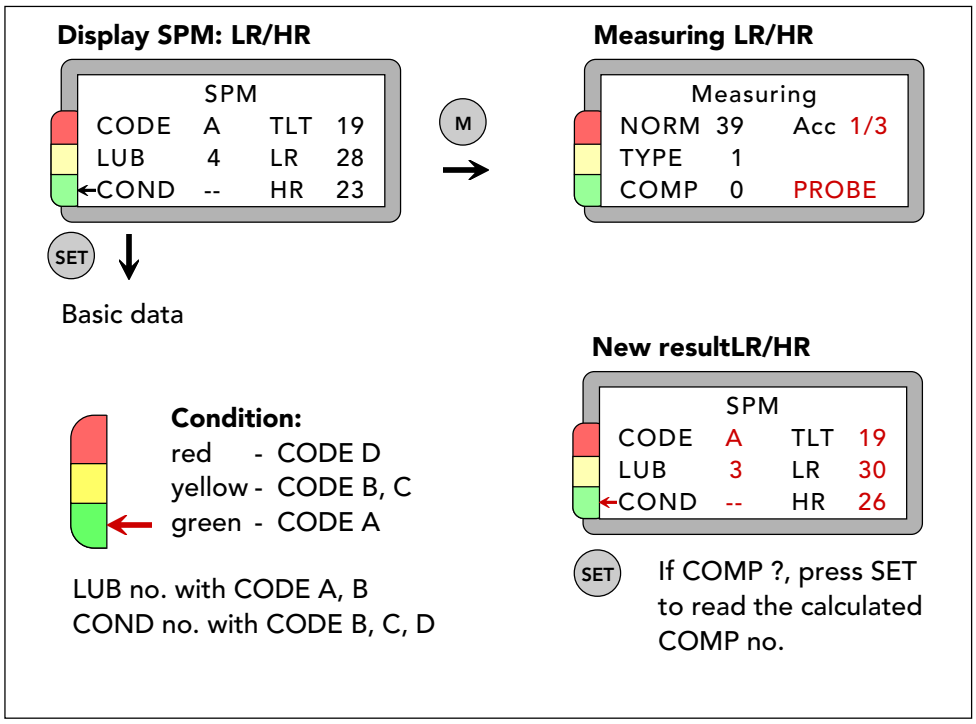
For an evaluated reading of bearing condition with an A30, you input the NORM and TYPE nos. of the bearing. The TYPE no. you can get from the figure on page 23. You can also set ACC from 1 to 9, and COMP between –15 and +30. When you set COMP to **?**, the instrument calculates a COMP no.

If you do not have a NORM no., go with SET to the end of display (B) and press SET once more. On display (C), you can input the rotational speed (rpm) and the mean diameter Dm. The A30 will calculate and display the NORM no. Instead of the mean diameter, you can input the last three digits of the ISO bearing number.

For readings without evaluation (CODE, LUB, and COND not shown), set the NORM no. to 0. You do not input TYPE or COMP (D).

To change a setting, you step to the line with SET. RIGHT/LEFT moves the cursor to individual numbers, UP/DOWN scrolls the number and toggles TLT on/off. SET brings you to the next line, and ENT back to the SPM menu.

When TLT test is on, the instrument will display the result of a transducer line test on the display for data input, so you can check the quality of signal transmission between transducer and instrument. This is used when you measure with permanently installed transducers. Values below 15 are not acceptable and you have to check cables and connectors for bad connections and moisture. When values deteriorate from a previously higher level you should also check the transducer line.



SPM measurement [Analyzer A30]

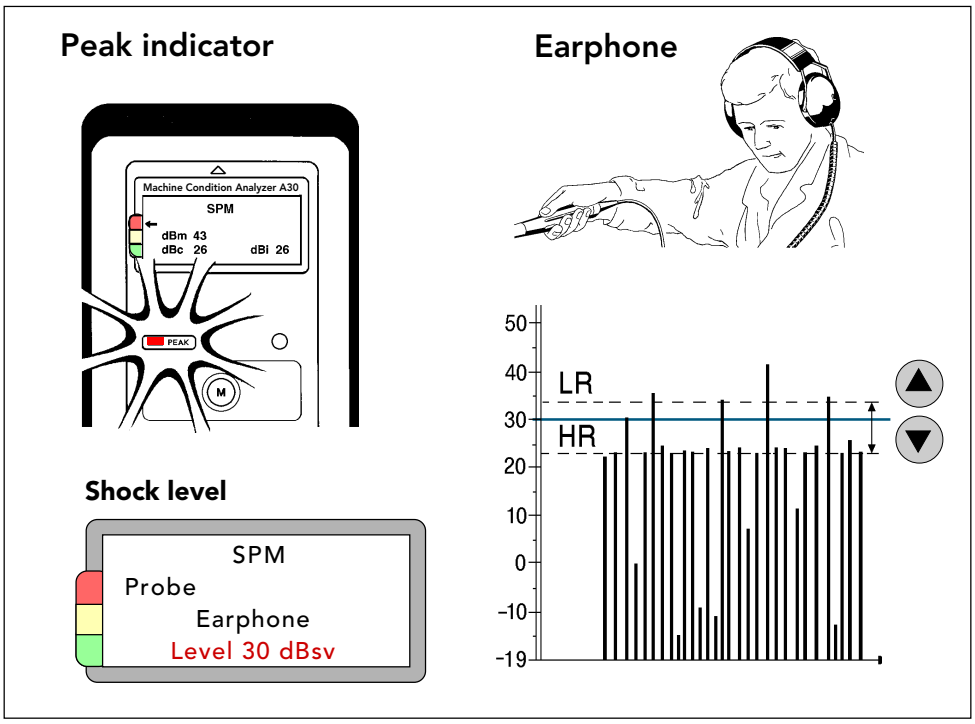
Back in the SPM menu, you can connect the transducer to the measuring point and press the M key to start a measurement. It takes approx. 10 seconds per accumulation, during which time the connected transducer type is displayed: PROBE for hand-held probe, TRA for the quick connect transducer and the standard 40000 transducer, TMU for a transducer matching unit in the transducer line.

A normalized reading (NORM and TYPE nos. set) returns values for LR and HR plus the evaluation results CODE (A to D), LUB (with CODE A and B), and COND (with CODE B, C, D). You also see the TLT test result (or TLT off). The LR/HR values shown are an average of the accumulated readings. The evaluation results are based on these LR/HR values plus the COMP no. Depending on the CODE, an arrow will point at the green, yellow or red field of the condition scale.

In case you had set COMP to **?** on the basic data menu, you can press the SET key to see the calculated COMP no. **Note**: Calculated COMP nos. should always be carefully checked (see page 25), and of course this function is only intended to give you the COMP no. for a **new** measuring point.

When you get high readings (CODES B, C, D), you should immediately verify their nature and probable cause. Do not give the verdict "bearing damage" before making a further investigation. As a first measure:

- use the earphone to identify the shock pulse pattern.
- use the probe transducer to measure on and outside of the bearing housing to identify the shock pulse source.

