

Balancing with the VIBXPERT® II

Presented By Colin Pickett



Content

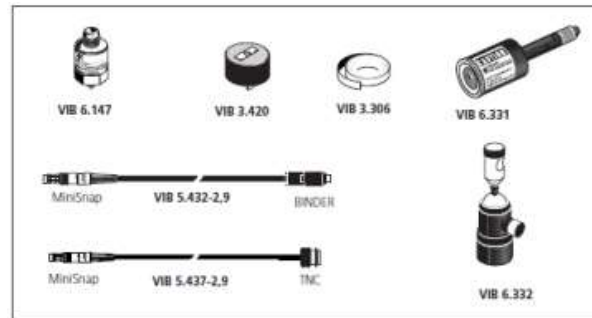
- ▶ **Requirements**
- ▶ **Balancing functions and settings in VIBXPRT® II**
 - ▶ Diagnostic measurements
 - ▶ Balancing in 1 & 2 planes
 - ▶ Sensor arrangement
 - ▶ Measurement setup
 - ▶ Machine setup
- ▶ **Additional useful information**
 - ▶ Balancing reports VIBXPRT® II & OMNITREND®
 - ▶ Recovery file
 - ▶ 1-plane balancing with control plane
 - ▶ Influencing coefficient

Requirements



- ▶ **Balancing hardware**

- ▶ VIB 5.386-HW
- ▶ VIB 5.388-HW



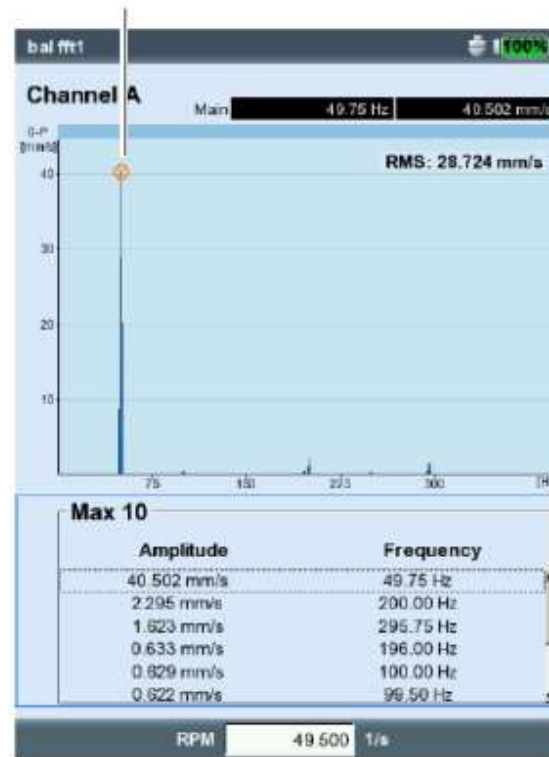
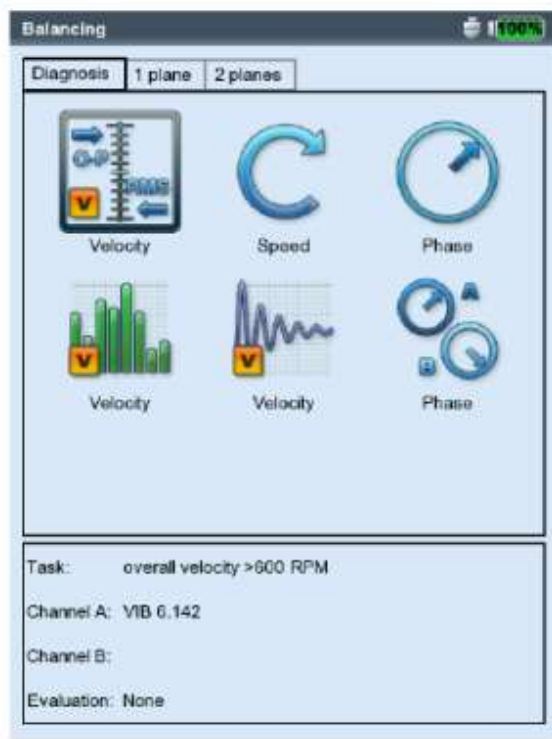
- ▶ **Balancing Firmware**

- ▶ VIB 5.316-BAL



Balancing Functions & Settings in VIBXPERT® II

► Diagnostic measurements '1st Harmonic'



VCMR


Balancing Functions & Settings in VIBXPERT® II



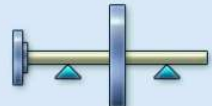
► Balancing in 1 & 2 planes

Balancing

Diagnosis 1 plane 2 planes



1 plane overhung



1 plane intermediate

Task: 1 plane intermediate


Channel A: VIB 6.142

Channel B:


Machine: (no machine setup)

