КОНТЕСТ

KOHTECT AVV-701
LASER SHAFT ALIGNMENT SYSTEM
OPERATING INSTRUCTIONS MANUAL

CONTENT

1.0 General

1.1 Laser Safety Precautions

The KOHTECT AVV-701 alignment system is the class II laser device at typical wavelength of 670nm, delivered output power of less than 1 mW and maximum radiant energy per pulse of 0.1 mJ. The Class II laser comply with requirement outlined by USA's FDA as well as international ANSI, BS 4803 and IEC 825 standard.

Be sure to follow the following safety precautions to avoid personal injuries and damage to the system

Do not look directly into laser the beam at any time!

Do not direct laser beam on to the people's eyes!

ATTENTION!
Do not try open / dismantle measuring units and the display unit – this can damage the system, and your after-sales service warranty will come void.

Warning!
Be sure the machines to be measured, cannot be started unintentionally as this can cause injuries. For this purpose, before the mounting of equipment, either block the power switch in the "Off" position or remove the safety fuses. These precautionary rules must be followed until the measuring system is dismantled from the measured machine.

INJURY RESPONSIBILITY DISCLAIMER

Neither the NPP ConTest enterprise nor our authorized dealers are liable for the damages caused to machinery or equipment by use of the AVV-701 system. We carefully check text of this manual to eliminate errors, nonetheless there may be mistakes or inaccuracy involved. We will be grateful for your reporting to us about any error, and we will be able to correct them in the subsequent editions of the manual.

2.0 Technical Description

2.1. Designation

AVV-701 alignment system (C911 sub-system) (further as System) is designed for:
checking of shaft alignment of mechanisms;
estimation of the surface flatness.

The checking of shaft alignment means adjustment of the relative position of two coupled machines (e.g. motor and pump) so that the centre line of the axis will be concentric when the machines are running during normal working conditions.

2.2. Specification and Features

2.2.1. Separation distance between measuring transducer units, 5m
2.2.2. Display control operating temperature range, -10..+55 degree C
2.2.3. Measurement accuracy, 1%+0.01
2.2.4. Laser type: Visible red 635-670 nm, <1 mW
2.2.5. Detector type: Positional-sensitive photodiodes, 10x10 mm
2.2.6. Display resolution, 0.01 or 0.001 mm
2.2.7. Measuring resolution, 0.001mm
2.2.8. Electronic inclinometer resolution, 0.1 degree
2.2.9. Power supply: Rechargeable NiMH battery
2.2.10. Gross weight, kg
2.2.11. Built-in application programs and options:
horizontal shaft alignment at any 90º shaft position;
vertical shaft alignment; Setup options;
horizontal shaft alignment with rotation angle less than 120º;
Soft foot;
thermal growth;
selection of shimming simulator to calculate for expected alignment;

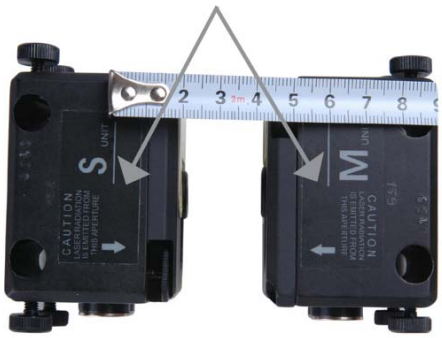
2.3. System Package.

The System includes (Fig. 1):
AVV701 display control unit
two measuring transducer units
universal chain brackets for mounting of the
measuring units
measuring tape, mm/inch
220 Volts AC charger
connecting cables;
CD-ROM PC software
USB PC communication cable
Operating instructions manual in CD
Carrying case with form-inserted

Fig-1a: Transducer front & top view Fig-1b: Transducer side view

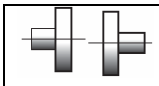
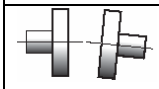
** Top positions to be faced up while setting up both the transducer.*

Datum lines for measuring of dimension input



2.6 Misalignment Parameters

Misalignment of any rotating machine is expressed in parallel (Offset) and angular (Gap) of the shafts. Most frequently in practice, both of them are present simultaneously. Different kinds of misalignment of axes are shown in Fig. 2.

	Parallel misalignment of axes – Offset (displacement)
	Angular misalignment of axes – Gap
	Parallel and angular misalignment of axes – (Offset + Gap)
	Fig 2

The parallel (Offset) and angular (Gap) misalignment of axes is determined in two mutually perpendicular planes. For the purpose of elimination of the parallel and angular misalignment of axes, in each of the planes a correction of position of the movable machine (M) will be done.

