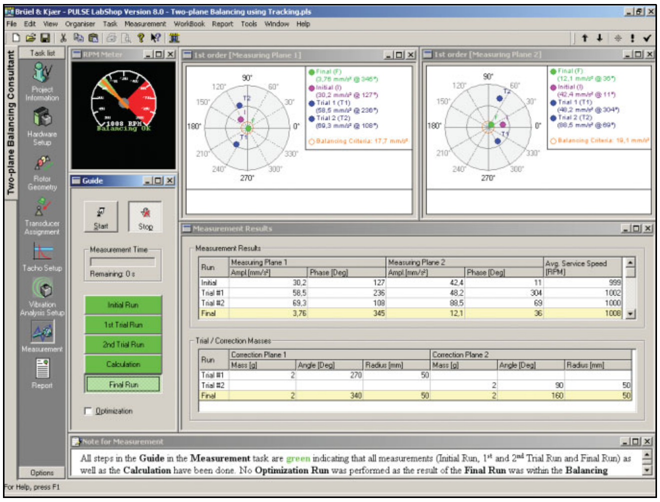
PRODUCT DATA

Two-plane Balancing Consultant — Type 7790-A
Multi-plane Balancing Consultant — Type 7790-B

for use with PULSE™, the Multi-Analyzer System Type 3560

Two-plane Balancing Consultant Type 7790-A is an intuitive and effective tool for in-situ (field) single-plane and two-plane balancing of rotating machinery. Multi-plane Balancing Consultant Type 7790-B adds three- and four-plane balancing. A task-oriented user interface guides you quickly and safely through the necessary steps for setting up, measuring, validating and reporting. Fast trim balancing using stored rotor data is also supported.

The balance quality can be determined according to established balance quality grades (ISO 1940–1) or according to maximum machine vibrations. The balancing procedure can be FFT-based or based on order tracking for the most accurate results.



USES AND FEATURES

USES

- Dynamic, in-situ balancing of rotating machinery
- Trim balancing using stored rotor data (influence coefficients) from previous balancing measurements
- Part of complete solutions for rotating machinery analysis and machine diagnostics including:
  - Measurement transducers and accessories
  - Conditioning, measurement and analysis using the PULSE multi-analyzer system

FEATURES

- Task-oriented user interface that guides you through all the stages of a balancing measurement
- Balancing based on phase-assigned spectra
- FFT-based balancing method for standard balancing on machines with stable speed
- Order tracking-based balancing method for complex balancing on machines with unstable speed (requires Order Analysis Type 7702)
- Balance quality according to established grades (ISO 1940–1) or maximum machine vibrations
- Alarms for excessive vibration levels and speed
- 3D rotor geometry illustrations for easy overview of measuring planes and correction planes
- 2D graphical views of correction planes with weight positions and of measuring planes with transducer positions
- RPM meter with analog and digital read-outs, service speed range and maximum allowable speed
- Display of triggered tacho signal for optimal settings of tacho detection parameters
- Display of vibration time signals and spectra
- Vector polar plots of fundamental frequency/1st order
- Indication of initial, trial, final and optimisation run results in vector polar plots
- Tables of measurement results and applied masses
- Weight splitting for use of standard masses and/or predefined mass positions
- Support of predefined, distinct masses for simplified input
- Fast direct print of reports in predefined layout
- Reporting using Microsoft® Word in predefined layout or formatted according to ISO 20806
- Vibration as displacement, velocity or acceleration
- Support of both SI and Imperial units

Brüel & Kjær

Basic Idea behind In-situ Balancing

Reasons for Balancing

Unbalance is a result of uneven distribution of a rotor's mass and causes vibration to be transmitted to its bearings and support structure during operation. The imperfect mass distribution can be due to material faults, design errors, manufacturing and assembly errors or especially due to faults occurring during operation of the machine, for example, wear, thermal deformation and erosion.

By reducing these vibrations, deterioration of the machine and, ultimately, fatigue failure can be avoided. This can be done by balancing the rotor where masses are added or removed at certain positions in a controlled manner.

