BALTECH
RELIABILITY TECHNOLOGIES

OPERATION MANUAL

BALTECH VP-3450
device for bearing diagnostics using shock pulse method

2016

Before you start using the device for bearing diagnostics using shock pulse method read this operation manual carefully. Baltech doesn't bear responsibility for any damages occurred due to nonobservance of the instructions given in this operation manual.

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Content

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1. Introduction

This operation manual is intended to familiarize users with application, design, operation principle, operation instructions, measurement performance, safety requirements and requirements to transportation and storage of the device for bearing diagnostics using shock pulse method BALTECH VP-3450.

Note

Baltech wants our customers to be satisfied with the device for bearing diagnostics using shock pulse method BALTECH VP-3450. Therefore if you have any questions do not hesitate to address to us at any time.

1.1. Conventions

Below are the conventions used in this operation manual and intended to emphasize the text.

Note

Note paragraphs contain special comments and instructions.

Attention!

Attention paragraphs warn you about actions that can injure you or the device.

Caution!

Caution paragraphs warn you about actions that can result in serious injury or the device damage.

2. Safety requirements

When working with the tester strictly observe the safety requirements.

Caution!

Nonobservance of the safety requirements may result in serious injury or failure of the device. Strictly observe the following requirements:

- Do not use the device if it has any damages;
- Use the device only for its intended purposes.

3. Technical description

3.1. Application

The device for bearing diagnostics using shock pulse method BALTECH VP-3450 (Figure 3-1) is intended to perform monitoring of rolling bearings of rotatory machinery, check of equipment mechanical condition for mechanical damages.

Figure 3-1. Appearance.

3.2. Technical characteristics

Table 3-1

Characteristics	Value
Measurement range, dBsv	-9 ~ 99
Resolution, dBsv	1
Maximum absolute error, ≤dBsv	±2
Supply voltage , V	9
Dimensions, mm	255x105x60
Weight, kg	0,8

3.3. Delivery set

Table 3-2

No.	Name	Q-ty	Appearance
1	Measurement unit	1	
2	Sensor with cable	1	
3	Headphones	1	
4	Screw driver	1	
5	Battery, AA	6	
6	Checklist	1	
7	Operation manual	1	
8	Transportation case	1	
9	Package	1	

3.4. Design and operation

3.4.1. Operation principles

Shock pulse method

Installation, operation, repair and maintenance are main factors that influence bearing life. Periodic bearing monitoring during its operation is the best way to prevent damage and costly repair. There are several bearing monitoring methods: temperature measurement, vibration measurement, sound measurement and shock pulse method. The shock pulse method allows measuring bearing condition during normal bearing operation without influence of vibration generated by a machine or bearing. The shock pulse method allows timely detecting bearing defects resulted from improper manufacture, improper assembly, improper lubrication and scratches on rotation surfaces.

Bearing condition is determined by the shock pulse method as follows: initially a new bearing has a low shock pulse value and if this value increases up to 1,000 times of the initial shock pulse value, it means that the bearing life has expired.

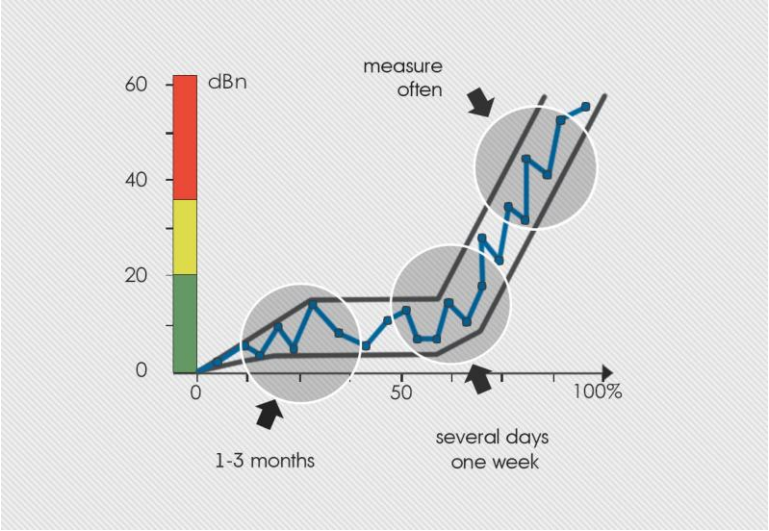

Figure 3-2. Bearing wear development.

Shock pulse strength depends on a shock velocity V, if A represents a peak shock value, then there is a relation of A = f (V), while the shock velocity V also depends on a bearing size, rotation speed and defect size.

The shock pulse method uses several decibel values (Figure 3-3):