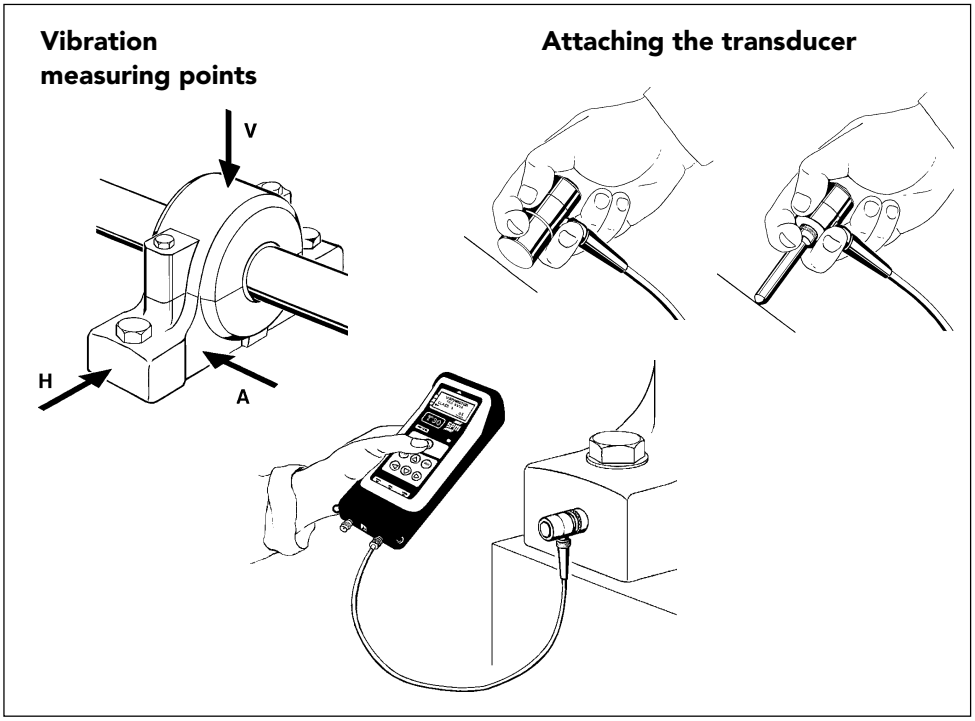


Earphone and peak indicator [Analyzer A30]

The use of the earphone is exactly the same as with the Tester T30, see pages 21 and 22. You manipulated the measuring threshold with UP/DOWN and match the sound you hear with one of the characteristic patters shown on page 22.

It does not matter that, with the A30, you are not using the normalized dBn scale. The important information is the distance between peaks and noise carpet (start of the continuous tone as you step downwards), plus the rhythm of the peaks (random or regular).

With the A30, the peak indicator only works in the earphone mode. It blinks each time the A30 registers a pulse stronger than the present measuring threshold. You have exceeded the shock level of the strongest peak when it stops blinking.



Measuring points and transducers for VIB

Vibration severity is defined as the RMS (root mean square) value of vibration velocity measured in the frequency range of 3 to 1000 Hz. It is the best indicator for the energy contents of machine vibration.

Vibration velocity is primarily a measure for general machine condition. Vibration at the measuring point should be representative for the overall vibration of the machine. Typical measuring points are bearing housings. By measuring in three directions, you can get an indication of the causes for increased vibration:

VIB H: Horizontal in the plane of rotation, most representative for balance condition.

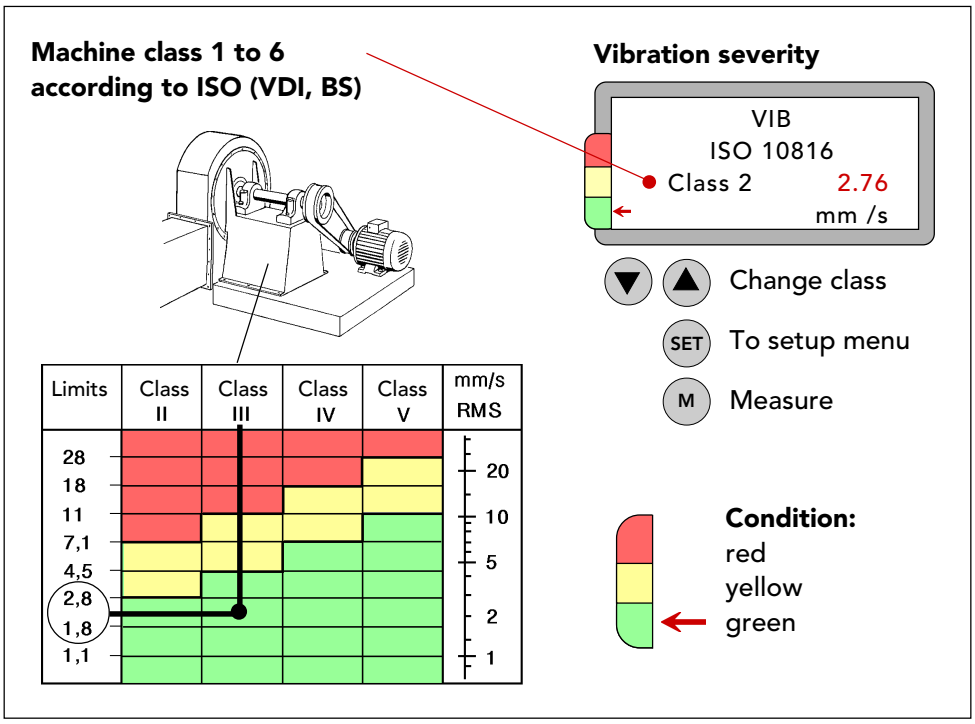
VIB V: Vertical in the plane of rotation, most representative for structural weakness.

VIB A: Axial along the line of the shaft, most representative for faulty alignment and bent shafts.

The transducer TRV-22 (23) can be used

- as a hand-held probe, with or without the probe tip attached
- with a magnet for attachment to ferrous metal parts
- with the M8 (UNC 1/4) mounting screw.

The firmer the contact with the machine, the better the measuring result.



Vibration severity measurement

A VIB measurement returns the RMS value of vibration velocity in mm/s (or inch/s). As input data you set the ISO machine class with the UP/DOWN keys.

Pressing SET brings you to a menu where you can define a spectrum reading, see next page. The M key start a reading.

The evaluation consists of a comparison of the measured value with the ISO limit values recommended for the different classes. An arrow points at the condition scale. If no class is input, the arrow is not shown.

The majority of industrial machinery belongs to the vibration classes 2, 3, and 4:

Class 2: Medium size machines without special foundations

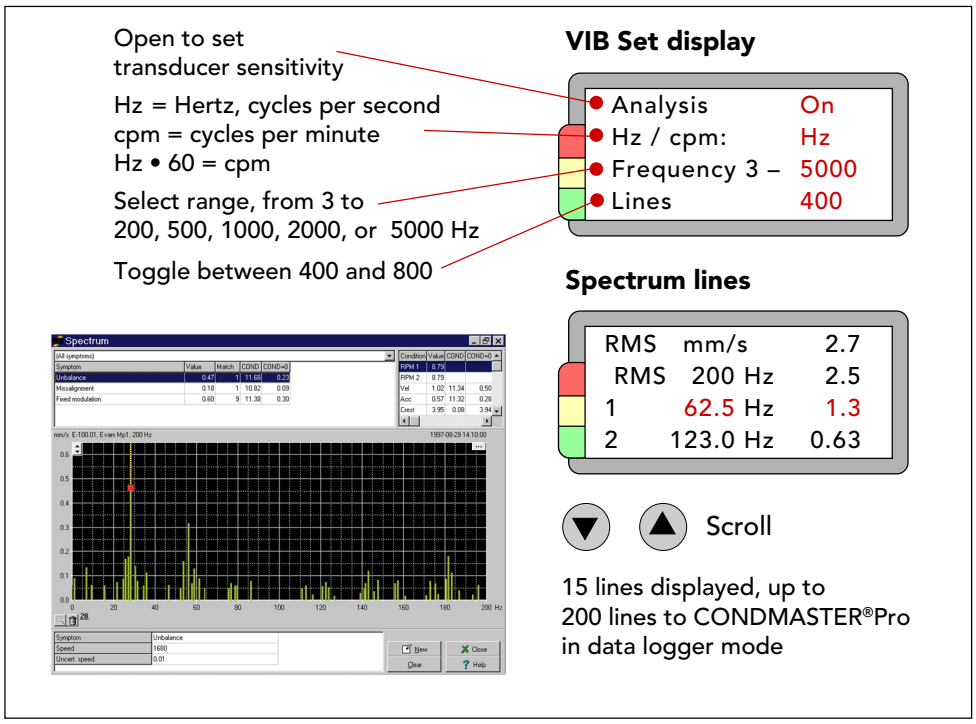
Class 3: Large machines on rigid foundations

Class 4: Large machines on soft foundations.

For example, most smaller process pumps in a chemical plant would be Class 2. A 100 kW fan on a concrete foundation would be Class 3. However, the same fan fastened to the less rigid metal deck of a ship could be considered as Class 4.