Important factors in modern machine design are dictated by increasing service speeds, higher performance/weight ratios and improved reliability. Balancing leads to more optimal design, better performance, cost-effective operation, longer service life, and increased safety. Although errors and faults can be reduced, they can never be eliminated to the extent where balancing becomes unnecessary.

In-situ Balancing

In-situ balancing – also referred to as field balancing – is the process of balancing a rotor in its own bearings and support structure rather than in a specially designed balancing machine. It provides a fast and economic method for test facilities and plant maintenance to balance completely assembled machines. Investment in a balancing machine can be quite substantial and without the need to dismantle the machine and transport the rotor(s) to a suitable balancing facility, significant time and cost can be saved.

Another advantage of in-situ balancing is that the rotor is installed in its working environment thereby ensuring actual rotor support and operating conditions. Assembly and operationally induced changes can be measured and compensated and there are no practical limitations regarding rotor weights and dimensions.

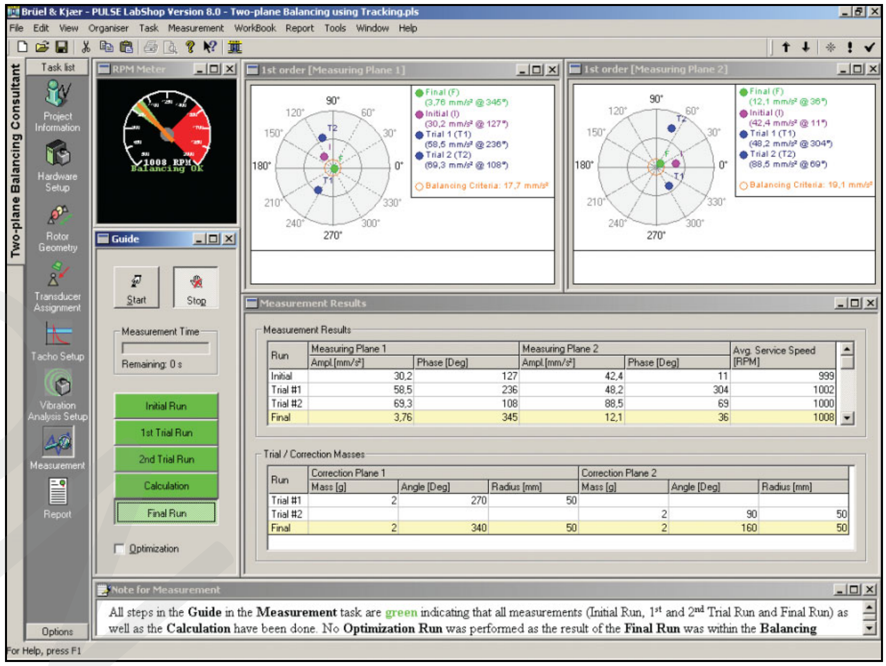
In-situ balancing is done by measuring the vibration in a limited number of measuring planes perpendicular to the shaft axis and adding or removing correction masses in a number of correction planes along the rotor. This will reduce the vibration and thereby the residual unbalance to an acceptable level so that the machine can operate efficiently and safely.

Two-plane Balancing Consultant Type 7790-A supports in-situ balancing of rigid rotors in single or two planes. Multi-plane Balancing Consultant Type 7790-B supports balancing in up to four planes. The balance quality can be determined according to established balance quality grades (ISO 1940–1, single- and two-plane only) or according to maximum machine vibrations. The terminology used is according to ISO 1925.

Interface and Layout

Types 7790-A and 7790-B, hereafter referred to as Balancing Consultant, have a user interface with a task bar down the left-hand side of the screen. Being native Windows®-based software running under the Microsoft® Windows® 2000, Windows® XP and Windows Vista® operating systems, windows can be dragged, scaled, minimised, opened or closed with the mouse. An example of the user-interface is shown in Fig. 1.

Fig. 1
The Measurement task



The Task Bar takes the form of one or more task groups in the left-hand column. Each task group has a series of tasks associated with it. These are activated from icons in the task bar. A basic set of tasks comes with templates which should not be altered. However, additional tasks can be created, rearranged or removed giving you the option of customising the balancing process to the given situation or your specific preferences.