Balancing

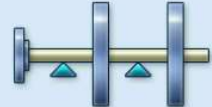
Diagnosis 1 plane 2 planes



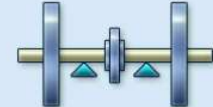
2 planes overhung



2 planes intermediate



2 planes overhung & intermediate



2 planes overhung (belt-driven)

Task: 1 plane intermediate

Channel A: VIB 6.142

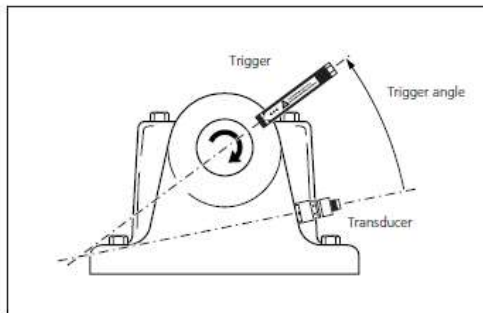
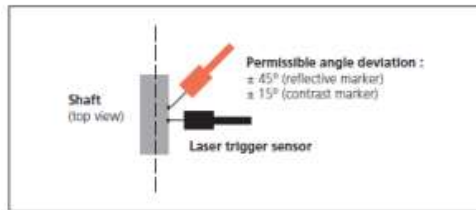
Channel B:

Machine: (no machine setup)

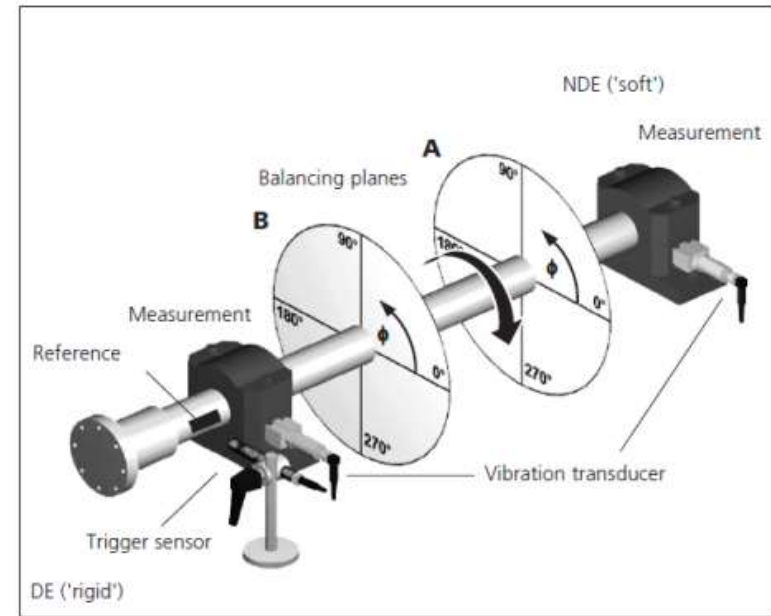
Balancing Functions & Settings in VIBXPERT® II



► Sensor arrangement



Trigger angle:
Angle between transducer and trigger is calculated counter to the direction of rotation of the rotor



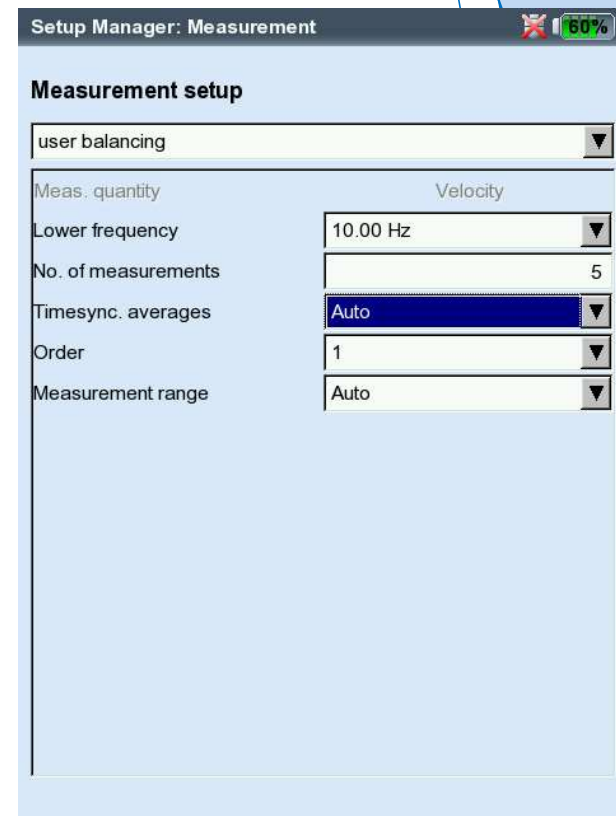
Angle convention: the angular reference mark lies at 0°;
The fixing angle φ for the balancing weight is counted against the direction of shaft rotation.
TIP: Number the fan blades corresponding to the counting direction of the fixing angle.
Blade no. 1 is taken as the 0° position.

