BALANCING SOFTWARE
FOR THE DC-12M
VIBRATION ANALYZER

Ver. 3.79

USER'S MANUAL

CONTENTS

1. BALANCING BASICS

1.1. INTRODUCTION

This manual describes the balancing procedure using the DC-12 data collector. This instrument's inner balancing program can be very useful for balancing rotors with up to 3 balancing planes (or weight attachment planes) and up to 8 measurement points. Aside from computation of balancing parameters (weight and angle magnitudes) the software provides the following

❐ automatic monitoring of measurement parameters and measurement accuracy;

❐ continuous automatic monitoring of the tacho signal along with initerrupting measurement process if the signal gets unstable.

❐ estimation of vibration response to the trial weights at each measurement point;

❐ automatic test for balancing planes which are equal by vibration response and exluding one of them from calculation. Balancing by three non-equal planes;

❐ balancing using only necessary balancing planes but not maximum number of them;

❐ computation of the expected viration response to the calculated corrective weights;

❐ balancing is possible even though a harmonic noise is present at frequency resolution of 0.01 per cent.

❐ balancing by the known influence coefficients (trim balancing with no trial runs).

❐ balancing both by the known influence coefficients and trial weights at once.

❐ balancing with trial weights either removed or left in place. You may select one of the above after measurement data on the trial weight is available.

❐ preliminary estimation of trial weights by the parameters of the machine under balancing;

❐ optional keyboard input for measurement data;

❐ splitting the correction weights if impossible to place the calculated weight at the determined mounting angle;

❐ adding the weights mounted at the same plane;

❐ balancing reporting.

1.2. WHAT IS
A MACHINE UNBALANCE?

Unbalance of a rotating part of the machine is uneven mass distribution, the offset between the shaft center of mass and center of rotation. While rotating, any masses are influenced by inertial forces, but without unbalance those forces are compensated. When unbalance occurs, these forces are not fully compensated and the rotor is influenced by the forces at operating speed of the machine. Unbalance is the nature of any rotating object and is present always. Therefore, in engineering there is a distinction between acceptable unbalance when a machine can be operated and the excessive one that leads to defects and the defect development and may cause a machine failure. Balancing is the procedure for correction of the latter. Worth to mention that as well as you reduce vabration by balancing you increase rotor loading that may cause its failure.

The rotor unbalance can be detected by the presence of a great component of machine vibration at its operating speed. Acceptable unbalance in different machine types is considerably depending on their dimensions and type, support and bearing stiffness, and the machine operation modes. The operation modes may differ by rotating speeds, loads and temperature conditions.

One of the common causes for the excessive vibration at the rotation frequency is bend shaft line, shaft misalignment and some other defects. Hence before balancing it is recommended to check couplings, shaft line, and fix the problems since their presence makes balancing impossible.

1.3. BALANCING

Whenever possible, a machine ought to be balanced at its operation speed. If not, choose the closest to that. You must avoid balancing at critical shaft speeds because the measurements of magnitude and phase taken under these conditions are inaccurate and cannot provide effective balancing.

When balancing fans, pumps and turbines, it is strongly recommended to clean them up before you start balancing procedure. After that you may sometimes find that unbalance disappeared.

1.4. SINGLE PLANE
AND MULTIPLANE UNBALANCE

The single plane unbalance is usually called the static unbalance. This type of unbalance can be illustrated by an unbalanced disk placed on the balanced shaft in two bearing supports as shown in the next figure.

Fig. 1.1
Single-plane unbalance
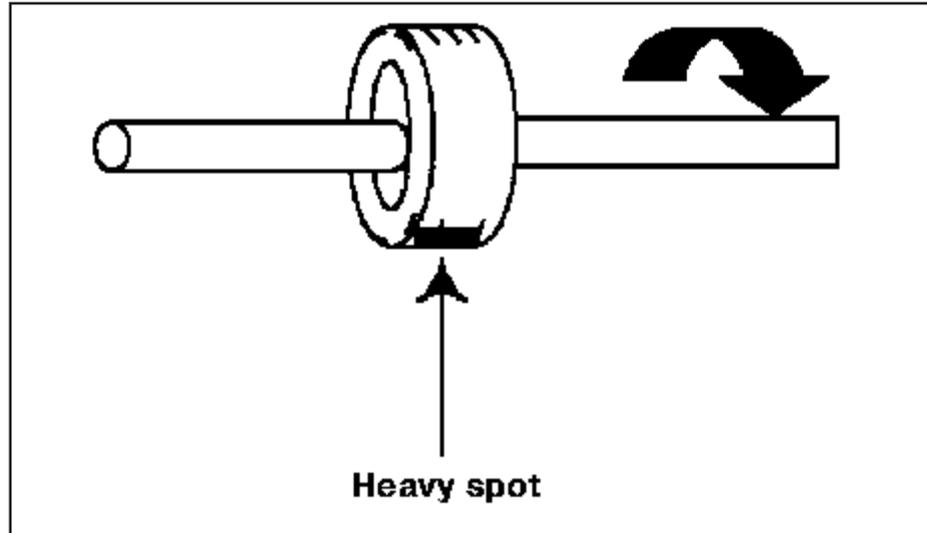
Multiplane unbalance can be referred to as the dynamic one because it occurs only during rotation. It occurs, for example, when two disks at two different planes create a couple of forces that generate vibration. The figure below shows an example of the dual plane unbalance.

Fig. 1.2
Dual plane unbalance
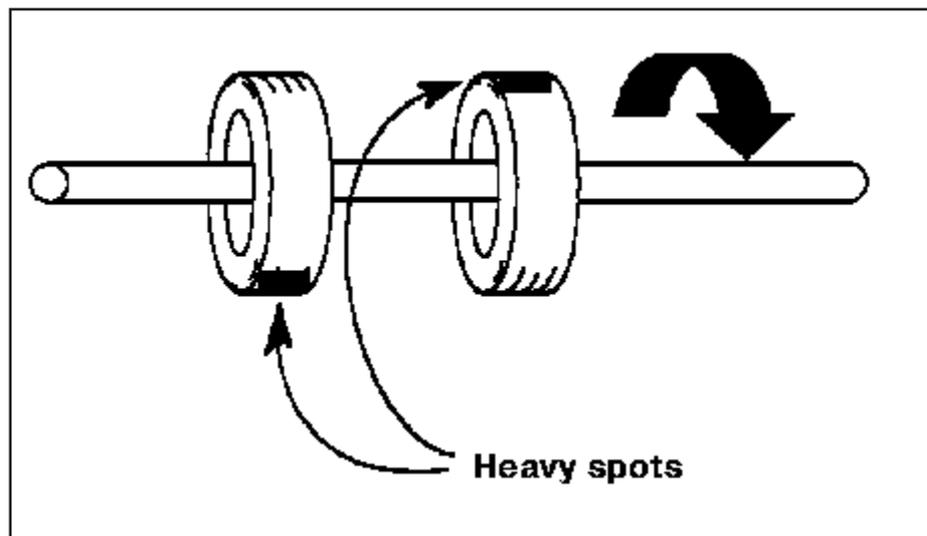
1.5. THE METHOD OF BALANCING WEIGHTS ANALYSIS

The DC-12 uses the method of influence coefficients to calculate balance weights. The vibration response of the machine to the given trial weight are calculated for all measurement points, first at the first plane, then at the second, and so on. Thus the influence of each balance plane is taken into account in all the measurement points. Influence coefficients are calculated after the initial machine run (without trial weights) and trial runs (with trial weights attached).

If there is no big repair of the machine between balancing cycles, it is possible to balance the machine with one run using the influence coefficients computed during the previous balancing. It may be a very efficient for multiplane balancing.

The influence coefficients are complex numbers and both real and imaginary parts of them should be stored for each coefficient.

On the DC-12's screen the influence coefficients are displayed in the balancing report. While balancing by influence coefficients, the operator has to enter the balancing coefficients for each plane in the same sequence, otherwise the correction weight calculation will be wrong.

Note that while balancing by influence coefficients you MUST attach tacho in the same location and position as it was in the previous balancing cycle. The mark for tacho also should be in the same location of the shaft (better use a stationary mark).

2. DC-12 BALANCING PECULIARITIES

This chapter covers main steps of the field balancing using the DC-12's balancing software including computation of balancing weights.

2.1. BALANCING STEPS OVERVIEW

Balancing a machine with the DC-12 inner software involves the following essential operations:

1. Prepare the places in all measurement points to mount the accelerometer. Place the phase reference mark on the rotating part of the machine and attach the phase reference tacho probe.

2. Check the tacho signal with the command Tacho Test from Applications menu. This allows you to view the tacho signal in the oscilloscope mode. The pulses must be evenly spaced. If the signal is not stable, it is recommended to change the tacho mounting (shift it relative to the shaft or horizon).

3. Set up vibration measurements (amplitude and phase of vibration at the rotation frequency, rotational speed).

4. Take measurement data of initial vibration in all measurement points (prior to trial weight mounting).

5. Place the first trial weight.

6. Measure the vibration parameters at all the selected control points with the trial weight attached.

7. Proceed with calculations of the corrective weight.

8. By the calculated value of efficiency (in this program, the estimated vibration level is the maximum vibration value in all measurement points) make a decision on whether terminating trial runs and going to the correction weight mounting, or mount the next trial weight if the estimation is more than needed.

9. If you make decision to continue the trial runs, place the next trial weight and repeat the previous steps.

10. After you are satisfied with the estimated balancing efficiency or you have done all trial runs (placed all trial weights in all possible planes - at most 3), attach the determined corrective weights.

11. Measure vibration parameters in all points. By the measurement data the program computes the additional correction weights and vibration response to them. Make decision on the basis of the computation whether to finish at all, or start the new balancing cycle, or continue to measure after mounting the calculated weights. If expectancy is great enough (vibration would be reduced 1.5-2 times), you may mount calculated weights and take mesurement data once again as well as calculation of correction weights and balancing efficiency. If the expectancy is small, you may

● terminate the balancing cycle with the current machine (while the number of measurement points is greater than the number of balancing planes, the balancing efficiency is limited even theoretically),

● continue mounting trial weights if there balance planes yet unused.

● make one more full balancing cycle including trial runs with new trial weights. The reason for the later case may be the measurement errors or the dependance of the machine mechanical parameters on vibration magnitude.

The DC-12 balancing program features include balancing by known influence coefficients. If influence coefficients of the machine under balancing are known, for example, recorded during previous balancing cycle and the machine was not repaired considerably, it can be balanced without trial runs. Note also that the tacho mark should be on the same place.