These features make the balancing process both linear and logical. By simply working your way through associated tasks, you automatically perform all the necessary setup, measurement, validation and reporting tasks. New and occasional users can quickly acquaint themselves with the application and experienced users will appreciate the option of customising the task bar to suit their needs. Extensive used of tabular views and graphical illustrations makes the user interface straightforward and intuitive to work with.

Balancing Consultant comes with a template covering both FFT-based measurements and order-tracked measurements. Application projects covering the main uses of Balancing Consultant can be found in the PULSE Knowledge Library.

The tasks included in the default template are described below.

Project Information

The Project Information task is the first task encountered in the default template. In this task, you specify the number of planes, whether you will use FFT or Order Analysis as measurement method, and whether it is a new session or a trim balancing for rebalancing of a known rotor. By using stored rotor data (influence coefficients) and transducer data from previous balancing measurements, a trim balancing can be done quickly.

In the Project Information task you can type in relevant machine data, allowable service speed range, and whether you want to use Balance Quality Grades according to ISO 1940–1 (requires free-free rotor condition) or maximum machine vibrations as criteria for the balance quality. Alarms for vibration level and machine speed can be defined, and are indicated on graphics and with warnings, if exceeded. Operator name, project date and general information about the project can also be entered.

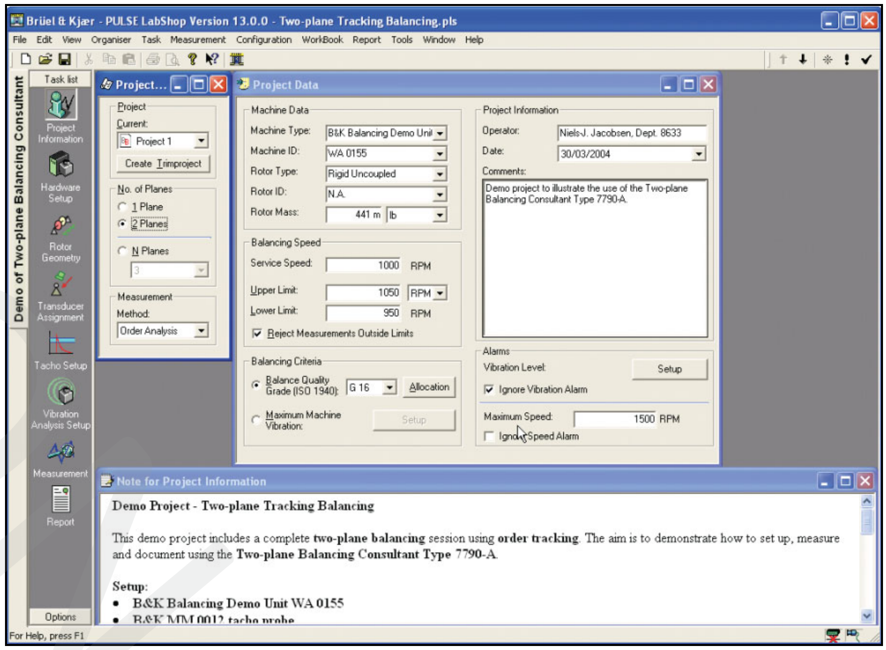


Fig. 2
The Project Information task

Hardware Setup

The front-ends and modules connected are automatically detected and their parameters displayed in tabular form, using the standard PULSE Hardware Setup table. IEEE 1451.4 capable transducers with standardised TEDS (Transducer Electronic Data Sheet), are automatically detected, attached to the correct channels of the input modules, and their data displayed in the Hardware Setup table. Non-TEDS, or non-standard TEDS transducers have to be set up manually. As the Hardware Setup table is linked to the PULSE transducer database, manual updating is quick and easy.

A number of customised layouts (views) of the Hardware Setup table can be quickly made by the user.