Balancing Functions & Settings in VIBXPERT® II

▶ Measurement setup

- ▶ Filter 0.5 / 1 / 2 / 10 Hz
- ▶ No of measurements (AVERAGING).
 - ▶ 1 - 20 the number of averages is automatically increased to the maximum value if the indicator shows strongly varying unbalance.
- ▶ Time sync. Averages:
 - ▶ 'Auto': Time synchronous number of averages is a function of the rpm.
 - ▶ 'Manual': Time synchronous number of averages can be entered (max. 254).
 - ▶ 'Infinite': Each individual measurement is averaged with the preceding individual measurement. The longer the measurement takes, the more stable the final result. → useful if "beating" is present
- ▶ ORDER: 1 - 5;
 - ▶ order filters enable the balancing at RPM harmonics of a higher order; these special cases can occur in special machine configurations.
- ▶ Measurement range

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Balancing Functions & Settings in VIBXPERT® II



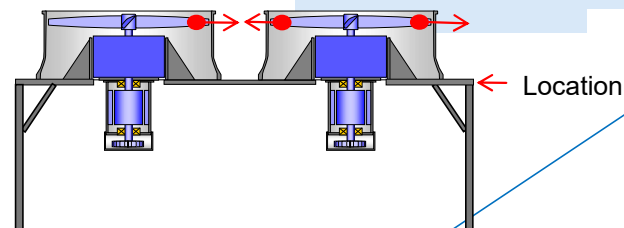
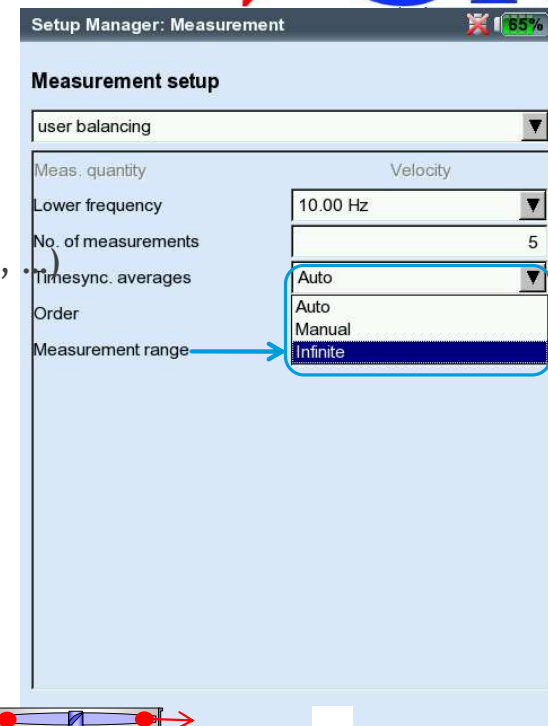
Time-synchronous average

- ▶ Parameter in the measurement setup
 - ▶ Auto: RPM-dependent
(1Hz => 3 averages, 2 Hz => 4 averages, ...)
 - ▶ Manual: Max. 254 averages
 - ▶ Infinite: Measurement stopped by user
- ▶ Motivation: suppression of beating

Beating

Superposition of two vibration components with similar frequencies (e.g., induction motor with identical speed but different slip)

Overall value v_{rms} varies with slip frequency, depending on phase difference of the two components



Balancing Functions & Settings in VIBXPRT® II



Machine setup

- Planes: 1 or 2
- ▶ CORRECTION MODE:
 - ▶ *Free / fixed location / fixed weight / meas. Tape*
- ▶ TRIAL/TRIM MASSES*:
 - ▶ *add / remove*
- ▶ BALANCE QUALITY:
 - ▶ *0 - 4000; according to DIN ISO 1940*
- ▶ USE DIFFERENT RADII:
 - ▶ *Yes / No*
- ▶ RADIUS:
 - ▶ *Balancing radius; distance of the balancing weight from the rotational axis*
- ▶ ROTOR MASS:
 - ▶ *The mass of the rotor is taken into consideration in the calculation of the trial weight.*
- ▶ AUTO TRIAL WEIGHT:
 - ▶ *Yes / No; VIBXPRT calculates a trial weight from the machine data and recommends this in the trial run. If this option is deactivated, the trial weight attached to the rotor must be entered in the data screen of the trial run.*
- ▶ TRIGGER ANGLE:
 - ▶ *Angle between transducer and trigger*

Setup Manager: Machine

Machine setup

fan1

Planes	1
Correction mode A	fixed location
No. of locations A	8
Trial/Trim weights	add
Balance quality	6.3
Use different radii	No
Radius A	6.55 inch
Rotor mass	25.00 lb
Auto trial weight	Yes
Trigger angle A	0°
Speed (bal. quality)	Disabled
Check speed	Yes
Control 2nd plane	Yes
Min. error in 2nd plane	Yes
Auto average	Yes
Check stable	Yes
Check bad influence	Yes
Recalc coefficient	No
Free-run	No