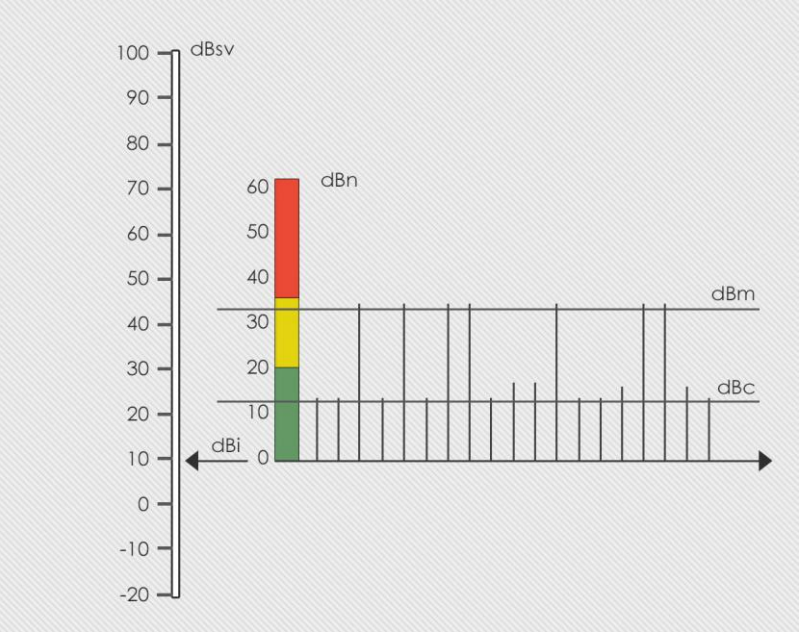

Figure 3-3. Shock pulse dB values.

dBsv (dB-shock value) –the absolute shock pulse dB value.

dBi (dB-initial)- the initial dB value. This is an average value obtained from a variety of tests and measurements conducted on new bearings, and correction of different bearing operation and their rotation speed according to the dBn standard.

dBn (dB-normalized)- the standard dB value. It is a standardized measurement and scale unit used as a standard to estimate bearing condition.

dBm (dB-maximum value)- the maximum dB value obtained from a bearing shock pulse measurement and used to measure the bearing damage severity.

dBc (dB-carpet value)- the carpet dB value used to measure bearing surface roughness, installation and lubrication condition.

Tester description

The BALTECH VP-3450 tester consists of the electronic unit and sensor. The sensor mounted in the handle is connected to the device via the cable. The tester has a housing made of ABS plastic and consists of a single-chip microcontroller, LCD and film keyboard on the front panel. The batteries are in the battery cabinet. The battery cabinet cover is fixed with screws. The outputs for the sensor and headphones are on the bottom panel.

During measurement the sensor is connected to the tester via the cable and is pressed to the bearing cover with the probe.

Appearance and control elements

The appearance of BALTECH VP-3450 and its control elements are shown on the Figures 3-1 and 3-4.

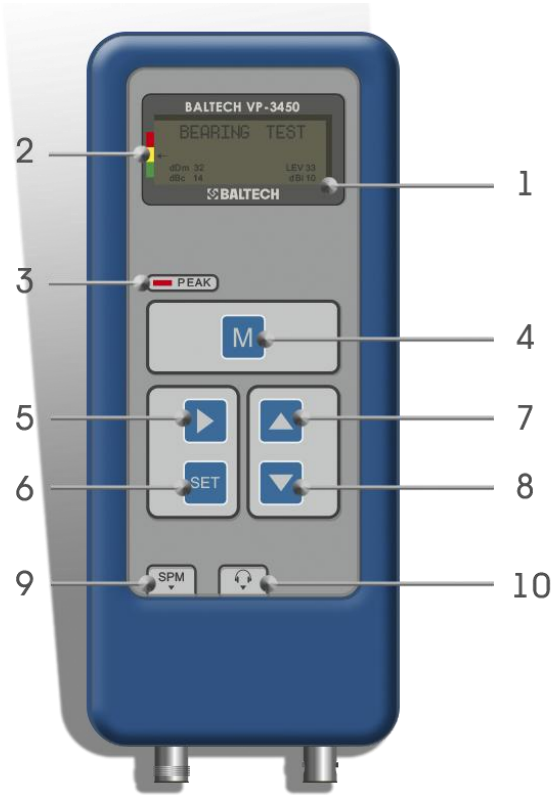

Figure 3-4. Control elements.

1. Display
2. Condition scale
3. Pulse indicator

4. Measuring key (**M**)
5. Navigation key (**Right**)
6. Set key (**SET**)
7. Navigation key **(UP**)
8. Navigation key (**Down**)
9. Output for shock pulse sensor **(SPM)**
10. Output for headphones **(EAR)**

1. Display

The display shows menu, input information and measurement results.

2. Condition scale

Current condition is determined by the shock pulse method according to the scale color: green, yellow and red:

Green – Good condition;

Yellow – Warning;

Red – Damage.

3. Pulse indicator

The pulse indicator flashes when peak values exceed the defined shock pulse range. The measurement range should be set prior to the shock pulse measurement. The indicator will stop flashing.

4. Measuring key

The M key is used for a single measurement. For continuous measurement press and hold this key.

5. Navigation key (Right)

Press this key to move right.

6. Set key

The SET key is used for data input and headphone volume adjustment.

7/8. Navigation key (Up) and navigation key (Down)

These keys are used for adjustment of volume and measurement range.

3.5. Marking, preservation and packing

The tester is marked with a serial number, which is specified in the technical specifications of the device along with the assembly and packing date.

The tester is packed in the transportation case, which is a part of the delivery set.

4. Operation

4.1. Operation conditions:

Ambient conditions:

- Ambient temperature: 0…+50 ºC
- Relative humidity at 25 °C: ≤80%

The tester is powered from the alkali batteries 1.5 V, type LR6 (AA). Nickel-metal-hydride or nickel-cadmium batteries can be also used. The continuous operation time without the battery replacement reduces considerably.

4.2. Preparation to operation

4.2.1. Unpacking and installation

To unpack the tester open the transportation case and take out the required components.

Before you start using the tester:

- Check all the tester components for any damages and contamination. If necessary, perform actions mentioned in the section 5 "Maintenance".

Attention!

Do not use the tester if it has any damages.