To do this, select the Balancing by Known Influence Coefficients after the initial vibration measurements made. Enter the influence coefficients for each plane and corrective weights will be calculated.

The detailed description of the balancing procedure with the DC-12 is presented below.

2.2. HOW TO PREPARE
THE DC-12 FOR BALANCING

An unpleasant surprise is if your instrument would automatically switch off during balancing. The data obtained would be lost, and the balancing cycle should be re-started. So you need make some precautions. Get to the DC-12 Main Menu.

Fig. 2.1

```
DC-12 MAIN MENU                       11:50:34

     [CHOOSE ROUTE                  ]

     [OFF ROUTE                     ]

     [DATA TRANSFER                 ]

     [UTILITIES                     ]

     [APPLICATIONS                  ]

```
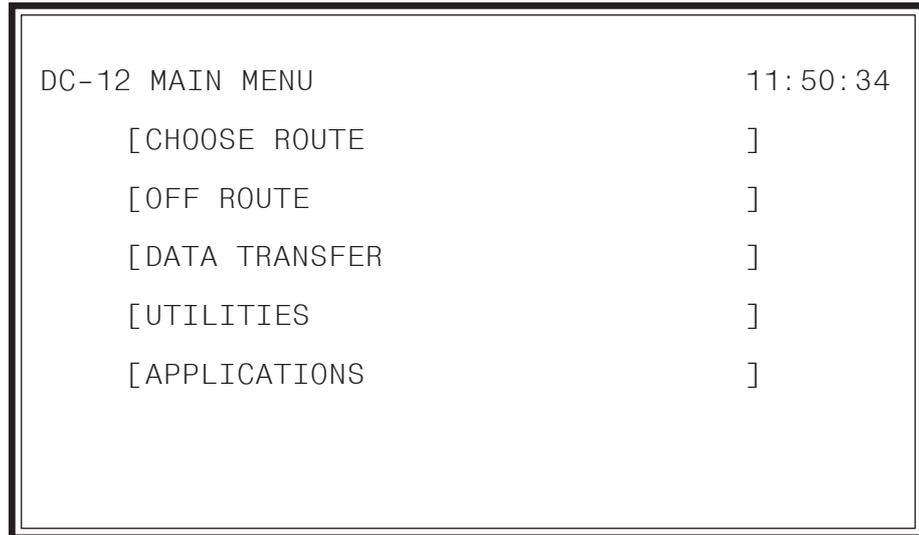
- Choose the **Utilities** command by the up/down arrow keys and press <Enter>.

Fig. 2.2

```
UTILITIES                             11:50:34

 [SETTINGS                     ]

 [DELETE ROUTE                 ]

 [CALIBRATION                  ]

 [ABOUT THE DC-12              ]

```
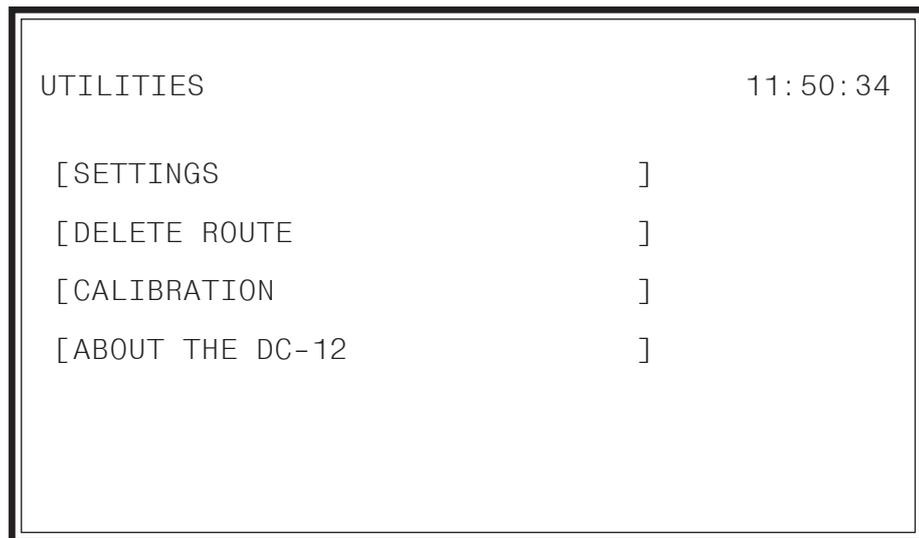
Select **Settings** on the screen and press <Enter>. The next screen appears.

Fig. 2.3

```
┌─────────────────────────────────────────────┐
│ SETTINGS                           11:50:34  │
│                                              │
│  [TIME/DATE                      ]           │
│  [RS-232 SETUP                   ]           │
│  [POWER SUPPLY                   ]           │
│  [DISPLAY AND KEYBOARD           ]           │
│  [MEASUREMENT MODES           ]              │
│  [TRANSDUCER                  ]              │
│                                              │
└─────────────────────────────────────────────┘
```
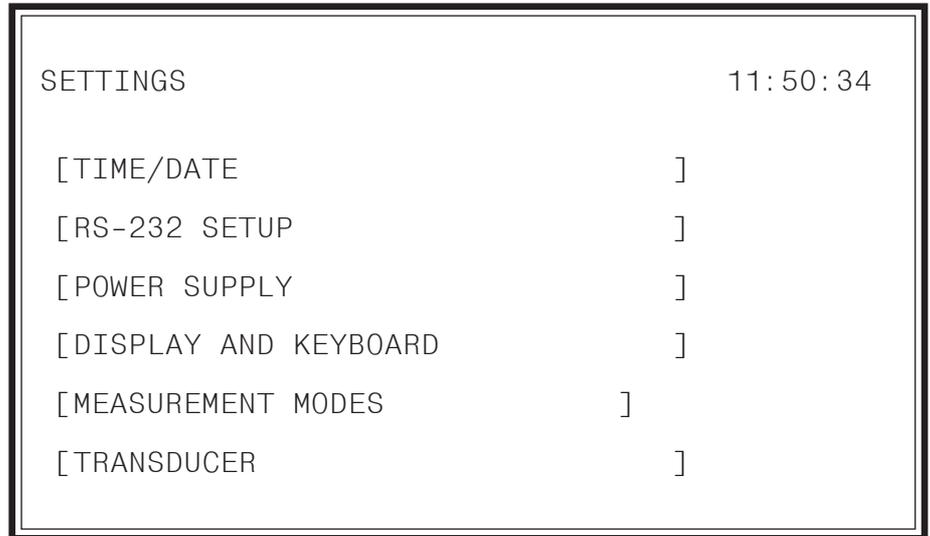
Choose *Power Management* and press <Enter> to display the Power Management screen.

Fig. 2.4

```
┌─────────────────────────────────────────────┐
│ POWER MANAGEMENT                   11:50:34  │
│  AUTO SHUT DOWN, min                  [20]   │
│  AMPLIFIERS SWITCH OFF                [ON]   │
│  BATTERY CAPACITY              5 h    56 min │
│  CHARGED BATTERY                             │
│       CAPACITY                 8 h     0 min │
│  OPERATING TIME               17 h    36 min │
│                                              │
│  [CHANGE ACCESS RIGHTS]                      │
└─────────────────────────────────────────────┘
```
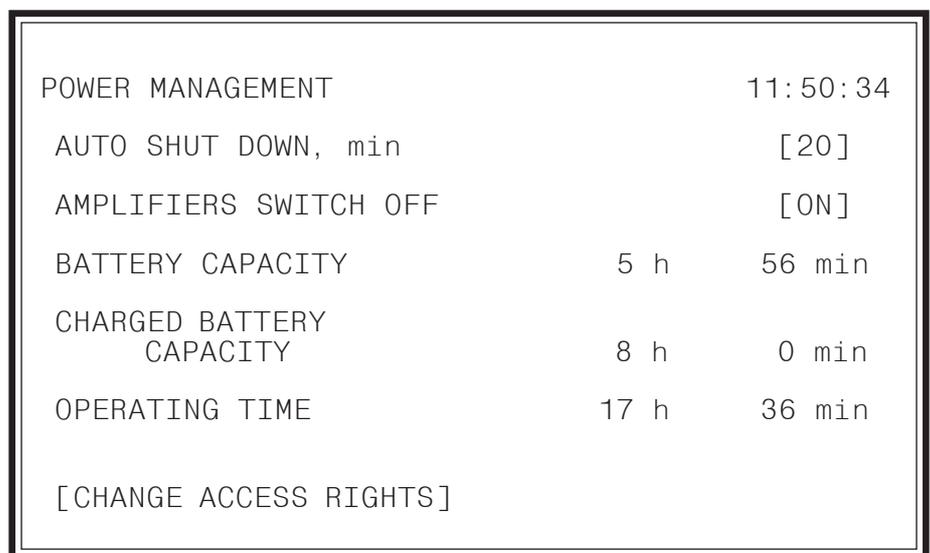
Set *Auto Shut Down* to **No** by the right-left arrow buttons. In this mode, the instrument should be switch off only manually. To do so, use the <Power> key. It displays the menu for saving your data as it is described in the next section.

2.3. SAVING YOUR DATA

From above it is apparent that it is important to save your data in the nonvolatile memory during balancing with DC-12. The software provides you with choices after pressing either the <Power> or <Cancel> keys. These keys are used to power down or go to the Main Menu but preliminarily you may save your data.

Pressing the <Power> key during balancing displays the Shut Down screen.