Class 1 refers to independent parts of machines, for example electric motors up to 15 kW. Classes 5 and 6 are used for heavy reciprocating prime movers and machines which are intended to vibrate, such as vibrating screens.

On the instrument, the ISO values for good and acceptable are shown as green. Just tolerable is yellow, unacceptable is red.



Recording a vibration spectrum [Expert]

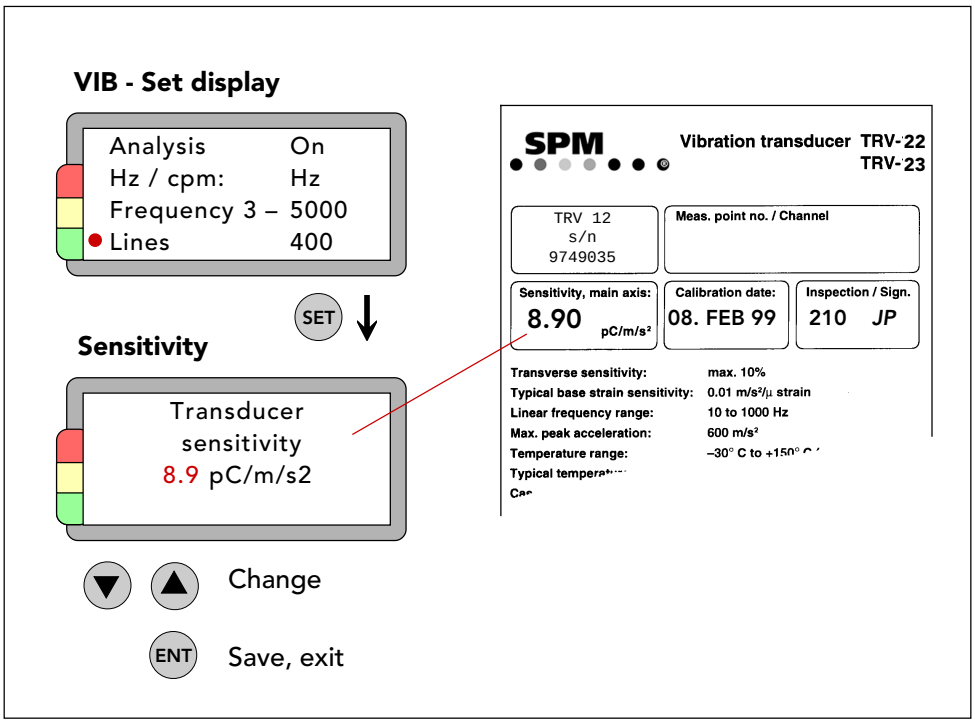
The SET key opens a menu where you can define parameters for recording a vibration spectrum. For this, set the line **Analysis** to On.

You can toggle **Hz** and **cpm** on line 3, even after the reading has been taken (but before you leave the measuring mode). Cpm means cycles per minute and is similar to the rpm (revolutions per minute) in which the machine speed is measured. This makes it easy to compare the displayed spectrum lines with the machine speed. In case of unbalance, the spectrum line at the top should correspond to the rpm of the machine.

You can select one of five frequency ranges, 200, 500, 1000, 2000, or 5000 Hz. The most significant range depends on the machine's rotational speed and vibration behaviour. A narrow frequency band gives you a better resolution.

The instrument performs an FFT (Fast Fourier Transformation). On line 1, it displays the overall vibration severity value (as for VIB), on line 2, the RMS velocity value for the selected range. The following lines show the value at each of 15 frequency lines (in mm/s or inch/s). The frequency can be toggled between Hz and cpm. The lines are sorted by vibration value, with the highest at the top of the list. Use the UP/DOWN keys to scroll.

In data logger mode, you actually save up to 200 lines and transfer them to CONDMASTER®Pro. There you can use the EVAM functions for graphical spectrum displays and machine fault identification.

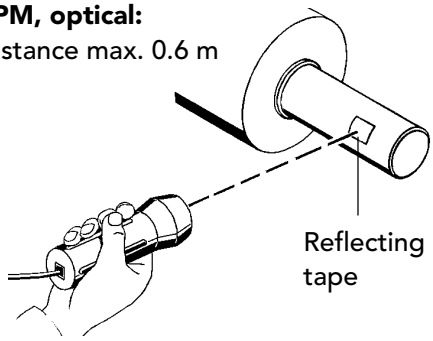


Setting vibration transducer sensitivity

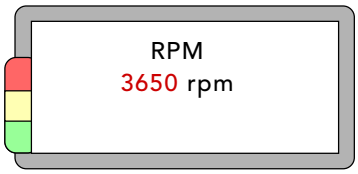
The vibration transducer which you use together with the instrument is delivered with a calibration card. The transducers are individually calibrated. The calibration value has to be set on the instrument. If you change transducers, you have to input a new calibration value.

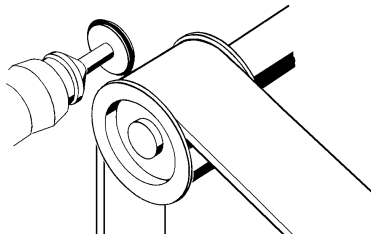
On the VIB display, press SET until “Transducer sensitivity” appears. Adjust the sensitivity to the value on the card, using UP/DOWN. Leave with ENT.

RPM, optical:
Distance max. 0.6 m

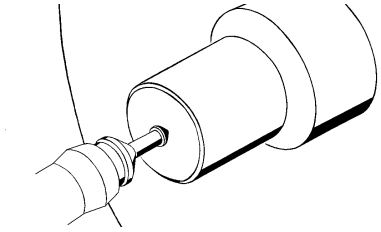


Speed reading





RPM, contact center:
Hold against shaft center



Peripheral, contact wheel:
Multiply reading by wheel factor

TAD-12	0.1 m/min.
TAD-13	0.1 yd./min.
TAD-17	0.5 ft./min.

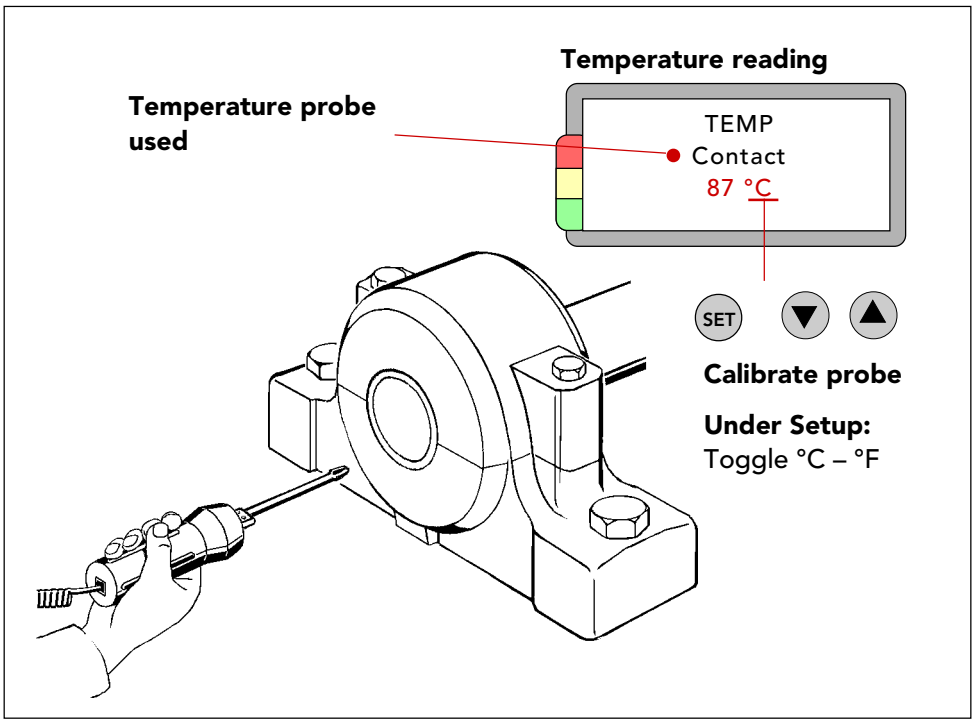
Measuring speed

To evaluate bearing condition and to make sense of a vibration spectrum, you have to know the rpm of the shaft. The RPM menu turns up as soon as the speed probe is connected to the EXT connector.