Balancing Functions & Settings in VIBXPRT® II



- ▶ SPEED (bal. quality):
 - ▶ *Balancing RPM; should be as close as possible to the operating RPM, but if not, here you can set machine full speed*
- ▶ CHECK SPEED:
 - ▶ *Yes / No*
- ▶ CONTROL 2ND PLANE:
 - ▶ *Yes / No; when balancing in a plane, the vibration in a second plane can be recorded and displayed as well*
- ▶ AUTO AVERAGE:
 - ▶ *Yes / No;*
- ▶ CHECK STABLE:
 - ▶ *Yes / No;*
- ▶ CHECK BAD INFLUENCE:
 - ▶ *Yes / No*
- ▶ RECALCULATING COEFFICIENT:
 - ▶ *Yes / No*
 - ▶ *If set to No, coefficient of trial run will be calculated*
 - ▶ *If set to YES, coefficient will be newly calculated for every balancing run.*
- ▶ FREE-RUN:
 - ▶ *Yes / No; for balancing experts only*

Setup Manager: Machine 65%

Machine setup

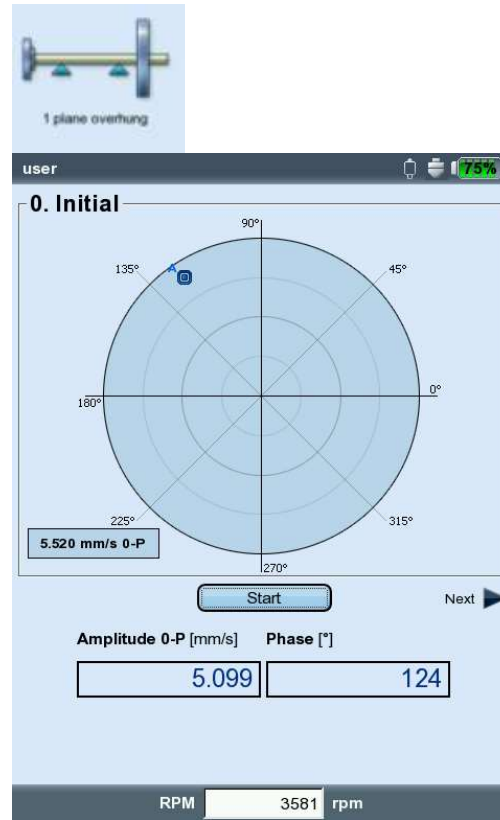
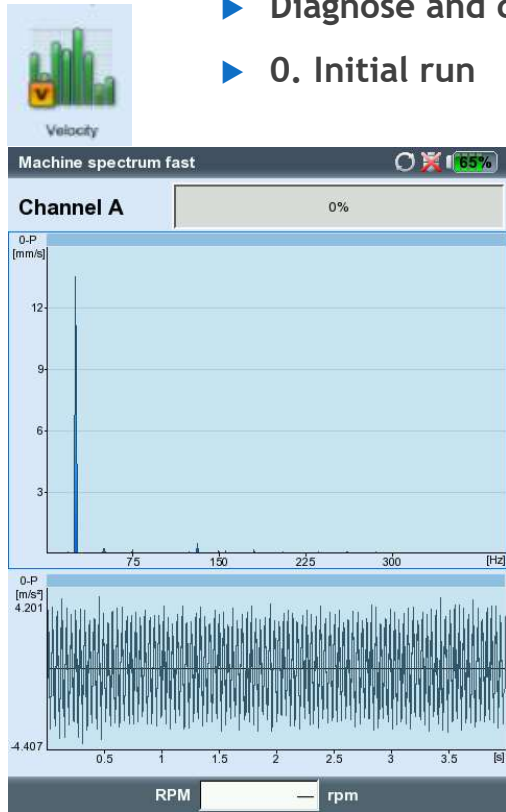
fan1

Planes	1
Correction mode A	fixed location
No. of locations A	8
Trial/Trim weights	add
Balance quality	6.3
Use different radii	No
Radius A	6.55 inch
Rotor mass	25.00 lb
Auto trial weight	Yes
Trigger angle A	0 °
Speed (bal. quality)	Disabled
Check speed	Yes
Control 2nd plane	Yes
Min. error in 2nd plane	Yes
Auto average	Yes
Check stable	Yes
Check bad influence	Yes
Recalc coefficient	No
Free-run	No

1 Plane Balance Procedure

1 Plane Balance

- ▶ Diagnose and confirm
- ▶ 0. Initial run



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1 Plane Balance

- ▶ Calculation of trial weight

$$\frac{TM = M_R \times S}{r}$$

Where;

TM = Trial Mass

M_R = Rotor Weight

S = Displacement amplitude of vibration

R = Correction radius

VIBXPRT® Can do this for you.