- Check the tester components according to the paragraph 3.3. "Delivery set".

4.2.2. Operation modes

GENERAL FUNCTIONS

Tester on/off:

Press any function key to switch on the BALTECH VP-3450 tester. The tester shuts down automatically in 30 seconds after the last pressing of any key.

Sensor and headphone connection

A screw BNC connector (9) is used to connect the shock pulse sensor, the output (10) is used to connect the headphones; once headphones are connected the headphone mode is activated; disconnect the headphones from the tester if you want to exit the headphone mode.

Memory

When the tester is shut down the following information is saved: the last shock pulse reading (dBm, dBc, dBi), arrow position on the condition scale; press the SET key to change settings, the last reading or arrow position on the condition scale will not be changed; press the M key to perform a new measurement.

SHOCK PULSE MEASUREMENT

The standard shock pulse reading (dBN) displays a bearing condition. The initial bearing dBi value should be input before measurement; VP-3450 received the dBi value within the range 9～40dBi; the absolute dBsv value measurement is used to adjust ranges.

When dBi is lower than -9 the display shows "--"(two hyphens).

Initial dBi value setting

There are two methods to set the initial dBi value:

1) Direct change of the initial dBi value

- Press the SET key to open the menu. The cursor will flash on the current dBi value (Figure 4-1).

Figure 4-1. Direct change of the initial dBi value.

- Press the UP key to increase the dBi value and the DOWN key to decrease the dBi value;
- Press the M key to exit the setting mode.

2) Setting rpm and diameter

- Press the SET key to open the menu.
- Press the SET key again to move the cursor to the rpm input field. Input the rpm value. Use the RIGHT key to move from one digit to another. The maximum rotation speed is 19,999 rpm (Figure 4-2).

Figure 4-2. Setting rpm and diameter. Step 1.

- Press the SET key to move the cursor to the diameter input field;
- Input a diameter value. Use the RIGHT key to move from one digit to another. The maximum diameter value is 1999 mm;
- Press the SET key to display the dBi value (Figure 4-3).

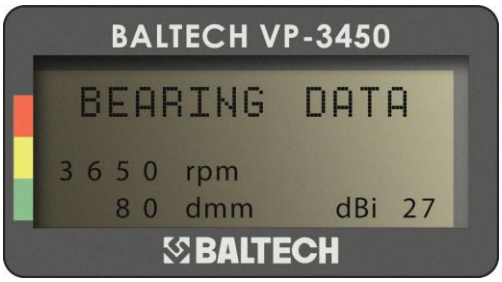

Figure 4-3. Setting rpm and diameter. Step 2.

- Press the M key to exit the setting mode.

Note

When dBi is lower than -9 or higher than 40, the display shows "--" (two hyphens).

Shock pulse measurement:

Switch on the tester BALTECH VP-3450, the last reading and dBi value will be displayed.

If necessary, change the dBi value

Move the sensor to a measurement point;

Press the M button.

Figure 4-4. Shock pulse measurement.

Within a few seconds a new maximum value dBm and carpet value dBc will be displayed on the screen; these values will be displayed on the screen until the M key is pressed to perform another measurement.

If the dBi value is set, the tester measures the standard values and the result is indicated on the screen by the arrow.

Green – Good condition (0～20 dBN)

Yellow – Warning (21～34 dBN)

Red – Damage

When dBi is not set, the tester will measure the absolute decibel value and the arrow is not displayed.

Press and hold the M key, the measurement results shown on the screen will be updated once in a few seconds until the M key is released.

MEASUREMENT RANGE SET

In the operation mode the tester continuously compares the measured shock pulse values with the last displayed dBm value. When the shock pulse value is higher than the displayed dBm, the pulse indicator flashes. If the dBm value is high (in yellow or red areas) and the pulse indicator flashes frequently, it is recommended to re-measure or to change the measurement range.

Press the UP key to increase the measurement range. Measurement step is one decibel. The initial level corresponds to the last measured dBm value. If the pulse indicator stops flashing, it means that the shock pulse values are within the current measurement range.

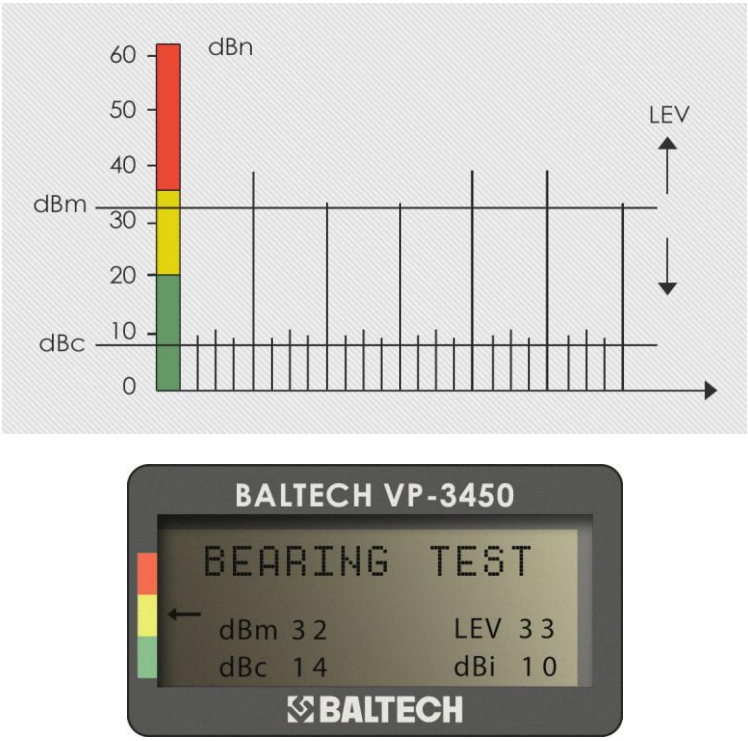

Figure 4-5. Measurement range set.