Easiest is the optical speed measurement. The preparations are simple: you paste a bit of adhesive reflecting tape on the rotating part. It has to be reasonably clean.
Direct the light beam at the reflecting tape. Press and hold down the M key until the result is displayed. The instrument counts 1 rpm for each received light reflex. The minimum is one count every 6 seconds (corresponding to 10 rpm). On slowly rotating parts you can use several reflexes at even intervals, and divide the displayed value by the number of tape bits to get the rpm.

For contact measurement, you place the contact adapter over the lens and fix a contact center or a wheel. The adapter has a reflecting tape inside, and each revolution sends one light reflex to the counter. The contact center is pressed firmly into the cavity at the center of the shaft, and the probe is aligned with the shaft's center line. The wheels are used to measure peripheral speed. One turn corresponds to 0.1 m, 0.1 yards, or 0.5 feet, depending on the wheel type. For meters or yards per minute, divide the displayed result by 10. For feet per minute, divide by 2.

The display cannot be zeroed. If you want to clear a reading before measuring again, hold the contact adapter over the lens, hold down the M key and turn the adapter shaft so that the peak indicator blinks once. Wait until the display shows <10 rpm, then release the M key.



Measuring temperature

Temperature can be measured with a contact probe, from -20 to +350 °C (-4 to +662 °F). There are two probe tips:

TEN-10 probe tip for solid objects

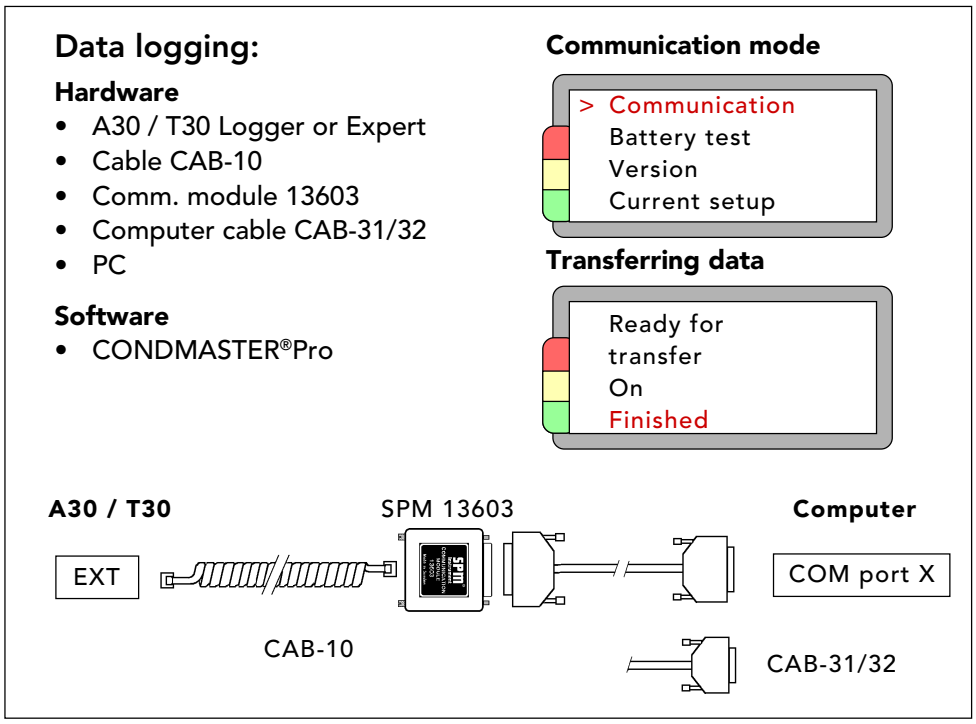
TEN-11 probe tip for fluids.

The TEMP menu turns up as soon as the temperature probe is connected to the EXT connector. Under the Current setup menu, you can switch between °C (Celsius = centigrade) and °F (Fahrenheit), see page 6 of this part.

To measure, hold the probe tip against the object. Press and hold down the M key until the result is displayed.

Calibration

There is a variation of approx. 4° C between probes. When using a new temperature probe, it has to be calibrated. The SET key opens a menu where you can calibrate ± 5° C or ±9° F. This can be done at room temperature. Measure against an object that has room temperature and compare the measuring result of the instrument with the reading of another thermometer. Press SET. then use UP / DOWN to adjust the temperature. Finish with ENT.



Data logging, general procedure [Logger, Expert]

For systematic condition monitoring, data logging is recommended because it saves much time. For long-time recording, comments, and vibration spectrum measurements you must have a Logger or Expert version. When loaded from the PC, the instruments contains

- the measuring points in the right measuring sequence
- the input data for all used measuring techniques
- the list of comments (option)
- the result of the last measurement.

You simply use the M and ENT keys to collect the reading and go to the next point. When a measuring round is reported, all measuring results and comments are transferred to CONDMASTER®Pro, without manual input.

For T30/A30 Logger and Expert, you need CONDMASTER®Pro for Windows, a communication module with cable (CAB-31 = 25 pin, CAB-32 = 9 pin connector to the PC's COM port). CAB-10 is the standard cable fitting the logger's EXT connector. In CONDMASTER®Pro, you must create either measuring rounds or work orders (individual measuring points cannot be transferred), plus special rounds for long-time recording if used. The access level of the operator is "Read/Edit". COM port and baud rate are input when you first activate the measuring instrument in CONDMASTER®Pro.

To transfer data, you connect the instrument to the PC as shown. In CONDMASTER®Pro, you use the transfer routines under either DATA TRANSFER or PLANNING, or under RECORDING, all under MAINTENANCE. The data logger is switched on and set to COMMUNICATION.

Measuring rounds
- Mix all measuring techniques except SPM LR/HR and dBm/dBc
- For SPM, do not mix uncompatible speed types

Valid measuring rounds, SPM:

M	measured speed only
C	constant speed only
P	pre-set speed (1)
C + P	constant speed + pre-set speed (1)

Data transfer

any	One round at a time

Planning

M	Several rounds in one work order. Max. 10 rounds with different preset speeds.
C	
P	
C + P	

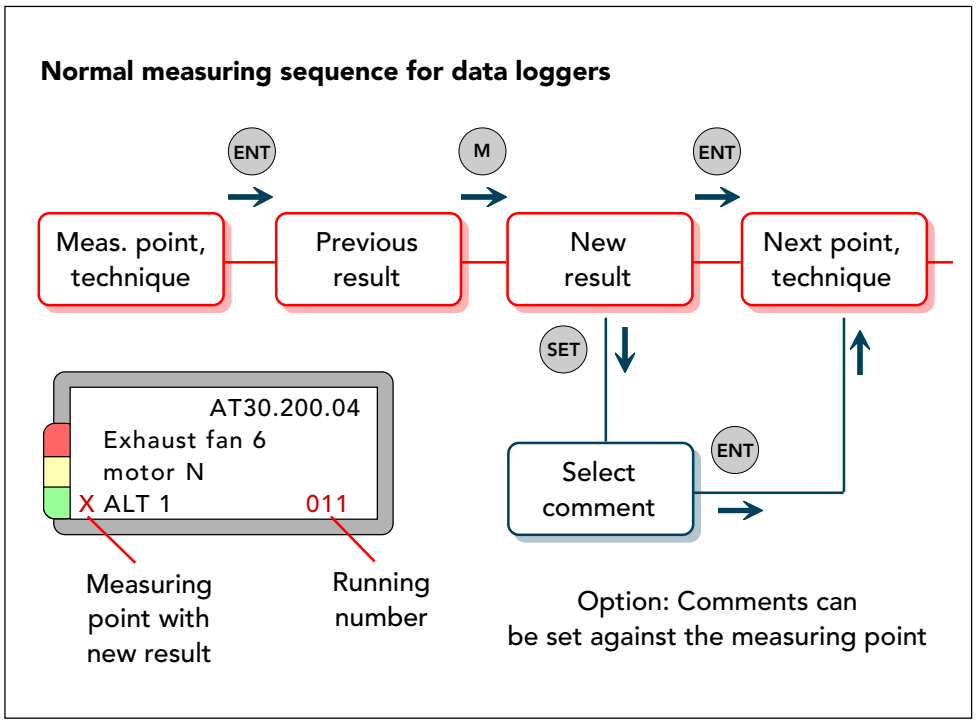
Measuring rounds in Condmaster®Pro [Logger, Expert]

The purpose of rounds is to:
- to group together a number of machines and measuring points which are to be measured at the same time with a hand-held instrument. For data loggers, you must have either rounds or work orders to be able to load the instrument.
- to define the measuring sequence by listing the points in a certain order.
- to simplify planning of periodic work by setting time intervals for its execution.
- to simplify measurements on machines with variable speed. If the rpm of a group of bearings is dependent on the variable speed of the process, as in a paper machine, a single data input at the time of measurement or reporting will adjust the speed data of all bearings in the round.