Note   *If you hold down the <Power> key more longer you cause the device to switch off and any balancing information will be lost.*

Fig. 2.5

```
┌─────────────────────────────────────────────┐
│                                               │
│  SHUT DOWN                          11:50:34  │
│                                               │
│       [SAVE STATUS & SWITCH OFF          ]    │
│                                               │
│       [SWITCH OFF                        ]    │
│                                               │
│       [SAVE STATUS                       ]    │
│                                               │
│       [CANCEL                            ]    │
│                                               │
│                                               │
│                                               │
│                                               │
└─────────────────────────────────────────────┘
```
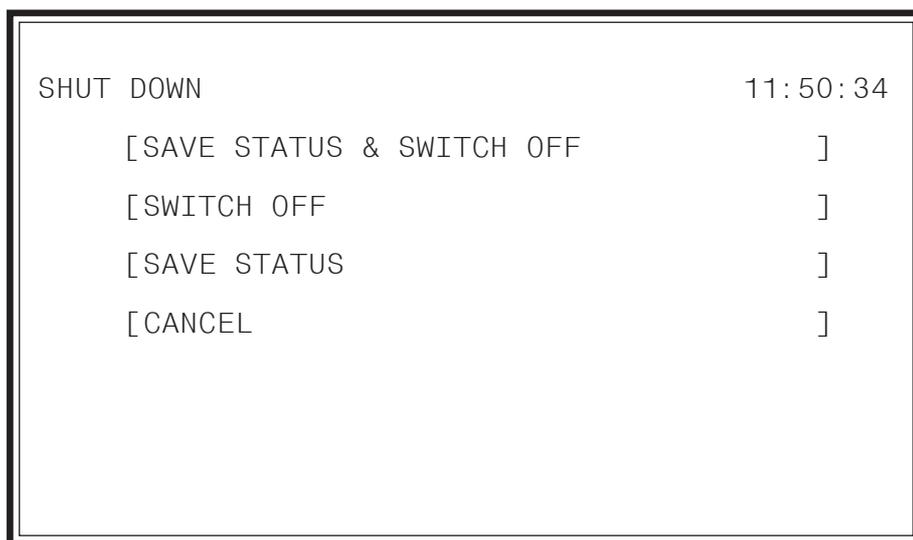
Using the up/down arrow keys, choose an options:

Save Status & Switch off   Use this command to save all data and switch off the DC-12. Next time when you switch it on, the screen is displayed you exit from.

Switch off   Use this command in case you want to switch off the DC-12 but not to save your balancing data.

Save Status   Use this command to save all data to nonvolatile memory of the instrument without switching off the DC-12 itself. You may use this command to backup your data at times to be sure they cannot be lost.

Cancel   You escape to the screen where you try to switch off the device.

If you have interrupt the balancing application by the <Cancel> key, the Balancing--Cancel screen displayed.

Typically, by using the <Cancel> on the DC-12, you exit the current program, i.e. balancing. In order not to loose essential data, you will be prompted first to save the measured and entered data. These data can be used later if you are not finished balancing a machine and may wish to continue balancing.

Fig. 2.6

```
┌─────────────────────────────────────────────┐
│ ┌─────────────────────────────────────────┐ │
│ │                                         │ │
│ │  BALANCING -- CANCEL           11:50:34 │ │
│ │                                         │ │
│ │     [EXIT TO MAIN MENU        ]         │ │
│ │                                         │ │
│ │     [SAVE STATUS & EXIT       ]         │ │
│ │                                         │ │
│ │     [SAVE STATUS              ]         │ │
│ │                                         │ │
│ │     [CANCEL                   ]         │ │
│ │                                         │ │
│ │                                         │ │
│ │                                         │ │
│ │                                         │ │
│ └─────────────────────────────────────────┘ │
└─────────────────────────────────────────────┘
```
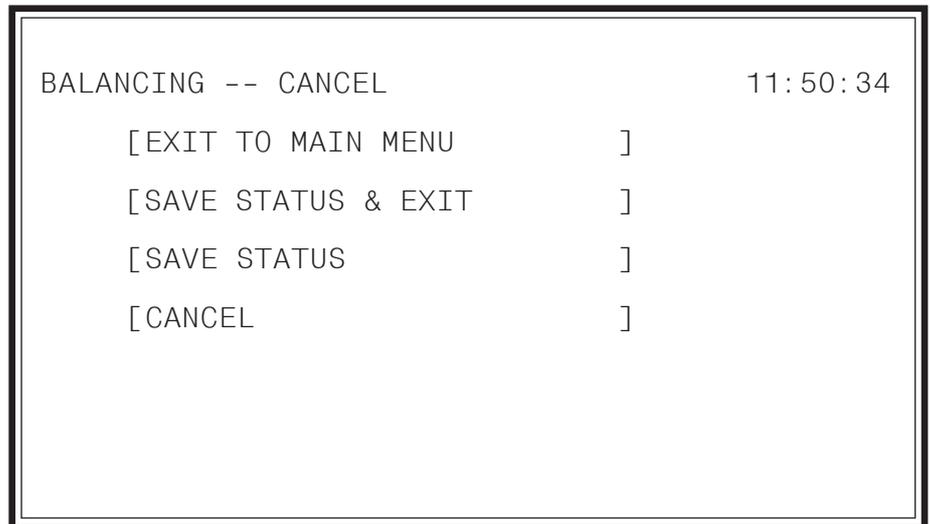
Using the up/down arrow keys, select the command of interest and press the <Enter> key.

Exit to Main Menu   The command to exit to the Applications menu without saving data.

Save Status & Exit   It saves balancing data and exit to the main menu of the DC-12. In balancing, you will be back to the screen where you have pressed the **Cancel** button.

Save Status   The command allows you to save balancing data and go back to your previous screen. You may use the command to back up your data.

Cancel   You will be back to the previous screen.

After you saves the balancing data using the <Power> or <Cancel> key and run the balancing program (Application Menu/Balancing) once again, the screen is displayed as follows:

Fig. 2.7

```
┌─────────────────────────────────────────────┐
│ ┌─────────────────────────────────────────┐ │
│ │                                         │ │
│ │  BALANCING - STARTUP MODE      11:50:34 │ │
│ │                                         │ │
│ │  PREVIOUS BALANCING CYCLE WAS INTERRUPTED│ │
│ │                                         │ │
│ │    [CONTINUE BALANCING    ]             │ │
│ │                                         │ │
│ │    [NEW BALANCING         ]             │ │
│ │                                         │ │
│ │                                         │ │
│ │                                         │ │
│ │                                         │ │
│ └─────────────────────────────────────────┘ │
└─────────────────────────────────────────────┘
```
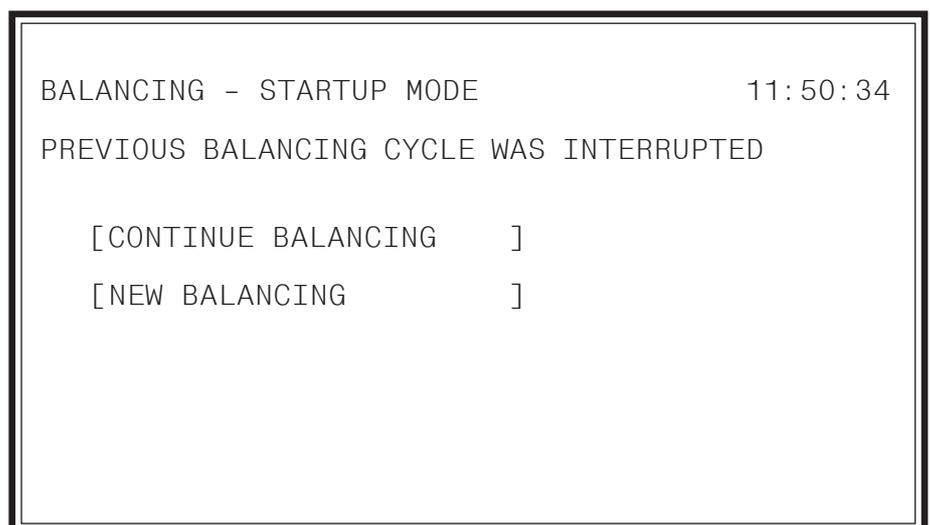
The screen allows you to make your choice between the following

Continue balancing   The command to go back to the previous screen.

New balancing   By the command you will be prompted to set up the new balancing cycle.

2.4. BALANCING SETUP OVERVIEW

To set up the DC-12 for balancing, select the Application command from the main menu of DC-12. To do it, use the up/down arrow keys and press <Enter>. Then select **Balancing** from the Application menu.

Fig. 2.9

```
APPLICATIONS MENU                          11:50:34


        [MESSAGES                  ]

        [TACHO MONITOR             ]

        [BALANCING                 ]

        [BALANCING LOGS            ]

        [VECTOR CALCULATOR         ]

        [REMOTE CONTROL            ]
```

Since you pressed <Enter>, the Balancing Setup screen appears.

Fig. 2.10

```
BALANCING SETUP                            11:50:34

 MACHINE ID                 [              ]

 NUMBER OF MEASUREMENT POINTS          [ 1]

 AMPLITUDE UNITS                  [   m/s² ]
 DETECTOR                         [   PEAK  ]
 ROTATION SPEED                   [   Hz    ]

 TACHO SIGNAL ANALYSIS        AUTO
 MEASUREMENT CONTROL          AUTO

 ANGLE READING DIR.       [ WITH ROTATION  ]

               [NEXT]
```

This dialog is used to setup a new balancing operation. Here you can enter the name of the machine to be balanced as well as parameters of measurement and balancing weight attachment.

During balancing measurements the DC-12 uses automatic analysis of the tacho and vibration signals. As soon as the desired measurement accuracy will be achieved, the measurements will be stopped or warning messages will be issued.

Here you can set the following parameters:

Machine ID   A machine name may contain up to characters.

Use the alphanumeric keys to enter the machine name. Each of the keys has 4 characters that scroll while pressed. For example, to enter "1", press the 1 key once, to enter "A", press 1 key twice, etc.

Use the left arrow for backspace and the right arrow to move to the next character.

Number of Measurement Points   This is the number of points at which you will measure the vibration amplitude. The number can be entered from the keypad or changed by using left/right keys.

Amplitude Units   Using the left/right arrows, choose the units you prefer for amplitude representation. Choices are: G, m/s^2, mm/s, ʋm, in/s, mils.

Detector   With the left/right arrows choose the detector to be used for graph representation, either RMS (Root Mean Square), Peak, or Peak-to-Peak.

Rotation Speed   Using the left/right arrow keys, select the units for rotation speed: Hz, RPM (revolution per minute), RPS (revolution per second - equals to Hz).

Tacho Signal Analysis   is set only to Auto during balancing measurements. You can read more about this setting in the DC-12 manual, phase measurements section. This mode provides that the quality of tacho signal will be analyzed. In the case of poore signal one of the following messages may be displayed at the bottom of the Vibration Measurement screen.

RPM is out of range   it means that the current machine rotation speed is not within the range of 60 through 100000 RPM

No synchronization   there is no signal from the tacho probe. The reason for it may be bad tacho probe placing or bad mark attached to the shaft or tacho is not connected to the DC-12. Recommendation is to change the tacho position or direction.

Unstable synchronization   there is a random signal or signals per shat revolution.

Measurement Control   MANUAL. The mode allows to produce up to 2000 averages of the measured parameters. The measurement process is interrupted manually with the <Enter> key.

AUTO. The measurement quality and possible errors are analyzed automatically during measurements. Then the following messages are displayed depending on the results of the analysis.