Press the DOWN key to reduce the measurement range, the more pulses exceed the defined measurement range, the more frequently the pulse indicator flashes. If the measurement range is close to the dBc value, the red pulse indicator is red.

HEADPHONES

To determine a shock pulse source the headphones can be used. The operation principle of the headphones is as follows- if the shock pulse value is higher than the measurement range, the pulse is audible; If the measuring range is higher than the largest shock pulse value, the pulse is inaudible. The more pulses exceed the measurement range, the more frequent the pulse occurs. When the range is close to dBc, the sound in the headphones becomes continuous.

If you want to exit the headphone mode disconnect the cable from the tester BALTECH VP-3450.

The measurement range is in **dBsv.**

Volume adjustment:

- To adjust volume press the SET key when the headphones are is connected, the volume level can be changed with the UP/DOWN keys from 1 to 10 (Figure 4-6).
- Press the M key to return to the headphone mode.

Figure 4-6. Headphone mode.

4.3. Use of the tester BALTECH VP-3450

4.3.1. Establishment of equipment monitoring system

In order to obtain accurate and reliable readings using the tester BALTECH VP-3450 two main requirements should be met:

- Choose a measurement point according to SPM rules;
- Calculate a correct initial dBi value according to a bearing diameter and rpm.

There are conditions under which the shock pulse measurement doesn't provide reliable results:

- Low rotation frequency or irregular loads;
- Interference from other pulse sources;
- Quick damage process;

To ensure efficient bearing monitoring the following conditions should be met:

- Careful preparation for obtaining effective initial values of good bearing and equipment condition;
- Planned and perfect procedure of periodic data collection;
- All-around evaluation of any result deviating from the good condition

4.3.2. Measurement procedure

Application

The measurement range of BALTECH VP-3450 allows measuring bearings with the maximum rotation frequency up to 19,999 rpm and maximum dBi 40. The minimum dBi value is -9dBi; the real limit is 0 dBi, as in case of low values for low-speed bearings it is almost not possible to obtain useful information on the bearing condition.

Measurement range

Normally, a bearing damage develops very slowly, and a measurement interval is determined according to the following rules:

- Bearings should be inspected at least once a month;
- Critical equipment and heavily loaded bearings shall be measured more frequently than standard bearings;
- Bearings should be monitored more frequently if their measuring values are not stable;
- Damaged bearings should be monitored as frequently as possible.

Note

After bearing lubrication at least one hour should go by before start operating it.

Measurement point selection

To obtain a correct measurement signal, a measurement point should be selected according to the following rules (Figure 4-7):

- Distance from the bearing to the measurement point should be direct and as low as possible;
- Not more than one mechanical component should be between the bearing and the measurement point;
- The measurement point should be in the bearing loaded area (in most cases upper part of the bearing).

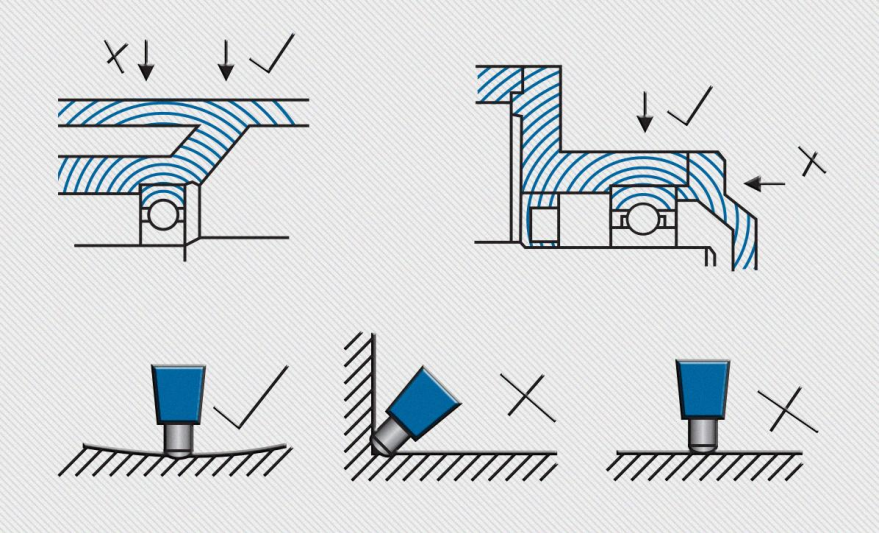

Figure 4-7. Measurement point selection.

If the measurement point doesn't correspond to the above requirements, the condition scale will not correspond to true values.

Determine the strongest signal: use the probe to determine a point with the strongest signal, if there are several points with the same signal level, select the easiest point to obtain readings.

Mark the measurement point: the measurement point should be clearly marked so that obtained readings are comparable.

Follow-up form (Figure 4-8)

This follow-up form allows detecting a bearing condition. As opposed to a single measurement, periodic measurements of the damaged bearing over a period of time is more reliable base for planning of repair and maintenance.