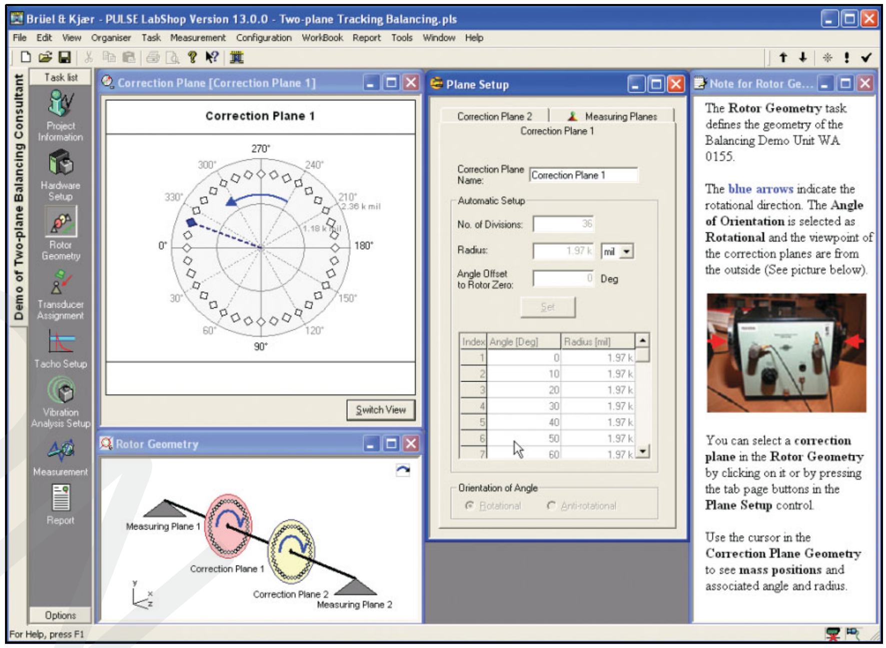
Rotor Geometry

In the Rotor Geometry task (Fig. 3), you define the geometry of your rotor by selecting from a number of predefined schematic drawings describing possible locations of the measuring and correction planes. Available trial and correction mass positions can be defined and edited and are shown in a tabular form, in 2D views of the correction planes, and in the 3D rotor geometry view. The setup of one correction plane is easily copied to another correction plane. The operator's viewpoint of the rotor can be changed and the measuring and correction planes renamed.

Transducer Assignment

In this task you define which of the connected transducers to use and assign their positions on the measuring planes using a Transducer Assignment table. A graphical overview is shown in 2D views of the measuring planes and in the 3D rotor geometry view. For potential later-repeated balancing measurements (trim balancing) on the same machine, knowing the transducer positions can be critical to obtain correct results.