1 Plane Balance

- ▶ Stop the machine
- ▶ Lock off / Isolate, make safe the machine
- ▶ Obtain access to the rotor
- ▶ Add Trial Weight
- ▶ Secure access to the rotor
- ▶ Re-energize the machine /remove lock
- ▶ Run the machine to the same speed as the original run.

1 Plane Balance



▶ 1. Trial run

user 75%

1. Trial

Mount balancing weight

0.025 oz 270 °

Previous Next

Data

No.	Weight [oz]	Angle [°]	Vibration 0-P [mm/s]	Angle [°]
0	—	—	5.099	124

Balance quality: —
Residual force: —

user 75%

1. Trial

9.994 mm/s 0-P

Previous Start Next

Amplitude 0-P [mm/s] Phase [°]

2.818 242

RPM 3584 rpm

1 Plane Balance

- ▶ Stop the machine
- ▶ Lock off / Isolate, make safe the machine
- ▶ Obtain access to the rotor
- ▶ Are you removing Trial Weight?
- ▶ Add Correction Weight to correct position/angle
 - ▶ Did you place the weight in the correct direction?
- ▶ Secure access to the rotor
- ▶ Re-energize the machine /remove lock
- ▶ Run the machine to the same speed as the previous run.

1 Plane Balance



▶ 2. run

2. Trim

Mount balancing weight

0.018 oz 291 °

Previous Next

No.	Weight [oz]	Angle [°]	Vibration 0-P [mm/s]	Angle [°]
0	—	—	5.099	124
1	0.025	270	2.818	242

Balance quality: 2.296 @ 3584 rpm
Residual force: 5.473 N @ 3584 rpm

2. Trim

3.100 mm/s 0-P

Amplitude 0-P [mm/s] Phase [°]

1.111 78

RPM 3583 rpm

1 Plane Balance

- ▶ All Good?
 - ▶ Yes - Great!
 - ▶ No - Trim run Required
- ▶ Stop the machine
- ▶ Lock off / Isolate the machine
- ▶ Add Correction/Trim Weight
- ▶ Re-energize the machine /remove lock
- ▶ Run the machine to the same speed as the original run.

1 Plane Balance



▶ 3. run

user 75%

3. Trim

Mount balancing weight

0.004 oz 245 °

Previous Next

No.	Weight [oz]	Angle [°]	Vibration 0-P [mm/s]	Angle [°]
0	—	—	5.099	124
1	0.025	270	2.818	242
2	0.018	291	1.111	78

Balance quality: 0.5 @ 3583 rpm
Residual force: 1.191 N @ 3583 rpm

user 70%

3. Trim

23% of A
135°

1.222 mm/s 0-P

Previous Start Next

Amplitude 0-P [mm/s] Phase [°]

0.834 211

RPM 3583 rpm

user 70%

4. Trim

Mount balancing weight

0.003 oz 18 °

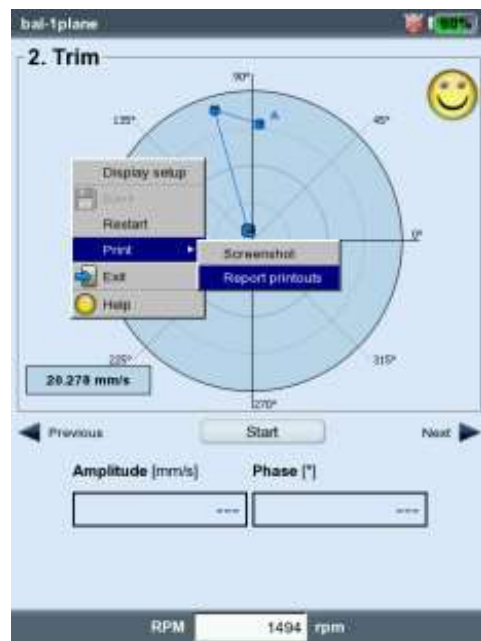
Previous Next

No.	Weight [oz]	Angle [°]	Vibration 0-P [mm/s]	Angle [°]
0	—	—	5.099	124
1	0.025	270	2.818	242
2	0.018	291	1.111	78
3	0.004	245	0.834	211