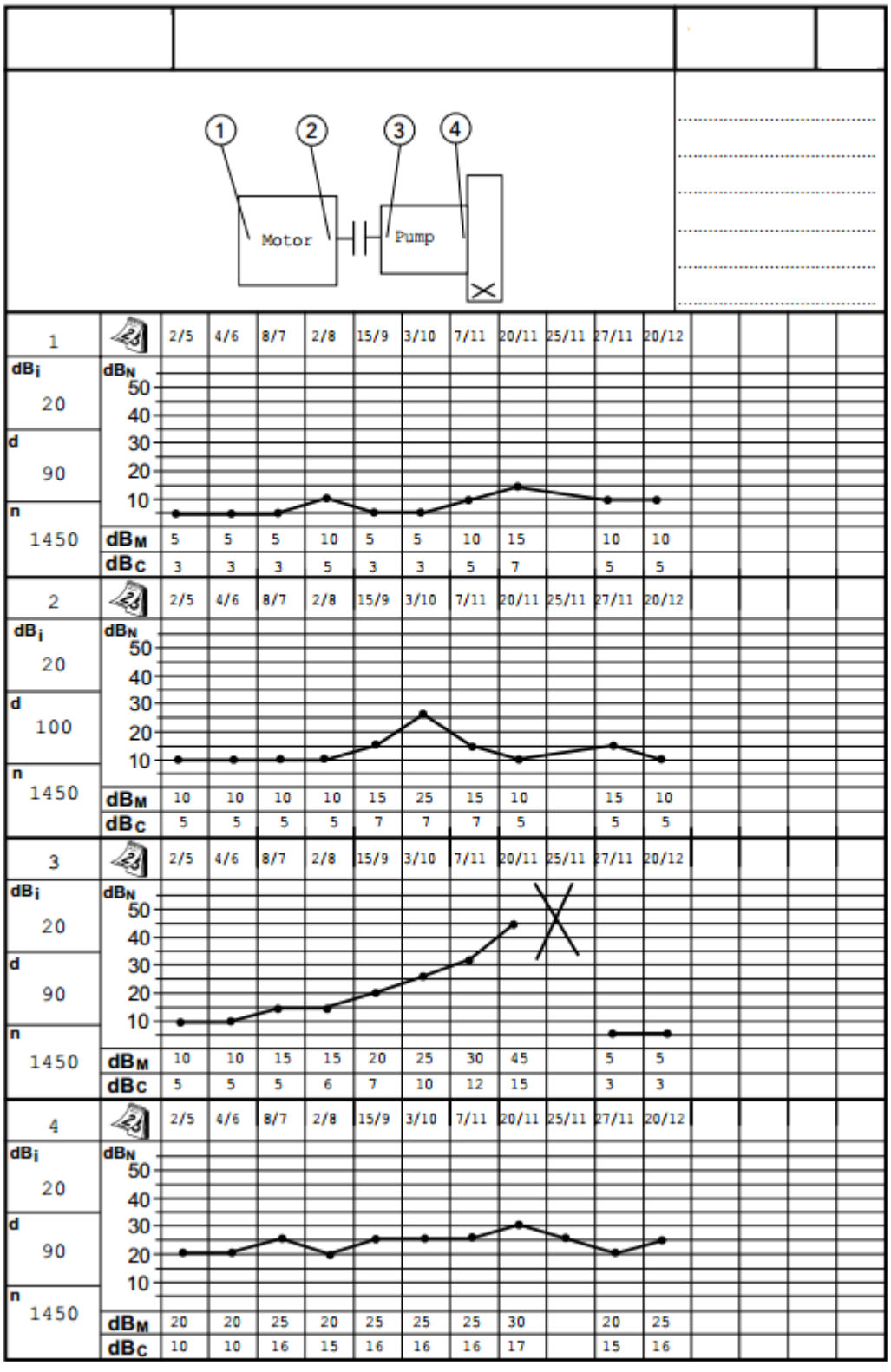

Figure 4-8. Follow-up form.

The follow-up form contains the following information:

1. Equipment description, name, number, position;
2. Display of measurement points, their position and number;
3. Notes;
4. Measurement point number;
5. Initial dBi value;
6. Bearing diameter;
7. Rotation frequency;
8. Measurement date;
9. Measurement result trend (**dBm, dBc**);
10. Measurement results (**dBm, dBc**).

4.3.3. Information analysis

Data process and analysis

For correct data process and analysis the information you provide to maintenance personnel should be detailed and reliable.

During measurements you should consider that some machines contain shock pulse sources. Besides, bad bearing condition may be resulted from lots of reasons other than damage; therefore during the data process and analysis you should use pulse indicator, probe, headphones and your own knowledge in order to avoid misinterpretation.

The data process and analysis are necessary in the following conditions:

- During the first check of a new bearing it is necessary to make sure that the received initial values are reliable.
- In case of considerable change of shock pulse values it is necessary to determine the reason of such changes - improper installation, improper lubrication, overload or damage so that to determine what maintenance work should be done.

To make sure that the measured information is correct:

- Check the defined rpm and diameter, dBi settings.

If the pulse indicator flashes, continue to measure dBm and dBc values to obtain the correct data.

Standard bearing operation modes

a) Bearing good condition (Figure 4-9).

The **dBm** value of the good bearing is lower than 20 **dB**, the **dBc** value – within the range 5 ~ 10 dB. If these values are very low, it can indicate incorrect measurements, for example, in case of improper measurement point or bearing no-load running.