Fig. 3
The Rotor Geometry task

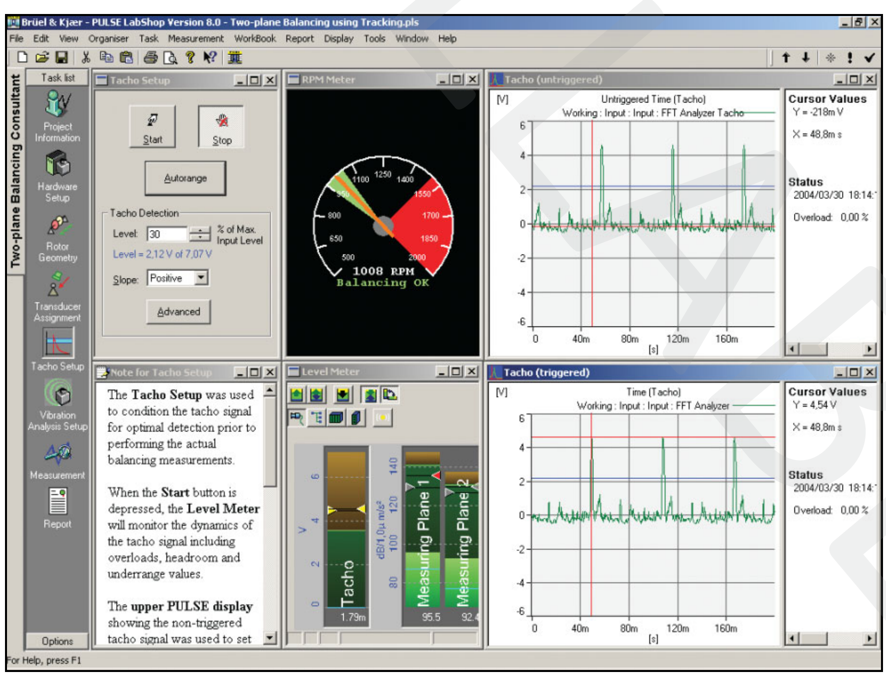


Tacho Setup

This task assists you in setting up the conditioning of the tacho signal for proper detection in practically no time. Using the standard Level Meter from PULSE, you can easily monitor the dynamics of the tacho signal including overloads, headroom and underrange values. The display of the triggered tacho signal helps you evaluate how well-conditioned the tacho signal is. Autoranging of the tacho signal can also be done so very little manual setup is required.

An RPM Meter with analog and/or digital read-out shows the current machine speed and indicates the maximum allowable speed as well as the defined service speed range. Alarms are given if these conditions are violated. The speed range can also be updated here using pop-up or drag and drop.

Fig. 4
The Tacho Setup task



Vibration Analysis Setup

In the Vibration Analysis Setup task you make a preliminary measurement to condition the vibration input channels and set up proper analysis parameters. As in the Tacho Setup, the Level Meter and the RPM Meter monitor the tacho and vibration signals.

Measurements can be based on FFT-analysis, or order tracking. FFT analysis is sufficient for most measurement situations. However, in cases with unstable machinery speed and/or high frequency resolution requirements, order tracking should be used. Order tracking eliminates smearing and provides improved results. Order tracking requires that Order Analysis Type 7702 is installed.

Graphs of the vibration time signals, and frequency spectra and vector plots of the 1st order (fundamental frequency) vibration are shown for each measuring plane, allowing you to easily validate the data before starting the actual balancing process. The preliminary measurement in the Vibration Analysis Setup task might reveal that balancing is not the vibration problem and that other PULSE applications should be applied instead.

Measurement

In the Measurement task the actual balancing process is performed. A Guide takes you through all the steps from initial run, through trial runs, to final run and potential optimisation runs for high-quality balancing. If trim balancing is done, no trial runs are needed and the Guide is modified accordingly. Colour coding of the steps shows where you are in the process. Each step has dedicated controls and windows to assist you in executing that specific step, for example, adding trial masses to the correction planes in the trial run.

During the entire balancing process the Level Meter and RPM Meter can be used for monitoring the tacho and vibration signals. Vector plots of the 1st order (fundamental frequency) vibration are shown for each measuring plane. Influence rings, which indicate the required change of vibration in one measuring plane by adding correction masses to another measuring plane's correction plane, can also be shown.

The measurement results in terms of the measured vibration amplitude and phase in each measuring plane during the various runs, and the applied trial and correction masses' weight and position are shown in a tabular view. Balancing Consultant calculates and shows the theoretical correction masses' weights and positions. As these theoretical positions might not be available, Balancing Consultant also indicates the nearest available position. Weight splitting is also supported, splitting the theoretical mass and position into two practical masses and positions. An example of the Measurement task is shown in Fig. 1.

Reporting

The Reporting task is the final task in a typical balancing session. A report containing project information, machine data, applied trial and correction masses, obtained measurement data from the various runs, and applied balance criteria can be created in predefined Microsoft® Word templates by pressing the "Export to Word" button. This opens up and transfers data to Word as appropriate textual, tabular and graphic data. Using Word, the report can easily be modified to include user-specific information such as company information and logos.

Reports can be based on ISO 20806 recommendations and it is possible to print a report with predefined layout directly without having to open Word first.

Options

The Options task contains additional settings that are used across projects and typically reflect user preferences. These are normally set up the first time Balancing Consultant is used and then not altered very frequently. Consequently, the Options task is located in a specific task group. The Options task includes settings such as choice of vibration parameters (displacement, velocity or acceleration), SI or Imperial Units, number of digits in read-outs, formula for proposed trial masses, etc.