Required accuracy was obtained   When the intended measurement accuracy is achieved, the measurement process will be automatically stopped.

If the intended measurement accuracy is not achieved, the measurement process will be stopped automatically after 30 averages. After that, the DC-12 suggests a possible cause of measurement inaccuracy such as:

Random noise detected

Harmonics noise detected

If measurement process is interrupted by the operator, the following message is displayed.

Measurement is stopped

If less than 3 readings have been taken, they whould be skipped.

Angle Reading Dir. Using the left/right arrow keys, you can select an angle reading direction, with or against rotation. The angle readings are used for trial and balancing weight attachment.

After you set up the measurements, select **Next** and press <Enter> to accept your settings and continue the balancing procedure. The Point-Channel screen will be displayed.

Fig. 2.10

```
   POINT         CHANNEL                    11:50:34
     1            [ 1]
     2            [ 1]
     3            [ 1]
     4            [ 1]
     5
     6
     7
     8




          [PREVIOUS]                 [NEXT]
```
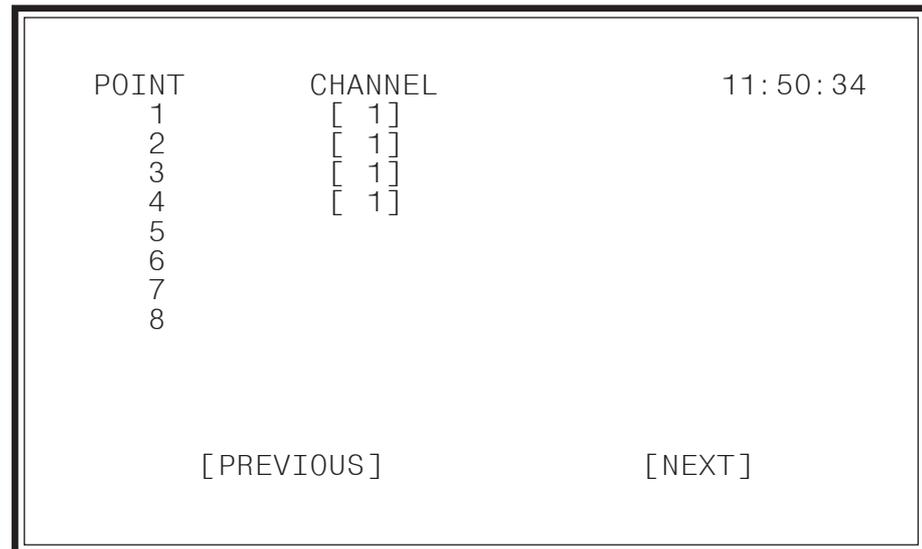
The screen is used for a multi-channel adapter to set one-to-one correspondence between measurement points and channels.

Since there is no indication at Vibration Measurement screen for any channel number, it is recommended to use the same channel numbers as for measurement points. Note that one channel may be also used to access several points.

Attention! This software version assumes that sensor sensitivities are the same and equal to the one chosen in the Transducer section of the Settings menu (Main menu->Utilities->Settings).

If one-channel adapter is used those settings are scipped.

2.5. VIBRATION MEASUREMENTS

This is one of the general balancing screen. It is used to measure amplitude and phase parameters at machine operating speed as well as the current rotation speed.

This is one of the general balancing screen. It is used to display the vibration measurement status. During measurement, the mean amplitude and phase values are displayed together with the current rotation speed and the number of averages done.

Displayed are the balancing step (for examle, Initial Vibration) and the number of a measurement point.

Fig. 2.11

```
┌─────────────────────────────────────────────┐
│                                               │
│   VIBRATION MEASUREMENT              11:50:34 │
│                                               │
│     INITIAL VIBRATION                         │
│                                               │
│     MEASUREMENT POINT          1              │
│                                               │
│     NOT MEASURED                              │
│                                               │
│                                               │
│                                               │
│     [PREVIOUS]        [START]       NEXT      │
│                                               │
└─────────────────────────────────────────────┘
```
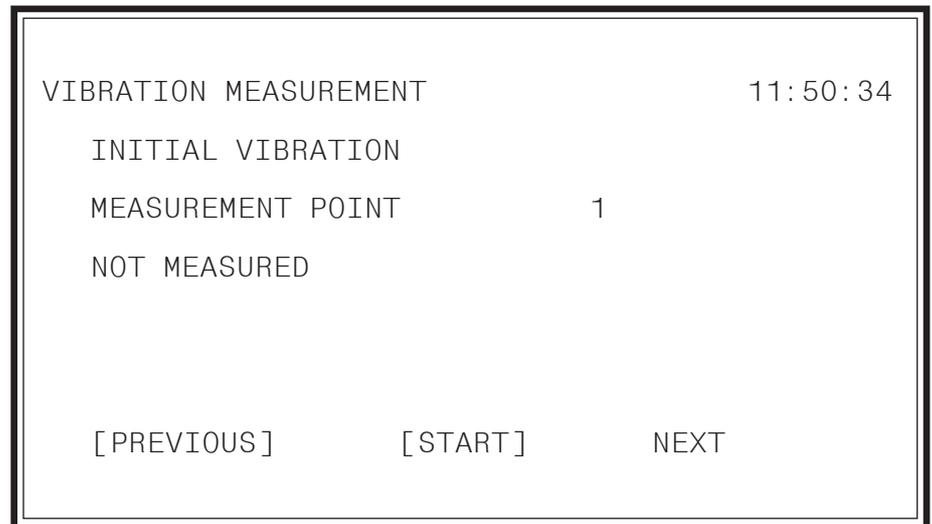
The current balancing stage is shown by indications Initial Vibration or Trial Weight N (where N is the number of a balance plane) or Test Measurement N (where N is the number of a test measurement) as well as the measurement poit number.

The measurement parameters are represented by magnitude and phase and running speed values. The number of averages obtained is also shown.

The automatic analysis of the input signal parameters is performed during the measurement. In the case of deviation from the required quality of the signal from the tachometer or the vibration transducer, the message appears. By default, the measurement is stopped automatically as soon as the required accuracy of the readings is achieved. In this case, the following message appears - "Required accuracy was obtained".

To check signal quality after a manual break, the signal variance is shown in per cent.

The commands at the screen bottom can be selected by the left/right, up/down arrow keys and provide the following operations:

Start/Stop	The command to start/interrupt measurement process.
Previous	Use this button to go to the previous screen.
Next	Brings you to the next measurement screen or a screen to select a job.

The screen allows you to enter data with the keyboard. To do so, press the up arrow. To navigate between fields, use the up/down arrows. Then press <Enter> to set focus on the *Next* command.

2.6. ATTACHMENT OF THE TRIAL AND CORRECTION WEIGHTS

This section covers the common balancing problems that occurs during weight attachment.

There is a large range of weight attachment types and they are not considered here.

The DC-12 balancing program provides two kind of placing trial weights - with or without removing the previous one. That is any trial weight can be removed or left in place.

Important!   *It is recommended to remove all trial weights before placing correction weights because the program computes them just for that case.*

If the trial weights cannot be removed due to some inconveniences, the value and mounting angle of a correction weight must be calculated with regard to the trial weight remained in the given plane.

To do this, use the **Sum Weights** subprogram (see section 4.3). You go to this subprogram from the Job Type screen which is displayed after correction weight calculation.

Fig. 2.12

```
 ┌──────────────────────────────────────────┐
 │ JOB TYPE                        11:50:34   │
 │                                            │
 │  [CONTINUE BALANCING]                      │
 │                                            │
 │  [TEST MEASUREMENT]                        │
 │                                            │
 │                                            │
 │  [SUM WEIGHTS]                             │
 │                                            │
 │  [SPLIT WEIGHT]                            │
 │                                            │
 │                                            │
 │                                            │
 │  [PREVIOUS]                                │
 └──────────────────────────────────────────┘
```
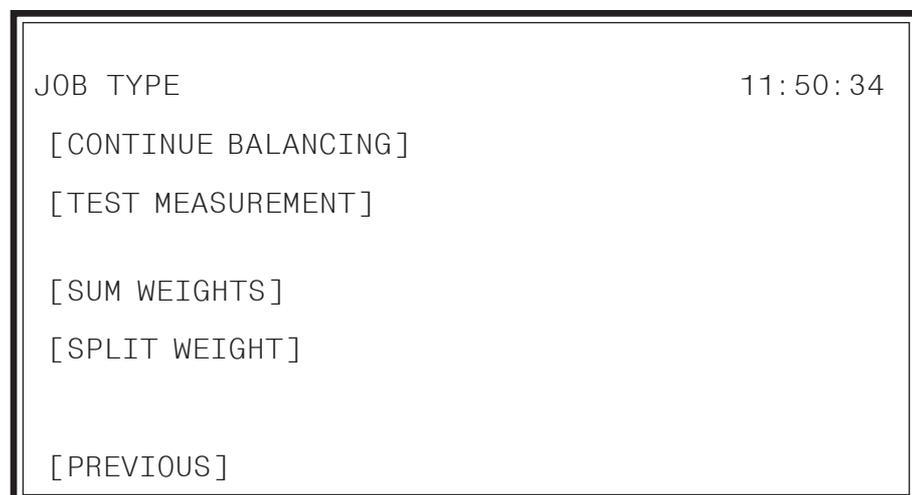
The utility allows you to calculate parameters of the required correction weight. To do so,

- select the calculated correction weight as the first part of the summed.

- select the trial weight left in place as the second part of the summed. Note that to put a minus sign before it, you need to press the dot key <ццц•>.

The computed weight should be attached as the correction one.

3. OPERATING THE DC-12 BALANCING PROGRAM

This section covers an entire balancing cycle using the DC-12 balancing program starting from measurement setup to balancing conclusion.

3.1. HOW TO SET UP BALANCING

The Balancing Setup screen with selected parameters is shown below.

Fig. 3.1

```
BALANCING SETUP                            11:50:34

 MACHINE ID                    [            ]

 NUMBER OF MEASUREMENT POINTS            [ 1]

 AMPLITUDE UNITS                     [   m/s²   ]
 DETECTOR TYPE                       [   PEAK   ]
 SHAFT SPEED                         [   Hz     ]

 TACHO SIGNAL ANALYSIS           AUTO
 MEASUREMENT CONTROL             AUTO

 ANGLE READING                  [ WITH ROTATION  ]

                    [NEXT]
```

The next command displays the Point - Channel screen.

See Section 2.4 for more information.