Balance quality: 0.3752 @ 3583 rpm
Residual force: 0.894 N @ 3583 rpm

Balancing Reports

► VIBXPERT® II pdf



Report selection

Printer: PDF

Reports: Auswucht-Report 2

Common settings | Measure info

Company PRUFTECHNIK CM

Logo pruftechnik

Customer

Inspector

Asset

Result filename

Report event

Setup info Detailed

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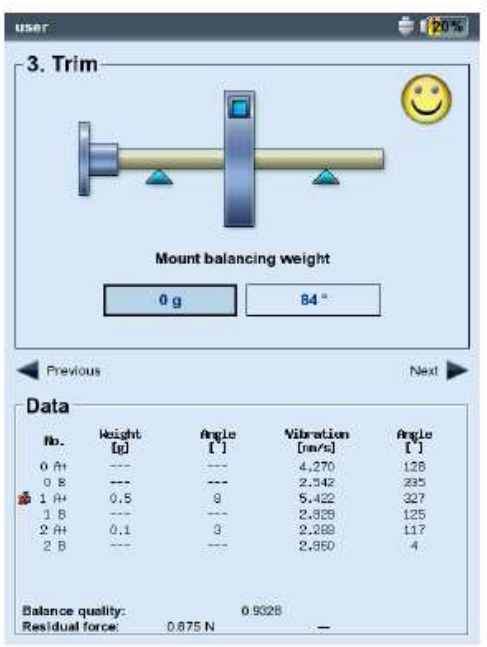
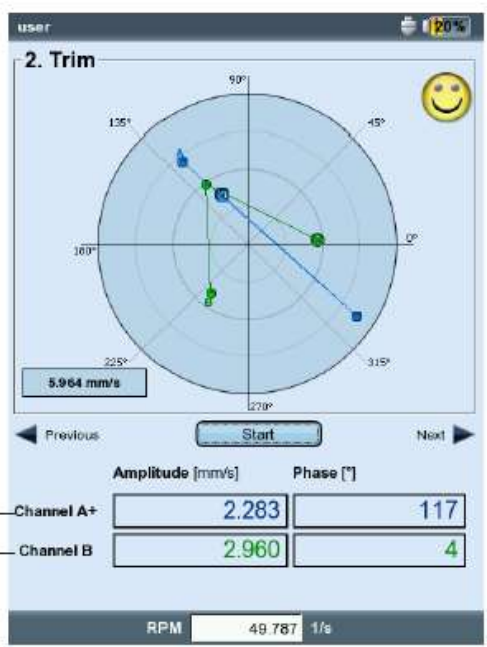
1 Plane Balance



- ▶ 1 plane balancing with control plane

Single plane balancing with control plane

Balancing plane is indicated by a '+'
Control plane

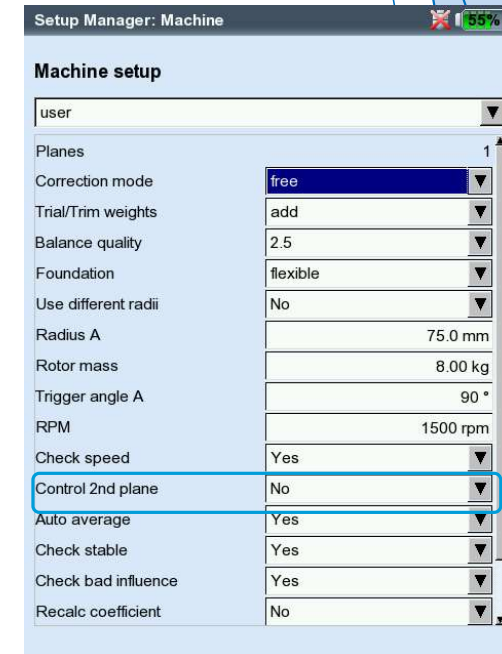
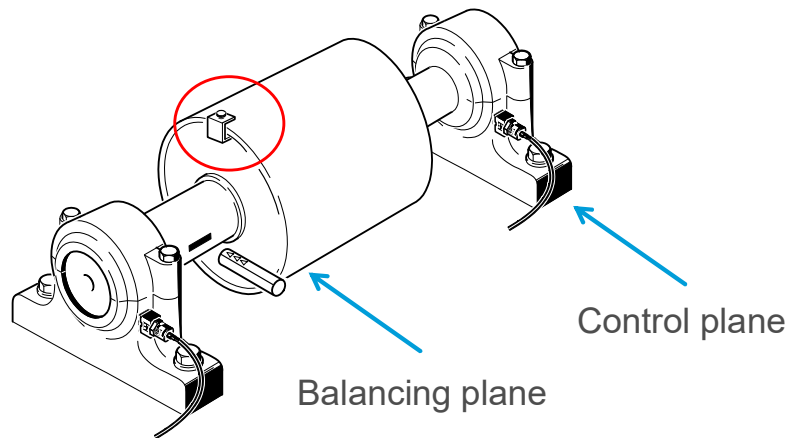


1 Plane Balance



1-plane balancing with control plane (in case 2 plane is not possible)

- ▶ Dynamic imbalance
- ▶ Measure the influence of the balancing mass in the second plane
- ▶ Correct the balancing mass for a minimum error in the control plane