You can mix all measuring techniques, except the two shock pulse techniques LR/HR and dBm/dBc, because both cannot be handled by the same instrument.

You must be careful with SPM measuring points where the rpm i a) measured or b) pre-set prior to measuring shock pulses. Points with measured speed are put into separate rounds. Constant and pre-set speed can be mixed, but you can input only one pre-set speed per round.

For each round, you set a first execution date. The next execution date is set automatically, by adding the set time interval to the date the round is reported and closed. Depending on the working mode you choose in Condmaster®Pro, you work with one round at a time (Data Transfer) or with work orders containing several (Planning). You can mix rounds with different speed types in a work order.



Data logging – measuring sequence [Logger, Expert]

Measuring with a data logger is very simple. You start the instrument by pressing any button. The first measuring point is displayed (or the point at which the instrument powered down). This display shows measuring point number and name plus the measuring technique to be used.

Press ENT. You see the result of the previous measurement on that point.

Press M. The instrument starts to measure and will display the new result. You do not enter or change any basic data.

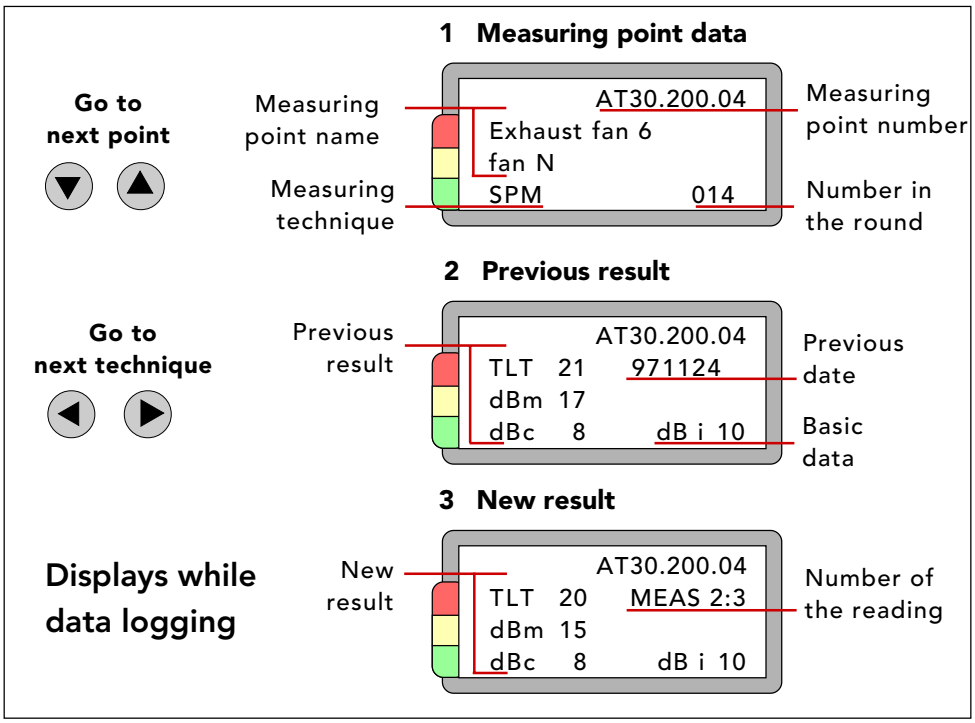
When the new measuring result is displayed, you have two choices:

- You can press SET to get the display where you can select comments. You leave this display with ENT and go on as below.
- You press ENT to get to the next measuring technique or next measuring point.

Normally, you measure in the pre-programmed order. You can, however, scroll forwards and backwards through the list of measuring points and techniques, see next page. A point/technique with a new measuring result is marked with X.

You can repeat measurements. The last result will be saved. For SPM measuring points, you can take twice 5 readings and save one result from each batch, see page 43.

You cannot add to the list of measuring points/techniques. If you measure on a point that is not part of a downloaded round(s), you cannot transfer the result to Condmaster®Pro.



Displays in data logging mode [Logger, Expert]

The figure shows the various displays while measuring with a data logger. The example shows an SPM measurement with the T30, but the principle is the same for both instruments and all techniques. For details, see the descriptions for manual measuring mode.

When you scroll through the round, you use UP/DOWN to go to the next measuring round, RIGHT/LEFT to go to techniques under each measuring point.

A note on vibration measurement:

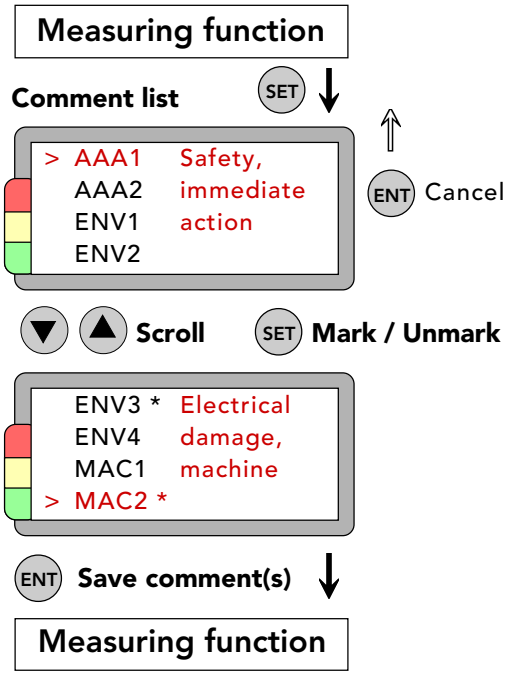
For VIB measuring points, you can set up one to three measuring directions and save a result for each. Moreover, for each measuring direction you can measure a spectrum and save up to 200 lines. With the spectrum measurement, you also save the EVAM condition parameters VEL, ACC, CREST, KURT, and SKEW. These are not displayed by the instrument.

Comments

from Condmaster®Pro (35 characters, max. 16)

Examples:

AAA1	Safety, immediate action!
AAA2	Safety, fixed by inspector
ENV1	Clean up
ENV2	Leakage
ENV4	Mech. damage, environment
ENV4	Electr. damage, environment
MAC1	Mechanical damage, machine
MAC2	Electrical damage, machine
MAC3	Poor lubrication
MAC4	Foundation fault
MAC5	Coupling fault
MEA1	Unstable reading
MEA2	Low reading
MEA3	Disturbance
MEQ1	Cable damage
MEQ1	Transducer damage