3.2. BALANCING PROCEDURE

After you have selected **Next** in the previous screen, the initial Vibration Measurement screen is displayed

Fig. 3.2

```
VIBRATION MEASUREMENTS    11:50:34

  INITIAL VIBRATION

  MEASUREMENT POINT        1

  NOT MEASURED




  [PREVIOUS]            [START/STOP]         NEXT

```

To initialize the measurement process, choose the **Start** button.

The same screen after the measurement made:

Fig. 3.3

```
 VIBRATION MEASUREMENT                    11:50:34

   INITIAL VIBRATION

   MEASUREMENT POINT:       1


   AMPLITUDE (  m/s²  )                      1.029
   PHASE     (~ DEG   )                          1
   SPEED     (  Hz    )                      49.09

   MESSAGES


   [PREVIOUS]        [START]        [NEXT]
```

The screen shows the numerical value of the vibration vector at the current measurement point. If needed, you may interrupt the measurement process with the Start/Stop command. To proceed with an iterrupted measurement use the same command. To check signal quality after a manual break, the signal variance is shown in per cent.

The screen allows you also to enter data with the keyboard. To set focus on an input field, use the up/down arrows, then enter you data. On conclusion, press the <Enter> key to select the Next command.

After the measurement is automatically finished - if no messages were on either measurement errors or inaccuracy - you must press the **Next** button.

The similar screen will be displayed for the next point now. If you need to view the previous measurements, press the **Previous** button. After the initial vibration data are taken, the Vibration Measurement Results screen will be displayed to show all the data.
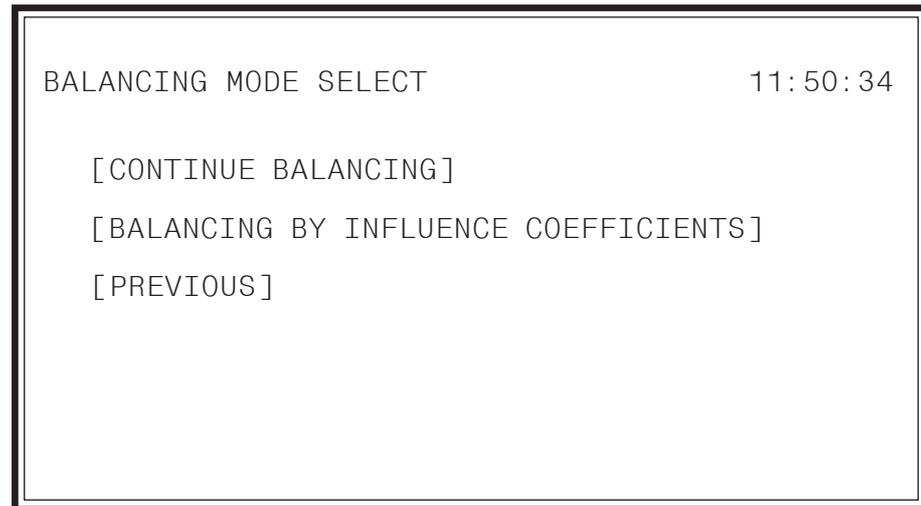
Fig. 3.4

```
 VIBRATION MEASUREMENT RESULTS            11:50:34

   INITIAL VIBRATION

  POINT #      AMPLITUDE       PHASE      SPEED
               (  m/s²  )      (DEG)      ( Hz  )
    [1]          1.029           1        49.09




                      [NEXT]
```

This dialog displays the vibration parameters in all measurement points. You can repeat vibration measurements at any point. To do this, use the arrow up/down keys to select the measurement point and press the <Enter> key to go to the measurement screen for the selected measurement point. The <Cancel> key brings you to the main menu and allows you to save data prior to it.

The **Next** command displays the Balancing Mode Select screen.

Fig. 3.5

```
┌─────────────────────────────────────────────┐
│                                             │
│  BALANCING MODE SELECT              11:50:34 │
│                                             │
│                                             │
│    [CONTINUE BALANCING]                     │
│                                             │
│    [BALANCING BY INFLUENCE COEFFICIENTS]    │
│                                             │
│    [PREVIOUS]                               │
│                                             │
│                                             │
│                                             │
│                                             │
│                                             │
└─────────────────────────────────────────────┘
```

This screen is for choosing a job to proceed. Now, you can decide whether to proceed through the full balancing cycle with trial runs or, if you know the influence coefficients, for this specific machine, you can proceed balancing by using influence coefficients without trial runs.

In the latter case, you have to place the phase reference tacho and mark for it at the same place of the shaft as they were when you recorded the influence coefficients.

Continue Balancing   Use this command to proceed with balancing - enter the parameters of trial weights and start trial runs.

Balancing by Influence Coefficients   Use this command to enter the influence coefficients for this machine and calculate correction weights without trial runs. (See section 3.4).

Previous   This command is used to revert to the previous window - Initial vibration measurement results.

If you selected the **Continue Balancing** command, the Trial Weight screen is displayed.

Fig. 3.6

```
┌─────────────────────────────────────────┐
│ ┌─────────────────────────────────────┐ │
│ │                                     │ │
│ │ TRIAL WEIGHT              11:50:34  │ │
│ │                                     │ │
│ │   TRIAL WEIGHT #               1    │ │
│ │   ATTACHMENT TYPE      [TEMPORARY]  │ │
│ │   ANGLE READING DIR.   WITH ROTATION│ │
│ │   WEIGHT (GR)          [   0.000]   │ │
│ │   ANGLE (DEG)          [     0]     │ │
│ │                                     │ │
│ │     NEXT                            │ │
│ │   [TRIAL WEIGHT ESTIMATION ]        │ │
│ │   [SUM WEIGHTS             ]        │ │
│ │   [SPLIT WEIGHT            ]        │ │
│ │       [PREVIOUS         ]           │ │
│ │                                     │ │
│ └─────────────────────────────────────┘ │
└─────────────────────────────────────────┘
```

You have to stop the machine and place the trial weight. This dialog box allows you to enter the parameters of trial weights to be mounted in the selected plane. Using the keypad, enter the following weight parameters

Attachment Type select whether the current trial weight will be removed or left in place prior to the next trial weight attachment. It is recommended to remove the previous trial weight.

Angle Reading Dir. The direction you have selected is shown for reference.

Weight can be measured in grams, as well as in any other unit, e.g. volume, length (if you use rods). The important factor is to use the same units during a balancing cycle.

Angle enter the angle of the trial weight mounting (in degrees) relative to the zero mark. It is recommended to use the trial weight mounting point as a reference. To do so, enter the angle = 0.

There are utilities you may call from this screen:

Trial Weight Estimation The utility allows you to estimate a trial weight by machine parameters.

Apply to Section 4.1 for details.

Sum Weights The command to replace two weights mounted at one plane with one weight which produce the same vibration response. See section 4.3 for comments.

Split Weight The command allows you to split a single weight (which should be mounted at a hardly available location) into several weights by two available locations. See section 4.4 for details.

This is a common case for fans and other bladed machines where you can not mount a weight between blades, but can attach weights to the blades. See section 4.2 for comments.

Using the **Previous** button, you may go to the previous screen - Balancing Mode Select.

To continue your job, choose the **Next** command, which is available only after you entered the required parameters. The Vibration Measurement screen appears again as follows.

Fig. 3.7

```
VIBRATION MEASUREMENT      11:50:34

   TRIAL WEIGHT NUMBER      1

   MEASUREMENT POINT        1

   NOT MEASURED




   [PREVIOUS]         [START]         [NEXT]
```

Press the **Start** button and measure the vibration response to the trial weight. Press the **Next** button, and the next similar screen appears for the next point. After all measurements are over, the Measurement Results screen appears.

Fig. 3.8

```
MEASUREMENT RESULTS                    11:50:34

   TRIAL WEIGHT                1

   POINT       AMPLITUDE       PHASE    SENSITIVITY
               (mm/s)          (degree)
     1          5.75            215
     2         13.16            127




                         [NEXT]
```

Using the up/down arrows, you can select the Measurement point and press the <Enter> key to go to the measurement screen for the selected point. In this way you can repeat the measurement procedure. If you press the <Cancel> key, the program goes to the Main Menu. In this case, you may save your data.

If the vibration response to the trial weight is low and you want to leave the weight in place once you have selected removing it, use the Previous button to get back to the Trial Weight screen and change the weight attachment type. You need not to repeat measurements.

The sensitivity column shows whether or not vibration response to the trial weight occurs at all measurement points. If not, the Low Sensitivity screen appears after you pressed the **Next** button.

Fig. 3.9

```
                                     11:50:34
  LOW TRIAL WEIGHT SENSITIVITY,
 POSSIBLE MISALIGNMENT OR SHAFT BEND.
 CAN NOT CALCULATE CORRECTION WEIGHTS
 TRY TO INCREASE TRIAL WEIGHT AND REPEAT
 TRIAL RUN, OR CORRECT THE SHAFT DEFECT




        [REPEAT]
```
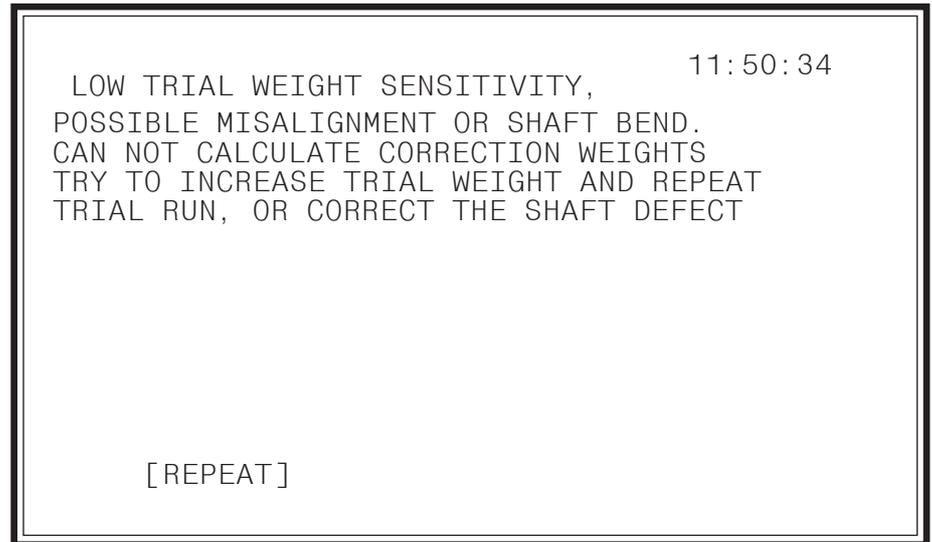
The **Repeat** button brings you the screen to enter trial weight parameters, the <Cancel> key allows you to go to the Main Menu.