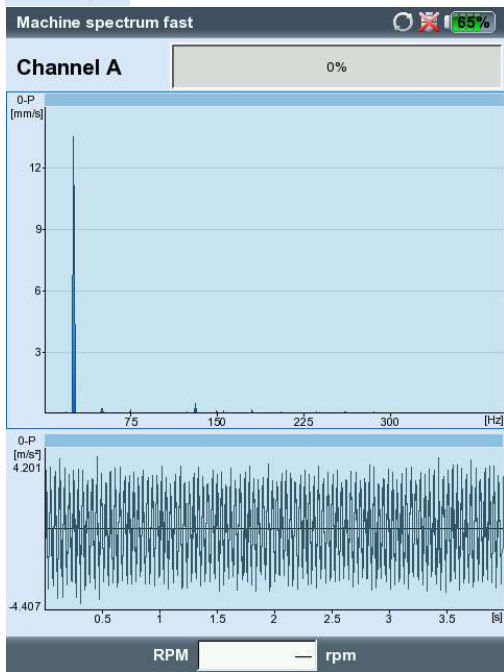
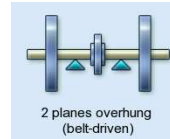


Parameters in the machine setup

2 Plane Balance Procedure

2 Plane Balance

- ▶ Diagnose and confirm
- ▶ Select which Plane has Sensor Channel A
- ▶ 0. Initial run



user 70%

Select plane A

Overview

user 70%

0. Initial

5.861 mm/s 0-P

Start Next

	Amplitude 0-P [mm/s]	Phase [°]
Channel A	5.304	133
Channel B	3.568	297

RPM 3581 rpm

2 Plane Balance

- ▶ Calculation of trial weight

$$\frac{TM = M_R \times S}{r}$$

Where;

TM = Trial Mass

M_R = Rotor Weight

S = Displacement amplitude of vibration

R = Correction radius

VIBXPRT® Can do this for you.

2 Plane Balance

- ▶ Stop the machine
- ▶ Lock off / Isolate, make safe the machine
- ▶ Obtain access to the rotor
- ▶ Add Trial Weight to Plane A
- ▶ Secure access to the rotor
- ▶ Re-energize the machine /remove lock
- ▶ Run the machine to the same speed as the original run.

2 Plane Balance



▶ 1. Trial run Plane A

user 70%

1A. Trial

Mount balancing weight in plane A

A

◀ Previous Next ▶

Data

No.	Weight [oz]	Angle [°]	Vibration 0-P [mm/s]	Angle [°]
0 A	—	—	5.304	133
0 B	—	—	3.568	297

Balance quality: —
Residual force: — —

user 70%

1A. Trial

5.835 mm/s 0-P

◀ Previous Start Next ▶

	Amplitude 0-P [mm/s]	Phase [°]
Channel A	2.073	224
Channel B	3.105	6

RPM rpm

2 Plane Balance

- ▶ Stop the machine
- ▶ Lock off / Isolate, make safe the machine
- ▶ Obtain access to the rotor
- ▶ Are you removing Trial Weight?
- ▶ Add Trial Weight to Plane B
- ▶ Secure access to the rotor
- ▶ Re-energize the machine /remove lock
- ▶ Run the machine to the same speed as the previous run.

2 Plane Balance



▶ 1. Trial run Plane B

user 70%

1B. Trial

Mount balancing weight in plane B

B

◀ Previous Next ▶

Data

No.	Weight [oz]	Angle [°]	Vibration 0-P [mm/s]	Angle [°]
0 A	—	—	5.304	133
0 B	—	—	3.568	297
✖ 1 AA	0.021	270	2.073	224
1 AB	—	—	3.105	6

Balance quality: —
Residual force: — —

user 70%

1B. Trial

6.551 mm/s 0-P

◀ Previous Pause ▶

	Amplitude 0-P [mm/s]	Phase [°]
Channel A	<input type="text" value="5.287"/>	<input type="text" value="133"/>
Channel B	<input type="text" value="5.979"/>	<input type="text" value="323"/>

RPM rpm

2 Plane Balance

- ▶ Stop the machine
- ▶ Lock off / Isolate, make safe the machine
- ▶ Obtain access to the rotor
- ▶ Are you removing Trial Weight?
- ▶ Add Correction Weights for Plane A & B to correct position/angle
 - ▶ Did you place the weight in the correct direction?
- ▶ Secure access to the rotor
- ▶ Re-energize the machine /remove lock
- ▶ Run the machine to the same speed as the previous run.