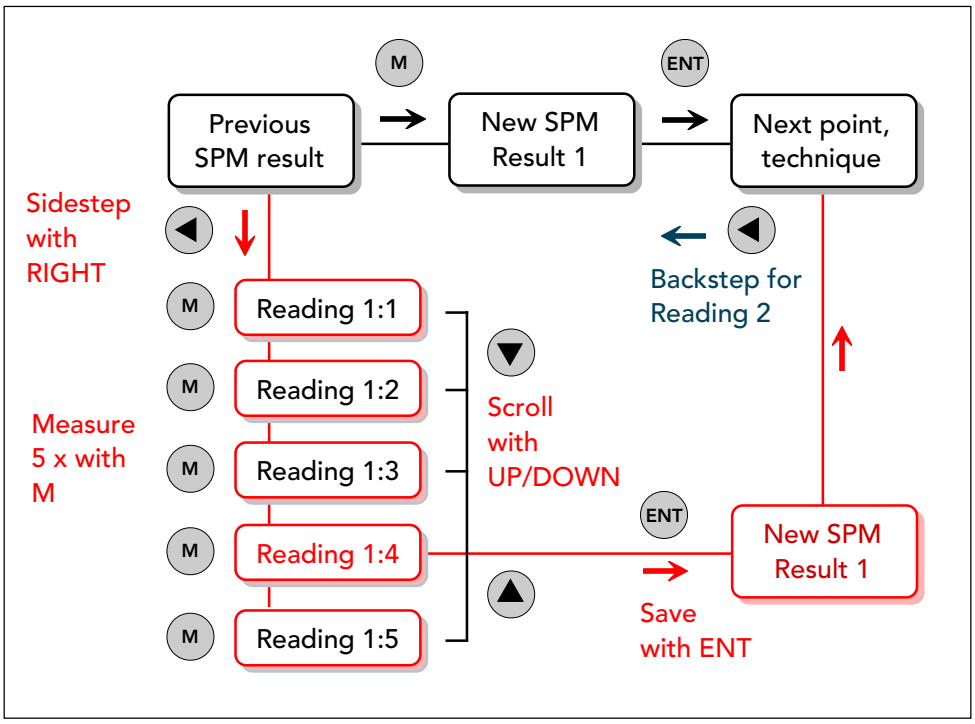
Setting comments [Logger, Expert]

Condmaster®Pro contains Standard comments which you can edit to suit your purpose. Up to 16 of these can be downloaded to the data logger. A Standard comment consists of a 4 character code and a title, and it can force a measuring point on the alarm list. When used, it becomes a Comment, saved with time and date under a measuring point. In Condmaster®Pro, you can add your own text to a comment. It turns up as a coloured square in the graphic display, and you can print a report showing how often a comment appears in the data base, which gives you a statistical record.

From each measuring function, you can go to the list of comments with SET. The UP/DOWN arrows scroll the list. The title of the comment in cursor position (>) is displayed. Pressing SET marks (*) or unmarks the comment in cursor position. ENT saves the marked comment(s) and returns you to the measuring function. The comment is saved even if you leave the measuring function without saving a new measuring result. You can save up to 16 comments per measuring point. They are not connected with a specific measuring technique and appear in Condmaster®Pro with one minute intervals, starting with the measuring time.

Use comments to record events which are **not** reflected by the measuring results, but are important enough to be included on your alarm list, e. g. safety hazards and general damage. Don't waste comments on meaningless remarks like "Checked, everything OK". The comments in the example all cause alarm. They concern:

- general safety (emergency exits locked, fire alarm not working, etc.).
- damage to the environment of the machine and to the machine itself.
- abnormal measuring conditions and damaged measuring equipment.



Multiple SPM results [Logger, Expert]

For each SPM measuring point, you have the option of taking two series of 5 readings each, and save one result from each series.

When you reach the SPM display, you would normally press M, measure once and go on with ENT. The result is recorded as reading 1. Instead, you can press RIGHT to start the multiple reading function.

You can now obtain up to five measuring results and afterwards scroll through them with UP/DOWN. When you press ENT the displayed result is saved as reading 1. This takes you to the next technique or measuring point. The SPM display you just left is marked with X = measurement complete.

You can, however, backstep to the SPM display and repeat the same procedure for reading 2. Both results will be uploaded to Condmaster®Pro and saved as two measuring results with a one minute time interval.

Alternative measurements, setup [Logger, Expert]

ALT measurement means the recording, by manual input with the UP/DOWN keys, of a user defined quantity in a user defined measuring unit.

In Condmaster®Pro, you select ALT 1 and/or ALT 2 as measuring technique. On the data input form, you enter:

- the measured quantity (flow, pressure, effect, whatever)
- the measuring unit (litres/min, bar, kW, ...)

Both are downloaded to the instrument and displayed.

You also define the range and the scale division of the graphics display in Condmaster®Pro. You can input two lower and two upper alarm limits.

Note: The ALT measuring functions can be used in a wider sense. Instead of recording the values off meters and dials, you can use them to record "general condition": the safety status of a locality or the genaral mechanical or electrical condition of a part of the plant or a machine. Example:

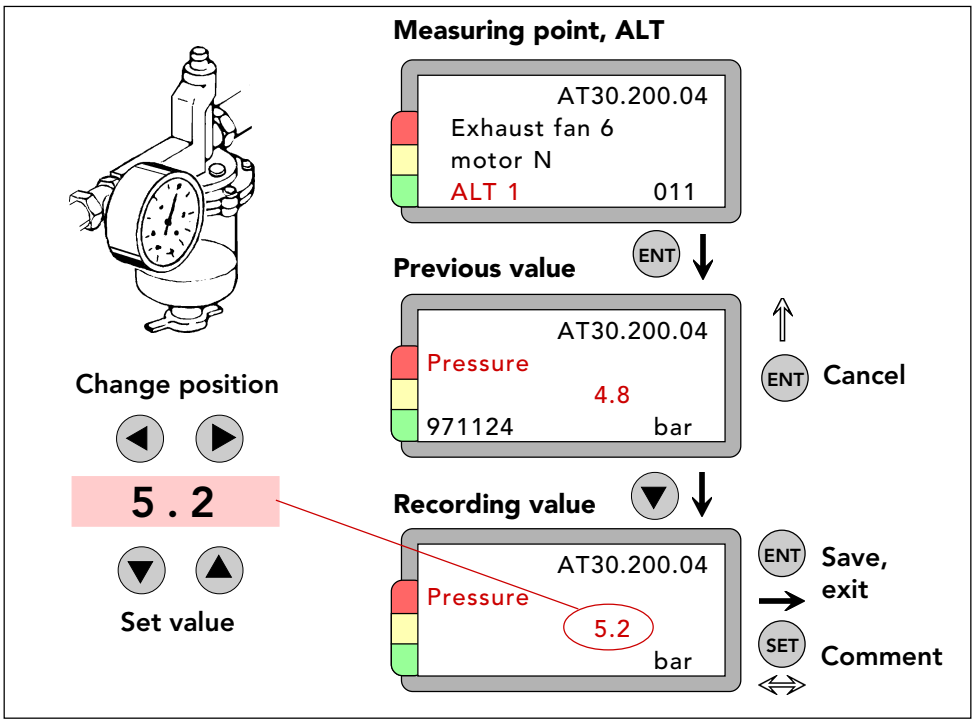
Meas. point: Safety status, Hall 3

Values: 3 (red alarm) = serious safety hazard, immediate action required.

2 (yellow alarm) = minor faults/risks, fixed by inspector.

1 OK.

Together with the Comment functions, you can thus, with little effort, produce valuable statistics and reports. Use you imagination!



Entering alternative measurements [Logger, Expert]