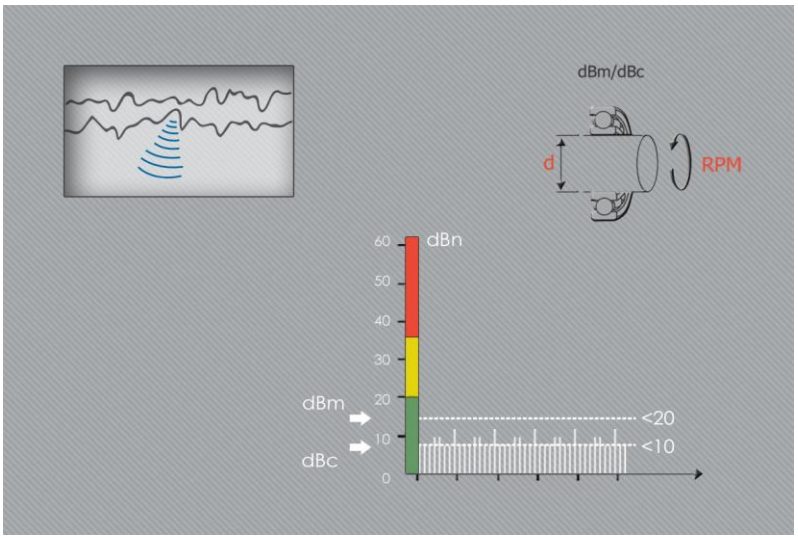

Figure 4-9. Bearing good condition.

b) Bearing damage at an early stage of development (Figure 4-10).

If the dBm value is within 20~35 dB (yellow area) a medium growth of the dBc value indicates minor bearing surface damages.

At this stage the measurements should be performed more frequently so that to determine if the bearing is in good working condition or deteriorating.

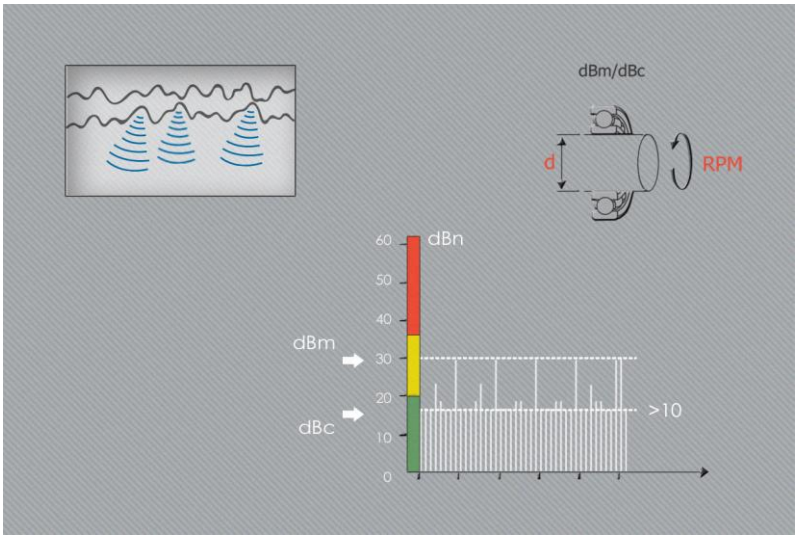

Figure 4-10. Bearing damage at an early stage of development.

c) Bearing with severe damage (Figure 4-11).

If the dBm value is higher than 35dB (red area), dBc and dBm values differ considerably, the dBm value indicates the bearing damage severity level:

•35~40 dBn: slight damage;

•40~45 dBn: severe damage;

•>45 dBn: breakdown risk.

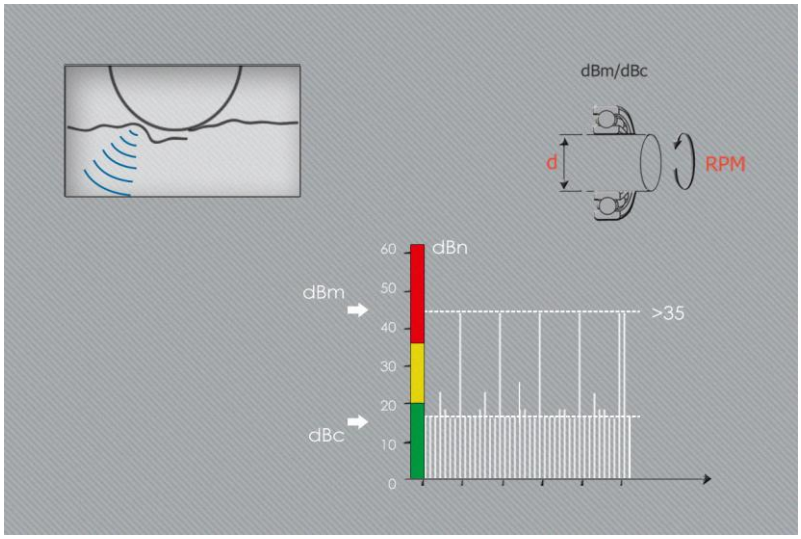

Figure 4-11. Bearing with severe damage.

Another reason can be strong lubrication contamination. Check the oil condition with the mini – laboratory BALTECH OA-5000. If after the lubrication change the dBm value decreases a little, it means that the bearing is damaged.

d) Periodic shock pulses (Figure 4-12).

A periodic shock pulse is typically equal or multiple of the bearing rotation frequency.