2 Plane Balance



▶ 2. run

user 70%

2. Trim

Mount balancing weight in plane A

A

B

◀ Previous Next ▶

Data

No.	Weight [oz]	Angle [°]	Vibration 0-P [mm/s]	Angle [°]
0 A	—	—	5.304	133
0 B	—	—	3.568	297
1 AA	0.021	270	2.073	224
1 AR	—	—	3.105	—

Balance quality: 2.454 @ 3582 rpm
Residual force: [A: 5.847 N B: 3.484 N] @ 3582 rpm

user 70%

2. Trim

6.592 mm/s 0-P

◀ Previous Start Next ▶

	Amplitude 0-P [mm/s]	Phase [°]
Channel A	<input type="text" value="1.151"/>	<input type="text" value="110"/>
Channel B	<input type="text" value="0.951"/>	<input type="text" value="288"/>

RPM rpm

2 Plane Balance

- ▶ All Good?
 - ▶ Yes - Great!
 - ▶ No - Trim run Required
- ▶ Stop the machine
- ▶ Lock off / Isolate the machine
- ▶ Add Correction/Trim Weight
- ▶ Re-energize the machine /remove lock
- ▶ Run the machine to the same speed as the original run.

2 Plane Balance

▶ 3. run

3. Trim

Mount balancing weight in plane A

A 0.004 oz 268 °

B 0.004 oz 78 °

Previous Next

No.	Weight [oz]	Angle [°]	Vibration 0-P [mm/s]	Angle [°]
1 BA	—	—	5.292	133
1 BB	0.021	270	5.992	323
2 A	0.020	291	1.151	110
2 B	0.012	108	0.951	288

Balance quality: 0.5336 @ 3584 rpm
Residual force: [A: 1.272 N B: 1.269 N] @ 3584 rpm

Recovery File



► Emergency storage

If the balancing procedure is stopped prematurely (e.g. battery discharged), the data are stored in a recovery file. When the device is switched on again, the balancing procedure can be continued with the aid of this recovery file.

Opening the recovery file



- Switch on the measuring device.
- In the start screen, click on the 'Balance' symbol.
- Open the tab in which the interrupted balancing procedure was started (e.g. '1 plane').
The recovery file is labeled with a warning symbol.
- Click on the recovery file to open the recovery dialog box. It shows information on when the emergency storage took place and the number of balancing steps (see below).
- Click on 'Restore' to open the file and continue the balancing procedure, or to save the data properly.
Click on 'Discard' to clear the data in the recovery file and start a new measurement.
Use 'Exit' to leave the recovery dialog box without deleting the recovery file.

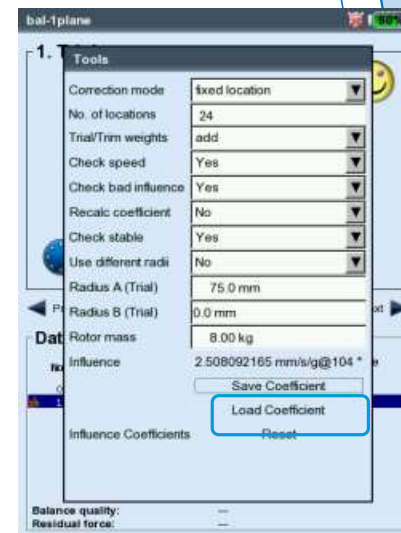
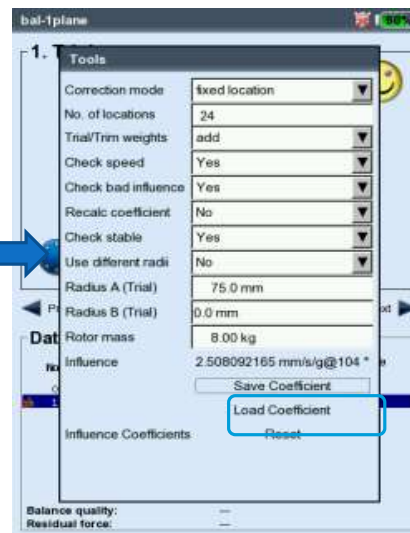
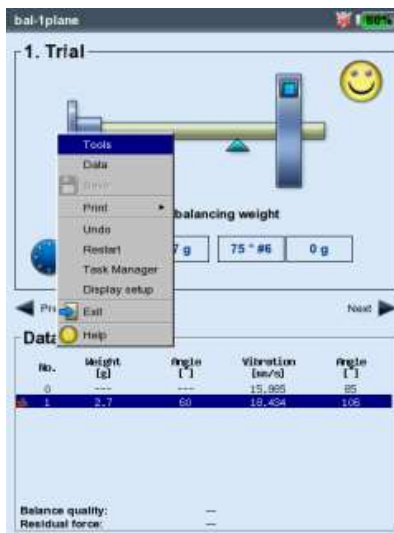


Influencing Coefficient



Influencing coefficient

- ▶ Save the influencing coefficient
- ▶ Load the influencing coefficient for repeat measurements => No test run necessary
 - ▶ Load from file
 - ▶ Take over from previous balancing measurements
 - ▶ Enter manually
- ▶ Same machine, same machine setup, same sensor arrangement is required



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Vibration Condition Monitoring & Reliability

Thank You