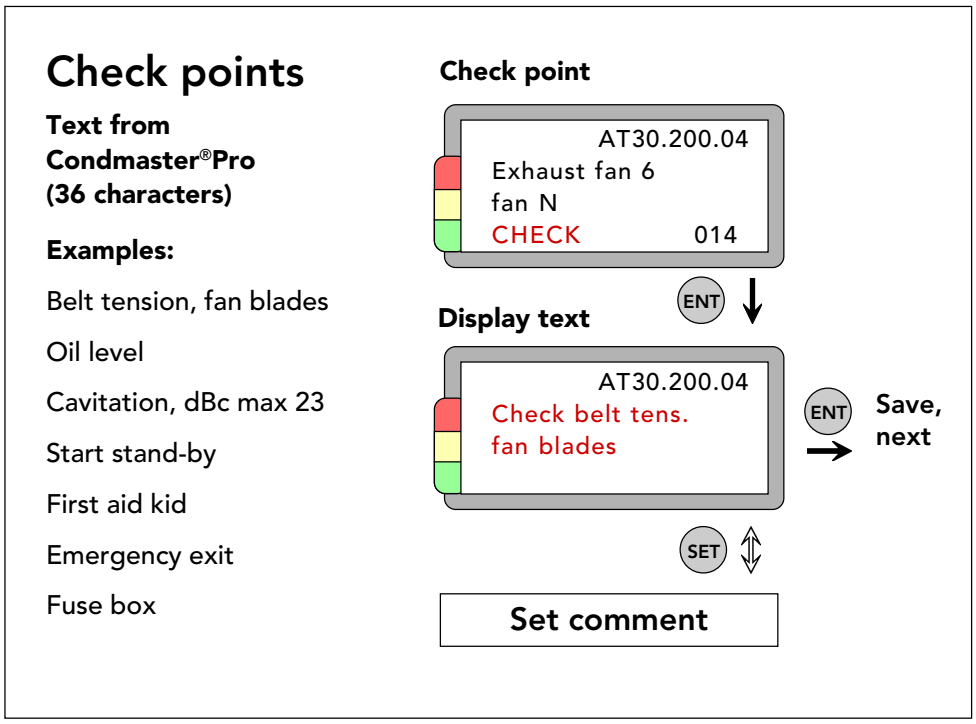
Recording alternative measurements is very easy. Measuring point number and name are displayed with either ALT 1 or ALT 2 to indicate the measuring mode.

Pressing ENT opens the display of the previous value. Pressing any arrow key opens the display for recording the new value.

The LEFT/RIGHT arrow keys are used to shift to the desired digit position.
The UP/DOWN arrow keys change the digit marked by the cursor.

By pressing the LEFT arrow key to the left of the highest digit you reach a position where the previous measuring value appears.

Like with other measurements, you can press the SET key to come to the comments display and record a comment.



Check points [Logger, Expert]

In Condmaster®Pro, **Check point** is a measuring technique with its own data input form. The input data are a short description, max. 36 characters free text, of something which should be inspected during a measuring or maintenance round. There are no measurements to be taken or values to record.

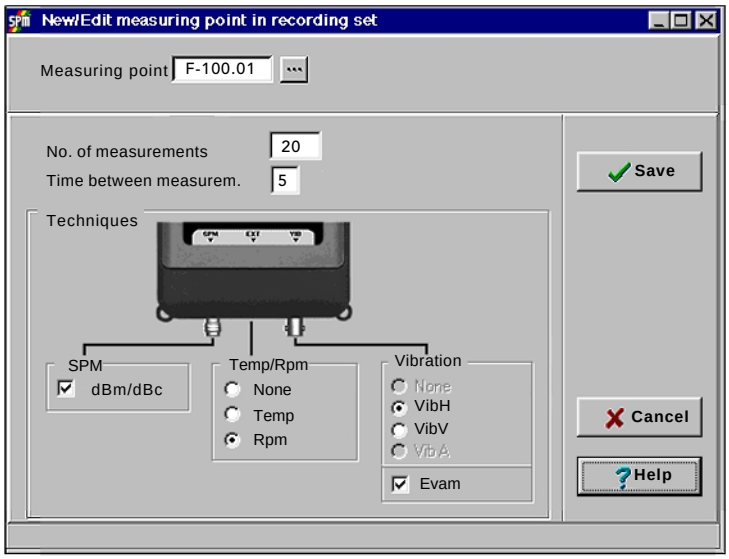
Like other downloaded data, the check point texts are shown on the instrument display. Normally, this is just a reminder - you do not have to enter or confirm anything.

In connections with comments, check points become efficient maintenance tools. Whenever something ought to be repaired, cleaned, investigated, set a comment against the check point, e. g. Repair! Force the measuring point on the alarm list, so that you can easily initiate and follow up the required maintenance activity.

Please note: Your checks are not limited to the machine you are monitoring. Especially in unmanned parts of a plant, a measuring round is the opportunity to use eyes and ears to make a general inspection. For example, you can:

- use a "normal" measuring point and add a check point function to remind you to open the fuse box and check for spares.
- give the fuse box a measuring point number and register it as a check point.
- input the fuse box as an "alternative measuring system" with the values 1 = OK, 2 = spares needed (yellow alarm), 3 = who took the last one? (red alarm).

Lights OK? Water leaking? Emergency exit blocked? Use your imagination, and the instrument as your note book.



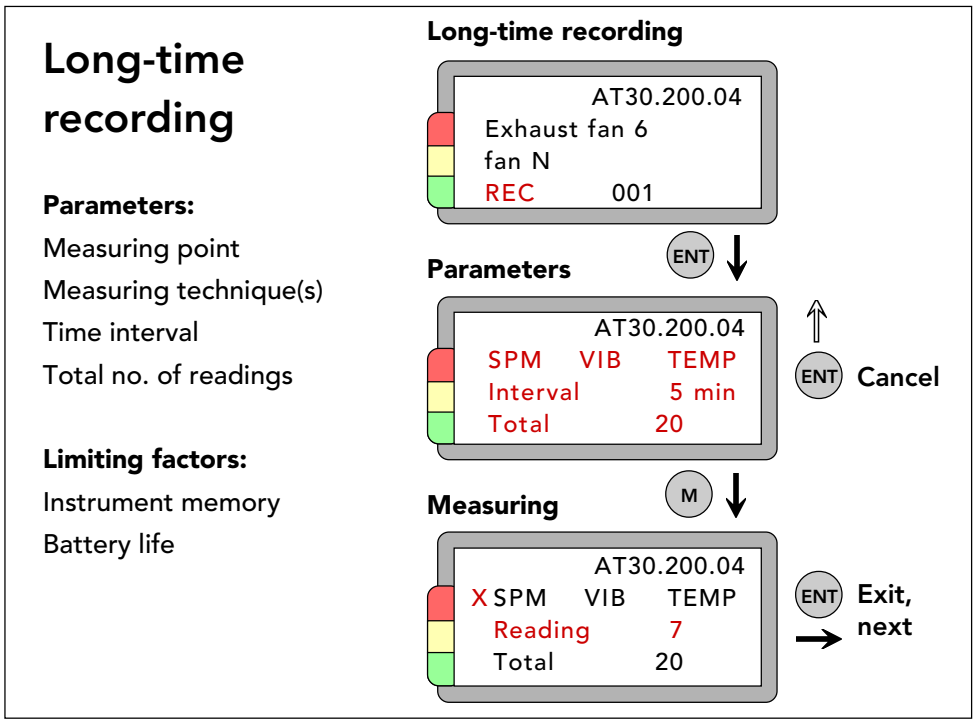
Long-time recording, program setup [Logger, Expert]

Long-time recording implies that you can measure continuously on one measuring point, simultaneously using one, two, or three transducers: **SPM + VIB + RPM**, or **SPM + VIB + TEMP**. Speed and temperature cannot be measured together because the probes use the same input connector.

The measuring instructions are set up in Condmaster®Pro, function RECORDING. You make a recording set containing one or more measuring points. After each input, you see how much memory is left for additional points. You input:

- the measuring point.
- the measuring technique(s) to be used.
- the time interval between readings, 0 to 60 minutes.

  0 = no pause between readings. The instrument will collect data as fast as it can. If the measuring time is set to e.g. 5 minutes, the instrument will measure all selected parameters once, switch to stand-by for the rest of the 5 minutes, then start the next reading.
- the total number of readings to be taken. The theoretical maximum is 9999.