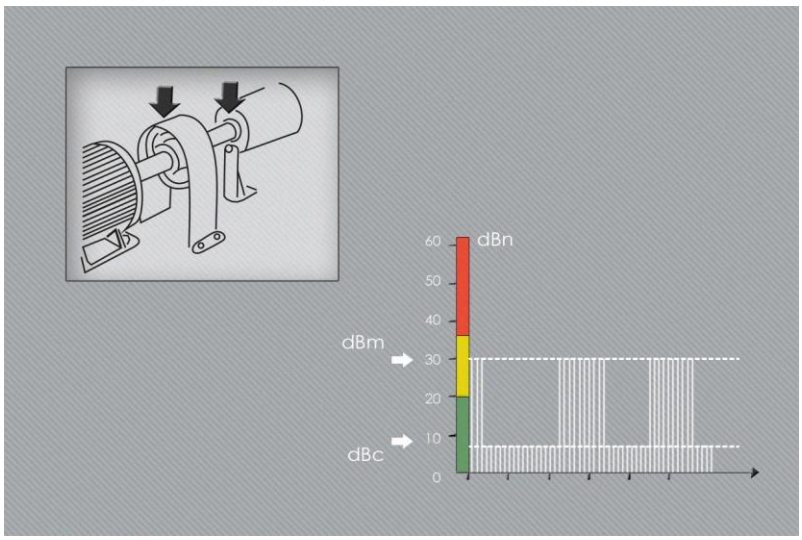

Figure 4-12. Periodic shock pulses.

e) Cyclic shock pulses (Figure 4-13).

A periodic single shock pulse can indicate overload, pressure shock, gear damage or other impacts.

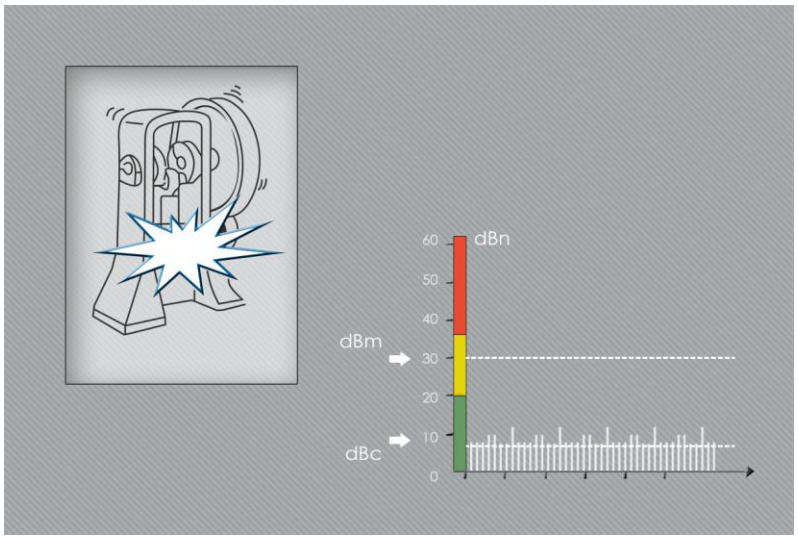

Figure 4-13. Cyclic shock pulses.

f) Improper lubrication (Figure 4-14).

High dBc value indicates bearing operation without lubrication, dBm and dBc values differ slightly, possible reasons are:

- Insufficient lubrication (lubrication of poor quality, use of waste, resin or condensated oil);
- Nonsymmetrical installation or bending;
- Emergency shutdown

Change oil or increase oil supply.

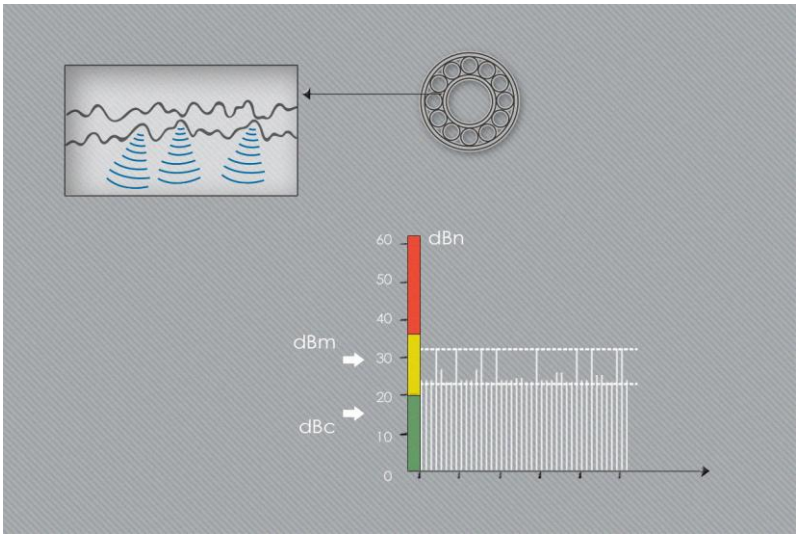

Figure 4-14. Improper lubrication mode.

g) Cavitation or similar problems (Figure 4-15).

Shock pulses in case of pump cavitation are the same as in case of improper lubrication. In this case the highest shock pulse values will be on the pump housing and on all the bearings.