After the trial weights are mouted at the second and third planes, the check is done on balancing planes equal by vibration response. If such planes are detected, the Equal Balancing Planes screen is displayed.

Fig. 3.10a

```
 EQUAL BALANCING PLANES              11:50:34
 SELECT PLANE TO COMPUTE:

  [1ST PLANE]

  [2ND PLANE]

  [BOTH PLANES]
```
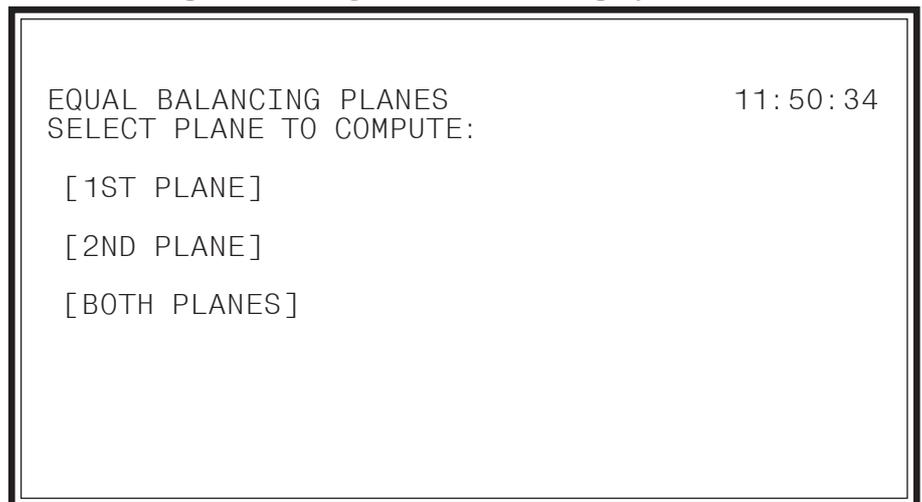
Make your choice. Note that using both equal planes can reduce calculation accuracy and balancing efficiency. Also it can lead to mounting too big balancing weights.

If you have selected one of the planes, skip the measurement data at the last plane. It allows you to work with three non-equal planes. To do so, select Both Planes and press <Enter>. Use the Previous button till you get to the Trial Weight screen. Mount the trial weight at the next plane and continue to balance.

If the measurement is sufficient, the Correction Weights screen is appears.

Fig. 3.10b

```
CORRECTION WEIGHTS                       11:50:34

ESTIMATED VIBRATION  (m/s²):                0.052

 ANGLE READING DIR.     WITH ROTATION

   PLANE #            WEIGHT         ANGLE
                       (GR)          (DEG)

      1               1.075           182




                    [NEXT]
```

This dialog presents the results of balancing weights calculations. Using this data, you must make a decision on whether you have to continue balancing or that the estimated result are sufficient for your machinery.

Here, you see the estimated maximum vibration level at all points if you mount the weights listed below in the specified planes. Also displayed is the Angle reading direction you have selected in the Balancing Setup dialog.

Press the **Next** button and the Job Type screen will be present.

Fig. 3.11

```
JOB TYPE                                 11:50:34

 [  CONTINUE BALANCING]

 [  TEST MEASUREMENT]


 [  SUM WEIGHTS]

 [  SPLIT WEIGHTS]



[PREVIOUS]
```

This screen enables you to select one of the following jobs:

Continue Balancing   You get to the Trial Weight screen to enter the next trial weight parameters and proceed with balancing.

Test Measurement   You get to the Weights Are Placed screen to take test measurement. In this case you must place the corrective weights which value must be more close to the calculated ones.

Sum Weights   A support program enables you to sum several weights placed at the same plane. See Section 4.3.

Split Weights   A support program enables you to distribute the calculated mass among the candidate places at the given plane. See Section 4.2.

Selecting the **Previous** button, you go to the previous screen - Correction Weights (Fig. 3.10).

If you have chosen **Test Measurement**, the Actual Weights Attached screen appears.

Fig. 3.12

```
ACACTUAL WEIGHTS ATTACHED               11:50:34


   PLANE #           WEIGHT           ANGLE
                      (GR)            (DEG)

      1        [        0.000]      [      0]




   [PREVIOUS]                        [NEXT]
```

In this screen you have to enter with keyboard the actual parameters of the trial weights placed - Weight and Angle which can differ from the calculated.

Using the **Previous** button, you may go to the previous screen - Job Type (Fig. 3.11).

Press the **Next** button, and the Vibration Measurement screen appears and the measurement process starts.

Fig. 3.13

```
VIBRATION MEASUREMENT                   11:50:34

  TEST MEASUREMENT

  MEASUREMENT POINT:              1

  NOT MEASURED




   [PREVIOUS]        [START]        [NEXT]
```

Below you can see the same screen after the measurement made.

Fig. 3.14

```
VIBRATION MEASUREMENT                    11:50:34

  TEST MEASUREMENT

  MEASUREMENT POINT:           1

  AVERAGE NUMBER:              4

  AMPLITUDE                    (  m/s²  ):
  PHASE                        (~ DEG  )
  SPEED                        (  Hz  ):

  MESSAGES


  [PREVIOUS]        [START]          [NEXT]
```

Displayed are the results of vibration measurement after the corrective weights have been placed. After the measurement made, the Measurement Results screen appears.

Fig. 3.15

```
MEASUREMENT RESULTS                      11:50:34

  TEST MEASUREMENTS

  SPEED  (RPM)                    3000

  POINT          AMPLITUDE            PHASE
                  (m/s2)             (DEG)
    1             5.75               215
    2            13.16               127




              [NEXT]
```

Using the up/down arrows, you can select the Measurement point and press the <Enter> key to go to the measurement screen for the selected point. So you can repeat the measurement procedure. If you press the <Cancel> key, the program goes to the Main Menu. In this case, you may save your data.

After you pressed the **Next** button, the program goes to the Job Type screen.

Fig. 3.16

```
┌──────────────────────────────────────────────┐
│                                                │
│  JOB TYPE                          11:50:34    │
│                                                │
│   [TRIM-BALANCING]                             │
│                                                │
│   [FINISH        ]                             │
│                                                │
│                                                │
│                                                │
│                    [PREVIOUS]                  │
│                                                │
│                                                │
└──────────────────────────────────────────────┘
```
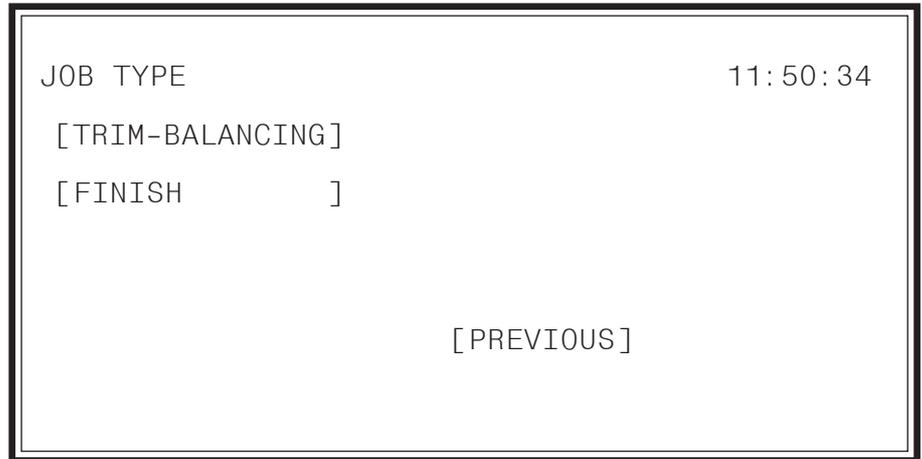
This screen provides you to select from the following options:

Trim-balancing If the intended balancing efficiency have not be achieved, you can increase it by this command. The command calls the Correction Weights screen, which displays the weights to be placed to increase efficiency. There may be several steps of Trim-balancing. See Section 3.3.

Finish terminates balancing and process its results. The program goes to the Balancing Report (see Section 3.4), which contains several screens. By the **Next** button you can view over each screenful.

Using the **Previous** button you can go back to the Measurement Results screen.

3.3. TRIM BALANCING

Trim balancing is a correction of the balancing weights value. It is performed after the balancing made and balancing weights attached. It is not required to place the trial weights as well as the trial runs at all. This job can be chosen from the Balancing Mode Select screen after the test measurement is taken.

Fig. 3.17

```
BALANCING MODE SELECT                      11:50:34



    [TRIM-BALANCING]



    [FINISH]



```
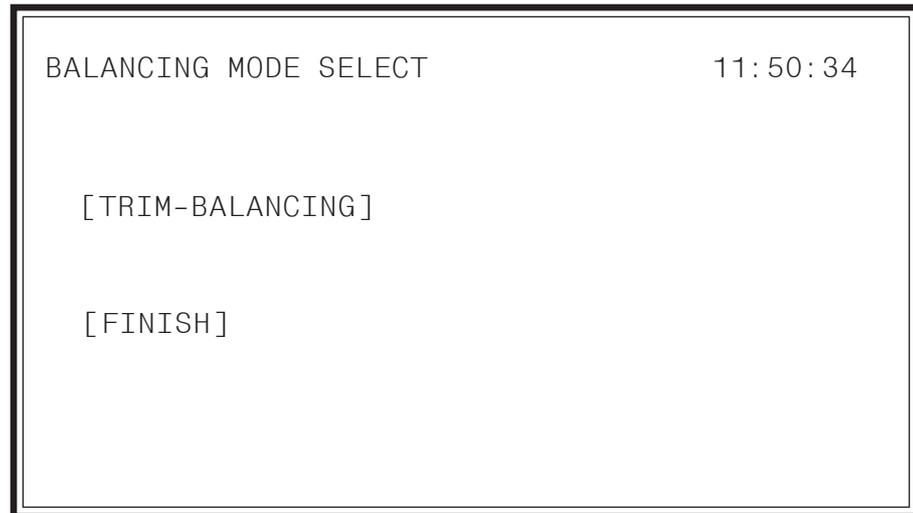
If you have selected this mode, the Correction Weights screen would appear.