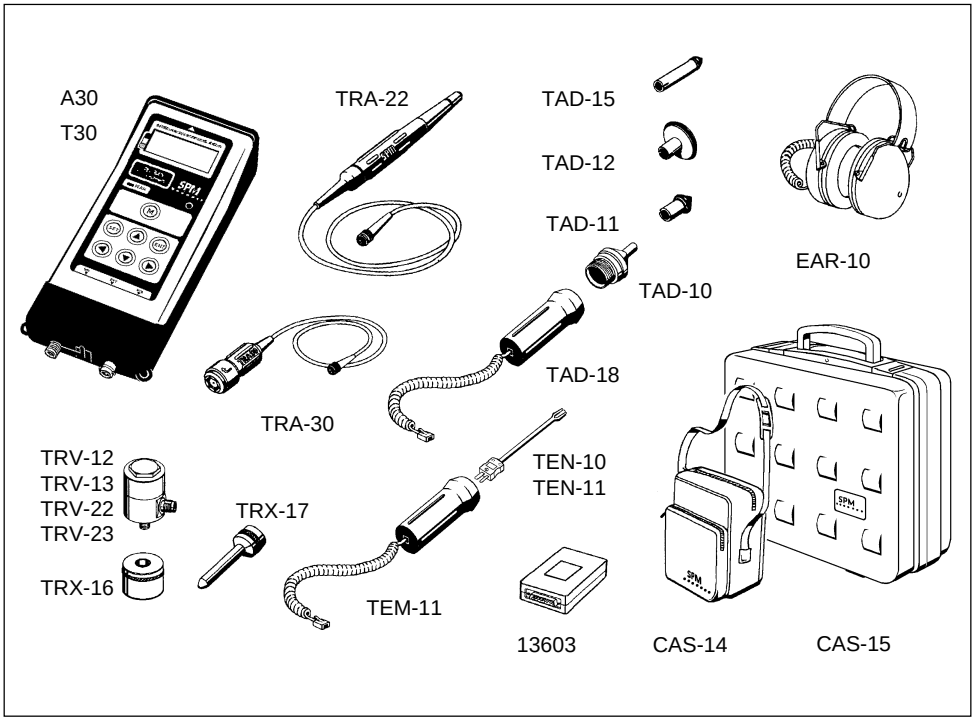


Long-time recording, measurement [Logger, Expert]

As always in data logger mode, you start with a display of measuring point number and name, plus measuring technique used: REC = long-time recording. Connect the transducers/probes and press ENT (parameters are shown), then the M key to start.

An X before the measuring technique marks the measurement in progress. Readings are saved continuously. If you interrupt with ENT before the total is reached, you can either upload the uncompleted recording to Condmaster®Pro or repeat the measurement, starting again with reading 1.

Selected points can be measured in any order. To save battery, the instrument powers down when the total is reached. If the batteries should become exhausted, the memory back-up will preserve you measuring results.



Part numbers, A30 / T30

A30-1	Analyzer A30, Basic
A30-2	Analyzer A30, Logger
A30-3	Analyzer A30, Expert
T30-1	Tester T30, Basic
T30-2	Tester T30, Logger
T30-3	Tester T30, Expert
13603	Communication module
CAB-31	Computer cable, male 25 pins – female 25 pins
CAB-32	Computer cable, male 25 pins – female 9 pins
CAS-14	Carrying case
CAS-15	Carrying case with foam insert
EMD-13	Carrying strap
FUP-01	Follow-up form for Testerer (mm)
FUP-02	Follow-up form for Analyzer (mm)
FUP-03	Follow-up form for Testerer (inch)
FUP-04	Follow-up form for Analyzer (inch)

Shock pulse monitoring

TRA-22	Shock pulse transducer, probe
TRA-30	Shock pulse transducer with quick connector
EAR-10	Earphone
EAR-11	Earphone for helmet
CAB-07	Cable for remote monitoring, 1.5 m (6 ft)

Vibration monitoring

TRV-12	Vibration transducer, M8
TRV-13	Vibration transducer, UNF 1/4”-28
TRV-22	Vibration transducer, M8
TRV-23	Vibration transducer, UNF 1/4”-28
TRX-16	Magnetic base for vibration transducer
TRX-17	Probe for vibration transducer
VIC-19	Cable for vibration transducer, 1.5 m (6 ft)

Speed monitoring

TAD-18	Tachometer probe with cable
TAD-10	Contact adapter for TAD-18
TAD-11	Contact center, short
TAD-15	Contact center, long
TAD-12	Contact wheel, meter/min.
TAD-13	Contact wheel, yards/min.
TAD-17	Contact wheel, feet/min.
TAD-14	Reflecting tape, pad of 5 sheets
TAD-16	Reflecting tape for thin shafts, pad of 5 sheets

Temperature monitoring

TEM-11	Temperature probe with cable
TEN-10	Temperature probe tip, surface
TEN-11	Temperature probe tip, liquid

Spare parts

13108	Sleeve for probe tip (TRA-22)
CAB-02	Cable for TRA-20, 1.5 m (5 ft)
CAB-06	Cable for TRA-22, 1.5 m (5 ft)
CAB-10	Spiral cable for EAR-10/11, TAD-18, TMM-11
CAB-30	Cable for TRA-30, 1.5 m (5 ft)
90022	Battery 1.5 V, alcaline, AA-cell

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Technical data for A30 / T30

Instrument specifications

General features:	language selection, battery test, continuous reading, transducer line test, autom. idle / power off
Temperature range:	0° to +50° C (32° to 120° F)
Power supply:	6 x 1.5 V LR6 alkaline cells
Battery life:	power down 1 year, or 5000 typical measurements, or continuous recording 50 hours
Size:	255 x 105 x 60 mm (10 x 4.2 x 2.4 in)
Weight:	0.85 kg (1.9 lb)
Casing / protective cover:	ABS / polyurethane
Keypad:	sealed membrane
Display:	LCD, 4x16 characters, LED backlight, adjustable, automatic on/off
Memory:	typical 500, max. 999 meas. points
Backup, memory/clock:	approx. 24 h.

Shock pulse (SPM®)

Measuring range:	- 19 to 99 dBsv [A30]
	- 9 to 99 dBsv [T30]
Resolution:	1 dBsv
Accuracy:	± 1 dBsv

Vibration severity (ISO 10816)

Measuring range:	0.5 to 49.9 mm/s RMS (0.02 to 2.0 in/s RMS)
Resolution:	0.1 mm/s (0.01 in/s)
Accuracy:	± (0.2 mm/s + 2% of reading)
Frequency range:	3 – 1000 Hz

Speed measurement

Measuring range:	10 to 19 999 rpm optical
Measuring distance:	max. 0.6 m (2 ft.)
Resolution:	1 rpm
Accuracy:	± (1 rev. + 0.1% of reading)

Temperature measurement

Measuring range:	-20° to +350° C (-4° to 660° F)
Resolution:	1° C (1° F)

[Logger, Expert]

Alternative measuring systems

No. per meas.point:	2
Additional info:	date / time and comments

Long time recording

Meas. parameters:	SPM, VIB, temp./speed
Measuring interval:	adjust. 0 - 60 minutes

[Expert]

Vibration analysis (EVAM®)

Window:	Hanning
Number of samples:	1024 / 2048
FFT result:	400 / 800 spectrum lines
Range, resolution at 400 / 800 lines:	3 – 200 Hz, 0.5 / 0.25 Hz 3 – 500 Hz, 1.25 / 0.625 Hz 3 – 1000 Hz, 2 .5 / 1.25 Hz 3 – 2000 Hz, 5.0 / 2.5 Hz 3 – 5000 Hz, 12.5 / 6.25 Hz
Lines displayed:	15 highest, toggle Hz / cpm
Lines saved:	1 - 200 highest

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Warranty and Responsibility

The warranty for the instrument is applicable as soon as SPM Instrument AB has received the signed warranty form from the possessor of the instrument.

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PRODUCT _____ VERSION NO. _____

PURCHASE DATE _____

COMPANY _____

ADDRESS _____

CITY _____ POSTAL CODE _____

COUNTRY _____ PHONE _____

USER NAME(S) _____ FAX _____

AUTHORIZED DISTRIBUTOR _____

SPM

CUSTOMER NO. _____

REGISTERED LIMITED WARRANTY

One (1) year limited warranty from date of purchase against defects in workmanship or materials. Warranty is void if instrument is altered or repaired by unauthorized service center. Warranty does not apply on any instrument subjected to misuse or damaged by leaking batteries. Warranty is for instrument only and does not cover batteries or cables. SPM reserves the right to determine disposition as to repair or replacement of goods.

Warranty form MUST be completed and returned to SPM Instrument to validate warranty.

Should the instrument require any service whether under warranty or not, you should contact SPM Instrument or your local distributor for instructions before returning the goods.

SPM Instrument AB
Box 4
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RETURN TO VALIDATE WARRANTY

SERIAL NO. _____

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