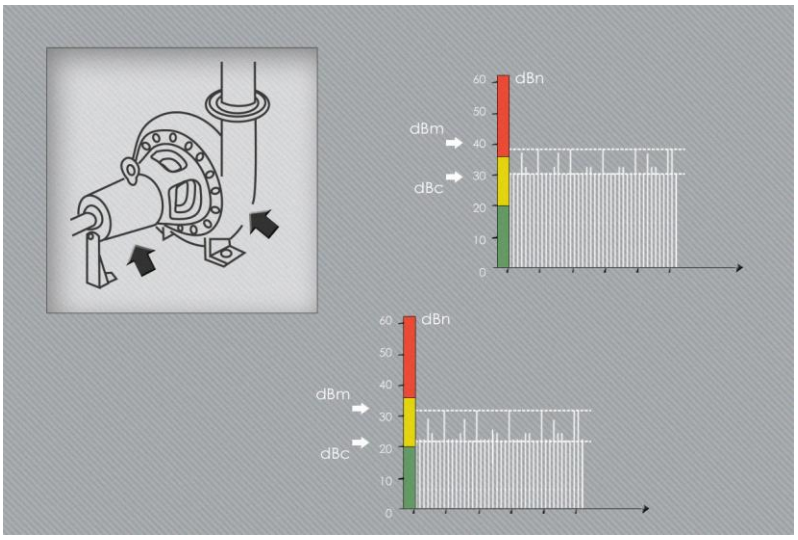

Figure 4-15. Cavitation or similar problems.

h) Irregular measurement results (Figure 4-16).

If low values appear suddenly or if the values disappear, the reasons are:

- Improper bearing operation, the sensor is attached to a measurement object not tightly or damaged.

If the tester and the rolling element bearing are in good condition, and the bearing have been recently lubricated, such low values can be a result of slippage between the rotating axis and bearing or between the bearing and bearing housing.

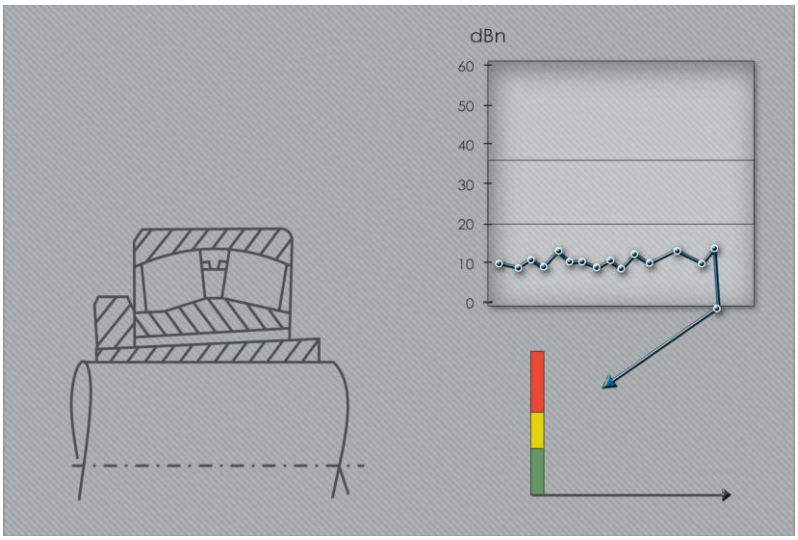

Figure 4-16. Irregular measurement results.

i) Inconsistent shock pulse values of damaged bearings (Figure. 4-17).

Damaged heavy duty needle roller bearings generate a dramatic increase of shock pulses. With time the damaged surface can be smoothed which will result in reduction of the shock pulse values. However such bearings are defect.

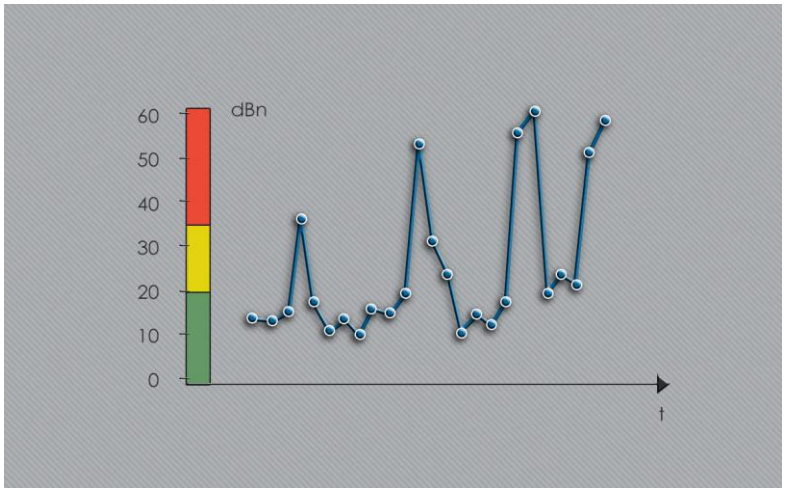

Figure 4-17. Inconsistent shock pulse values of damaged bearings.

5. Maintenance

5.1. Tester cleaning

The tester should be cleaned with a cotton cloth moistened with a mild soap solution and wiped dry.

5.2. Battery replacement

The tester is powered from alkaline battery 1.5 V (LR6) or from rechargeable batteries. If the display shows "LOW BATTERY" it means that the battery should be replaced. Unscrew the screws on the battery cabinet cover, remove the cover and replace the batteries, observing the polarity.

6. Storage and transportation

During transportation and storage the tester should be packed in the transportation case. It is recommended to remove the batteries before long-term storage.
Before long-term storage the batteries should be removed.

7. Warranty

The manufacturer guarantees the tester BALTECH VP-3450 to the technical characteristics in case of the observance of the operation, maintenance, storage and transportation conditions, specified in the operation manual.

The warranty period is 12 months from the shipment date.

Warranty storage life is 6 months from the production date.

The warranty liabilities cease to be in force:

- if there are visible mechanical damages;

- in case of using improper batteries.