Fig. 3.18

```
CORRECTION WEIGHTS                          11:50:34

 ESTIMATED VIBRATION  (m/s²):                  0.052

  ANGLE READING DIR.          WITH ROTATION

    PLANE #            WEIGHT        ANGLE
                        (GR)         (DEG)

       1              1.075          182



              [NEXT]
```
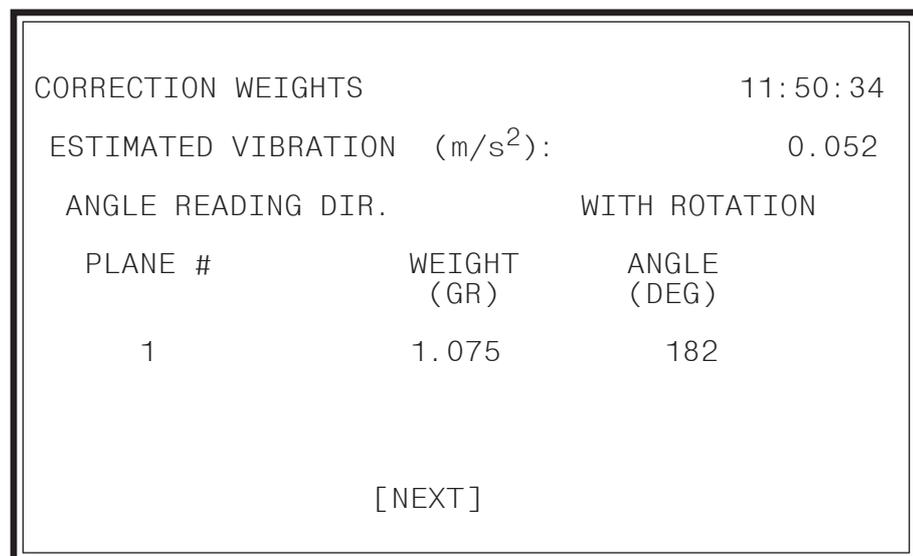
This screen displays the correction weights calculated by the program. To proceed with balancing, place the weights which actual value must be much more close to the calculated. Pressing the **Next** button displays the Balancing Mode Select screen appears.

Fig. 3.19

```
 BALANCING MODE SELECT                    11:50:34



 CONTINUE BALANCING
 [TEST MEASUREMENT]

 [SUM WEIGHT]
 [SPLIT WEIGHT]
```

Continue Balancing is not available. The DC-12 program made balancing by cycle. Each cycle begin either with balancing or with balancing by influence coefficients and continue through trim-balancing. To begin new balancing, you need to finish your job by the **Test Measurement** command. After the test measurement made and Report presentation the Job Type screen appears (see Fig. 3.28) through which you can start new balancing cycle. In this case the test measurement results will be considered as the initial vibration one.

By using the Test Measurement command you may repeat trim-balancing (up to 5 times) or go to the new balancing.

3.4. FINISH BALANCING

To end up the balancing cycle, choose **Finish** from the Job Type screen (Fig. 3.16). You will be enabled to view over a Balancing Report, which contains several screens. By the **Next** button you can view over each screenful.

All the data entered or obtained during this balancing cycle will be present in the report.

An example of this is shown in the next figures.

Fig. 3.20

```
 BALANCING REPORT                         11:50:34

  DATE: 05-02-98

   MACHINE ID:                 444
   NUMBER OF MEAS. POINTS      1
   NUMBER OF PLANES            1
   AMPLITUDE UNITS             um
   DETECTOR                    RMS
   ROTATION SPEED              RPM
   ANGLE UNITS                 DEG
   ANGLE READING DIR.          WITH ROTATION
   ROTATION SPEED              9520.97 (RPM)

    [PREVIOUS]                 [NEXT]
```

Fig. 3.21

```
INITIAL VIBRATION                              18:27:53

  POINT #      AMPLITUDE          PHASE
                 (um)             (DEG)
     1          29.264              2




     [PREVIOUS]                          [NEXT]
```

Fig. 3.22

```
TRIAL WEIGHT NUMBER 1                          18:30:30

  WEIGHT    300.000;   ANGLE        5; TEMPORARY

   POINT #              AMPLITUDE          PHASE
                          (um)             (DEG)
      1                   7.101             356



     [PREVIOUS]                          [NEXT]
```

Fig. 3.23

```
  CORRECTION WEIGHTS                           18:33:38

  PLANE No          WEIGHT                 ANGLE
     1              359.131                   2




     [PREVIOUS]                          [NEXT]
```

Fig. 3.24

```
┌─────────────────────────────────────────┐
│                                           │
│   ACTUAL WEIGHTS ATTACHED        18:34:52 │
│                                           │
│   PLANE No          WEIGHT          ANGLE │
│      1              2.000             0   │
│                                           │
│                                           │
│                                           │
│                                           │
│                                           │
│    [PREVIOUS]                    [NEXT]   │
│                                           │
└─────────────────────────────────────────┘
```

Fig. 3.25

```
┌─────────────────────────────────────────┐
│                                           │
│   TEST MEASUREMENT 1             18:36:52 │
│                                           │
│        POINT #       AMPLITUDE     PHASE  │
│          1            7.138          6    │
│                                           │
│                                           │
│                                           │
│                                           │
│                                           │
│    [PREVIOUS]                    [NEXT]   │
│                                           │
└─────────────────────────────────────────┘
```

Fig. 3.26

```
┌─────────────────────────────────────────┐
│                                           │
│  INFLUENCE COEFFICIENTS          18:37:54 │
│                                           │
│       PLANE No. 1                         │
│                                           │
│       1       -1.041e-01    -7.332e-05    │
│                                           │
│                                           │
│                                           │
│                                           │
│    [PREVIOUS]                    [NEXT]   │
│                                           │
└─────────────────────────────────────────┘
```

This screen shows the influence coefficients which have been calculated during the balancing for each weight attached.

These coefficient should be saved to balance the given machine by the known influence coefficients (without trial runs). It can be made by writing down them or printing the report.

Note   *Keep the order of coefficients to be successful.*

Fig. 3.27

```
┌─────────────────────────────────────────────────┐
│                                                   │
│  END OF BALANCING REPORT              18:37:58    │
│                                                   │
│  YOU JUST REACHED THE END OF BALANCING REPORT.    │
│  NOW YOU CAN CHOOSE ¨SAVE¨ OPTION TO SAVE THE     │
│  REPORT FOR FUTURE USE UNDER THE NAME             │
│  ¨bal002.log¨. YOU CAN PRINT IT OR VIEW AT HOST   │
│  PC USING DEDICATED SOFTWARE TOOLS.               │
│                                                   │
│                                                   │
│                                                   │
│                                                   │
│                                                   │
│  [PREVIOUS]          [SAVE]         [DISCARD]     │
│                                                   │
└─────────────────────────────────────────────────┘
```

Once you pressed the **Save** button, the report will be saved as File "bal001.log". The data collector can store a number of reports which is differed by an order number. For example, you can save reports of sequential balancing cycles for the given machine. See Section 1.2 of Appendix 1 for information on the storing and printing the reports using the PC.

After you view over the Balancing Report, and select the **Save** button to save the report or the **Discard** button to don't save it, the Job Type screen appears.

Fig. 3.28

```
┌─────────────────────────────────────────────────┐
│                                                   │
│  JOB TYPE                             11:50:34    │
│                                                   │
│                                                   │
│                                                   │
│  [FINISH BALANCING]                               │
│                                                   │
│  [NEW BALANCING]                                  │
│                                                   │
│                                                   │
│                                                   │
│                                                   │
│                                                   │
└─────────────────────────────────────────────────┘
```
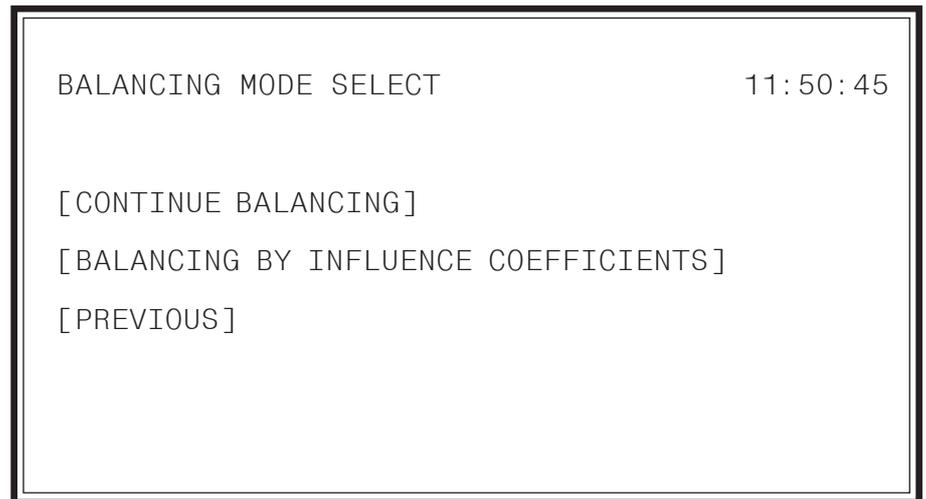
Using this screen, you may:

Finish Balancing - the balancing for the given machine is terminated, and the current data are deleted excluding the balancing report. The program goes to the Balancing Setup screen.

Start **New Balancing**. In this case, no need to measure the initial vibration because the program takes the last results of the Test Measurement and go at once to the Balancing Mode Select screen:

Fig. 3.29

```
BALANCING MODE SELECT                11:50:45


[CONTINUE BALANCING]

[BALANCING BY INFLUENCE COEFFICIENTS]

[PREVIOUS]
```

This screen allows you to select one of the next options:

Continue Balancing brings you to the Trial Weight # 1 screen.

Balancing by Influence Coefficients you get to the Influence Coefficients Input screen (see section 3.4).