Specifications – Two-plane Balancing Consultant Type 7790-A, Multi-plane Balancing Consultant Type 7790-B

PC AND HARDWARE REQUIREMENTS
- The PC and hardware requirements for PULSE Multi-analyzer System Type 3560, must be fulfilled (see BU 0228)

SOFTWARE REQUIREMENTS
- Microsoft® Windows® 2000, Windows® XP or Windows Vista® operating systems
- Noise and Vibration Analysis Type 7700 or FFT Analysis Type 7770 must be installed
- For balancing using order tracking, Order Analysis Type 7702 must be installed
- A minimum of a two-channel license is required for Type 7700 or Type 7770, and Type 7702 if tracking is used
- For simultaneous measurements on all measurement planes, an *n*-channel licence is required for Type 7700 or Type 7770, and Type 7702 if tracking is used (*n* = number of measurement planes + 1)

BALANCING METHODS
- Dynamic in-situ (field) balancing
- Balancing is best performed by measuring simultaneously in the measuring planes. This improves data quality as exactly the same speed and operating conditions exist for both planes
- Trim balancing using stored rotor data (influence coefficients) from previous balancing measurements
- Balance quality according to established grades as specified in ISO 1940–1 (free-free rotor condition) or max. machine vibrations

BALANCING ALGORITHMS
- Tacho signal used as phase reference and for RPM estimation. Balancing performed within specified service speed range
- Tacho parameters: level, slope, hysteresis, and hold-off
- Alarms for excessive vibration levels, exceeded maximum service speed and service speed outside specified range
- FFT-based using phase-assigned spectra between tacho signal and vibration signals
- Order tracking-based using phase-assigned spectra between tacho signal and vibration signals. Requires Order Analysis Type 7702
- Support of positive as well as negative (mass removal) masses
- Trial masses can remain or be removed between runs
- Weight splitting for use of standard masses and/or predefined mass positions

DISPLAY
- 3D rotor geometry as predefined schematic illustrations
- 2D graphical views of correction planes with weight positions
- 2D graphical views of measuring planes with transducer positions
- 2D graphical illustration for allocation of permissible residual unbalance to each correction plane (two-plane balancing)
- Level meter for monitoring tacho and vibration signals
- RPM meter with analog and digital read-outs, service speed range and maximum allowable speed
- Display of triggered tacho signal for optimal settings of tacho detection parameters
- Display of vibration time signals and spectra for validation
- Vector polar plots of fundamental frequency/1st order. Indication of initial, trial, final and optimisation runs results
- Table views of measurement results and applied masses in the various runs
- Vibration data as either displacement, velocity or acceleration
- Support of both SI and Imperial units

REPORTING
- Integrated reporting with predefined Microsoft® Word templates
- Measurement data from initial, trial, final and optimisation runs
- Ability to modify report to user-specific needs
- Ability to print report with predefined layout directly
- Reporting based on ISO 20806 recommendations

ON-LINE HELP
Comprehensive Help system including:
- Introduction to balancing
- Description of each task
- Context-sensitive help on controls and plots
- Tool-tips on buttons
- Descriptive demo projects included in PULSE Knowledge Library

PERFORMANCE
The processing power required of the PC is measured in terms of "beats". The more analyzers, and the more demanding the individual analyses, the greater the number of beats required. Type 7700 and Type 7770 offer 75 beats. Additional Analysis Engine Type 7707 provides more analysis capacity, if required, allowing unlimited analysis to the maximum capacity of the PC. For further details see the Software for PULSE System Data (BU 0229).

Ordering Information

Type 7790-A-X[a] Two-plane Balancing Consultant
Type 7790-B-X[a] Multi-plane Balancing Consultant

SERVICE AGREEMENT
With a PULSE Software Maintenance and Support Agreement (M1) you have access to software releases and to technical support from a global network of specialists.

a. Where X indicates the license model, either N: Node-locked or F: Floating

M1-7790-A-X	Annual Software Maintenance and Support Agreement for Two-plane Balancing Consultant
M1-7790-B-X	Annual Software Maintenance and Support Agreement for Multi-plane Balancing Consultant

See the Product Data on PULSE Software Maintenance and Support Agreement (BP-1800) for further details.

RENEWAL OF EXPIRED AGREEMENTS
If your agreement has expired, you must purchase an update (M3) together with a new agreement.

TRADEMARKS
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Local representatives and service organisations worldwide

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