Previous brings you to the Vibration Measurement Results screen with initial vibration results. You can either repeat the measurement by pressing the up arrow button and selecting a point to measure (confirm your choice by the <Enter> key) or press **Next**, which is selected by default to continue the balancing.
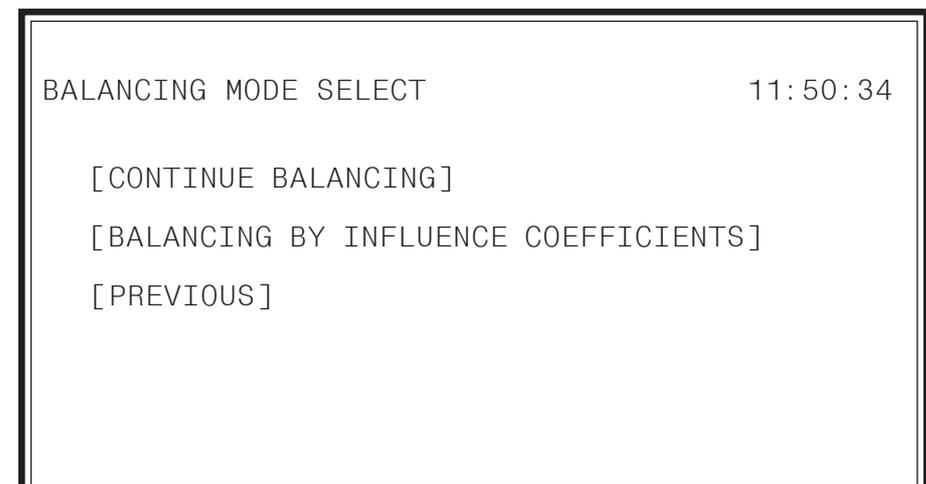
3.5. BALANCING BY INFLUENCE COEFFICIENTS

This job can be used after the initial vibration measurement made or after the previous cycle of balancing is terminated (by pressing the **New Balancing** button). This section describes the succession of steps of balancing by influence coefficients with the DC-12 balancing program.

This screen enables you to select a balancing type:

Fig. 3.30

```
BALANCING MODE SELECT                11:50:34

  [CONTINUE BALANCING]

  [BALANCING BY INFLUENCE COEFFICIENTS]

  [PREVIOUS]
```

Select **Balancing by Influence Coefficients** and press <Enter>. The Influence Coefficients Input screen appears.

Fig. 3.31

```
INFLUENCE COEFFICIENTS INPUT              11:50:34

PLANE NUMBER          1

1   [ 0.000e+00]     [ 0.000e+00]






[PREVIOUS]            [NEXT ]           [CALCULATE]
```

In this screen, you can enter the influences coefficients that have been saved for this machine. The order of coefficients must be the same as it was in the Influence Coefficients screen of the Report (Fig. 3.26).

To go to the next plane, press the **Next** button. You can return to the previous screen by the **Previous** button.

To confirm your input, press the **Calculate** button. The Correction Weights screen appears.

Fig. 3.32

```
CORRECTION WEIGHTS                        11:50:34

ESTIMATED VIBRATION ( m/s² )

 ANGLE READING DIR.     WITH ROTATION

  PLANE #          WEIGHT          ANGLE
                    (GR)           (DEG)
     1




              [NEXT]
```

The next steps have been described in Section 3.3.

4. SUPPORT PROGRAMS

This section describes the additional programs that are included in the DC-12 balancing program but not employed directly with corrective weights calculation.

4.1. TRIAL WEIGHT ESTIMATION

One of the most difficult operations in balancing is the choice of the trial weight amount. If it is small, the response might be comparable to a measurement error and the calculation would be impossible. Too big a weight may cause the machine breakdown.

The optimum method is to determine trial weights experience in balancing this machine type. If you do not have this experience, we recommend using the Trial Weight Estimation utility.

Fig. 4.1

```
TRIAL WEIGHT                              11:50:34

   TRIAL WEIGHT #                          1
   ATTACHMENT TYPE                  [TEMPORARY]
   ANGLE READING DIR.            WITH ROTATION
   WEIGHT (GR)                      [    0.000]
   ANGLE (DEG)                      [      0]

       NEXT
   [TRIAL WEIGHT ESTIMATION ]
   [SUM WEIGHTS            ]
   [SPLIT WEIGHT           ]
       [PREVIOUS          ]
```

After you selected the **Trial Weight Estimation** command and pressed <Enter>, the Trial Weight Estimation screen appears.

Fig. 4.2

```
TRIAL WEIGHTS ESTIMATION                   11:50:34


 ROTOR WEIGHT (KG)              [       100.000]

 RADIUS (mm)                    [        100.0]



 WEIGHT (GR)                              0.5


                               [NEXT]
```

For calculation you need to enter two parameters with the keypad:

Rotor Weight   enter the rough estimate of the rotor weight in kg.

Radius   enter the radius of the trial weight attachment points in mm, i.e. the distance between rotor axis and weight mounting place.

Put in these data and press <Enter>. In the Weight line, the calculated value appears of trial weight in g. After that you can change your inputted data and repeat calculation.

Press the **Next** button and you will be back in the Trial Weight screen to proceed with balancing.

Note that to do the more precise calculation of the trial weight you must follow the rules below:

- If the machine foundation is rigid (for example by the anchor bolts), then the calculated mass need to be magnified twice.

- If the machine is mounted on the damping support, then the calculated mass is close to the optimum.

- If you balance the rotor without the stator (on the balancing machine), then the calculated mass need to be divided by two.

4.2. SPLIT WEIGHT

In practice it is not always possible to place the calculated balancing weight at the required angle. In this case you need the operation called mass splitting.

The operation is to split the calculated mass in two parts which are placed in available locations. It is supposed that the mounting places are spaced regularly that is their mounting angle step and radius are the same.

You can go to this subprogram from the different screens. One of them is the Job Type screen.

Fig. 4.3

```
JOB TYPE                              11:50:34

 [CONTINUE BALANCING]

 [TEST MEASUREMENT]


 [SUM WEIGHTS]

 [SPLIT WEIGHT]



 [PREVIOUS]
```

Choose the Split Weight command and press <Enter>. The Split Weight screen appears.

Fig. 4.4

```
SPLIT WEIGHT                             11:50:34

 WEIGHT (GR)                                  141

 ANGLE (DEG)                         [ 45]

 NUMBER OF POSSIBLE
 ATTACHMENT PLACES                   [ 3]

 RESULTS OF WEIGHT SPLITTING
      WEIGHT        MOUNTING        ANGLE
       (GR)          PLACE          (DEG)
       100             1               0
       100             2              90

                  [NEXT]
```

Above is an example of the screen on the splitting mass of 141 g which is intended to be placed at angle of 45 degrees. The locations are spaced at 90 degrees. The location of the first weight is considered as the arbitrary zero for the mounting angle. The program recommend to place two weights of 100 g at 0 and at 90 degrees.

4.3. SUM WEIGHTS

In practice, there are often cases when several corrective weights are mounted at one plane. That is for example when one machine has been balanced several times. To sum all such weights into one, the Sum Weights subprogram is used. In the DC-12 balancing program the weights are added by two. To add more than two weights, the action must be repeated.

You go to this subprogram from the Job Type screen.

Fig. 4.5

```
┌─────────────────────────────────────────────┐
│                                               │
│ JOB TYPE                           11:50:34   │
│                                               │
│  [CONTINUE BALANCING]                         │
│                                               │
│  [TEST MEASUREMENT]                           │
│                                               │
│                                               │
│  [SUM WEIGHTS]                                │
│                                               │
│  [SPLIT WEIGHT]                               │
│                                               │
│                                               │
│                                               │
│  [PREVIOUS]                                   │
│                                               │
└─────────────────────────────────────────────┘
```

Choose the Sum Weights command from this screen and press <Enter>. The Sum Weights screen appears.

Fig. 4.6

```
┌─────────────────────────────────────────────┐
│                                               │
│ SUM WEIGHTS                        11:50:34   │
│                                               │
│            WEIGHT              ANGLE          │
│             (GR)               (DEG)          │
│                                               │
│ WEIGHT 1 [        100]      [      0]         │
│ WEIGHT 2 [        100]      [     90]         │
│                                               │
│ SUM              141               45         │
│                                               │
│                                               │
│                 [NEXT]                        │
│                                               │
└─────────────────────────────────────────────┘
```

You can see above an example of addition with one weight of 100 g, 90 degrees and another weight of 100 g, 0 degrees. The program recommends to mount the summary weight of 141 g at 45 degrees.

APPENDIX 1

HOW TO USE THE VAST PT-1 PHOTOPROBE
FOR BALANCING MEASUREMENTS

To measure vibration parameters with the DC-12, the VAST PT-1 photoprobe is available for use as an auxiliary equipment. It is shown in Fig. below.

Fig. A1.
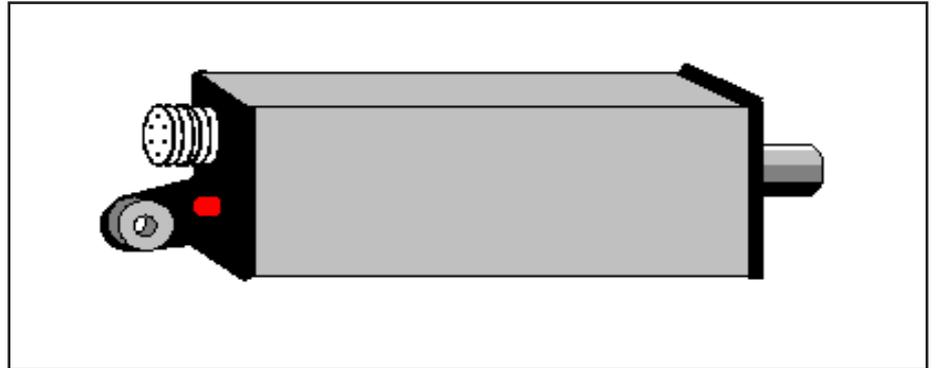
Cabling this probe to the DC-12, use the Tacho input on the input panel of the device. This input is also used to power the photoprobe, thus it is not required additional power supply.

On the rear panel of the photoprobe, there is a status led. While the probe transfers a signal, the led is lighting that indicates the proper state and mounting of the probe.

APPENDIX 2

APPLICATION SOFTWARE TO LOAD THE BALANCING PROGRAM
TO THE DATA COLLECTOR

The application software is installed onto the PC and provide loading the balancing program onto the DC-12. It consist of Program **DC__sfx.exe** which unpacks the file while you start setup and creates program files **dcle.exe**, **dclr.exe**, **dclwe.exe** and **dclwr.exe** in the program folder.

The letter meaning is

dcl   data collector

w   the program works under Windows-95

r   russian version

e   english version.

Warning   *To provide security, the balancing software would be work only with the DC-12 of the given serial number. Using the program with another DC-12 would be a frustrated experience.*

To load the software after you addressed VAST, Inc and received it, just follow the instructions on the screen.

APPENDIX 3

APPLICATION SOFTWARE TO LOAD AND STORE BALANCING REPORTS

To provide unloading the reports from the DC-12 to the host computer, their printing and storage, you need the **Rus.110** Application software. The software works under Windows-95.

To install it, just follow the instruction appeared on the screen.