For the horizontal mounted machine – the movable machine (M) position is adjusted in the horizontal and vertical planes.
For the vertical mounted machine, operator determines arrangement of the correction planes, basing on considerations of the convenience and technological effectiveness of moving of the movable (M) machine.
Stationary machine (S) - in the process of eliminating of the axes misalignment the position of this machine stay static, i.e. it does not move.
Movable machine (M) – the machine, which position is adjusted for eliminating of the parallel and angular misalignment of axes.
The measurement system calculates the values of the angular and parallel misalignment of axes in the plane of the coupling (in two mutually perpendicular planes), and the adjustment values for the machine feet on the movable (M) machine, that is necessary for elimination of this misalignment of axes. Fig. 3 shows misalignment of axes and the values for its correction just for vertical plane.

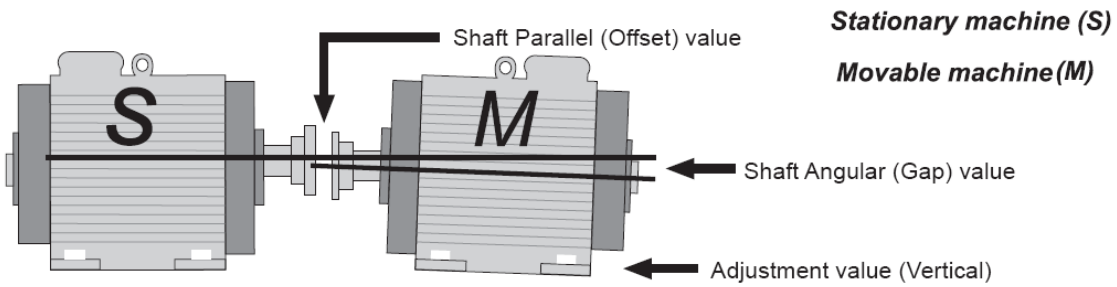


Fig 3.

3.0 Machine Alignment

- Mount the Measuring transducer units on the shafts of the (S) and (M) machines
- Select program according to the application of machine to be measured
- Input the distances between the (S) and (M) units, the coupling and the movable machine feet
- Press START to record readings from the measuring units at three different positions of the shafts
- Adjust the machine feet position of the movable machine in accordance with correction results of the calculated value on control screen
- Save the measured result into the file

Attention!

While making the measurement, it is necessary to observe and understand the orientation on rotation direction of the shafts with the (S) and (M) measuring transducer units with regard to the relative position of the (S) and (M) machines as in Fig.4.

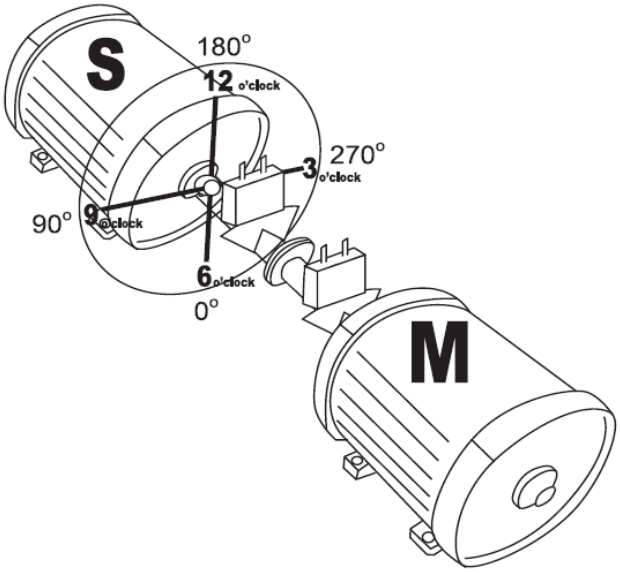


Fig 4.

Fig. 4 shows the view of (S) machine from the (M) end view, at the 12:00 o'clock position. The measuring transducer units have marking (S) and (M) on the top of each unit, should be mounted with brackets onto the shafts of the (S) stationary and (M) movable machine respectively.

3.1 Input Measurement Data

AVV-701 system function is based on the measurement of the laser beam movement on the detector receiver's window during the turning of shafts with the measuring units mounted.
To enable the System to carry out the shaft alignment calculation, it is necessary to record the measurement data in three positions of the shafts rotation, for example at 9 - 12 - 3 o'clock, i.e. turning the shafts in the range of 180º is sufficient.
If design features of the machines do not make it possible to carry out rotation of the shafts with the measuring units mounted up to 180º, the instrument also provides smaller shaft rotation angle measurement mode that allows possibility to enter the measuring data at three positions when the shafts rotation angle constitutes less than 120º.

Important!

To enable the system to correctly calculate directions of the movable machine position adjustment, the user must prior to the beginning of measurement chose the version of shafts rotation mode.

In the AVV-701, there are a few flexibility options for the data input at the following shaft positions:

9 – 12 – 3 , 12 – 3 – 6, 3 – 6 – 9 or 6 – 9 – 12

<120º - in this case, the shafts must be rotated to the equal angle into both sides from the 12 o'clock position.

With the variant of shaft rotation angle less than 120º, the System receives data on the shaft rotation angle from the electronic inclinometers installed in the measuring units.

The first measurement is made in the position between 9:00 and 12:00, the second measurement is made at 12:00 position and the third measurement – in the position between 12:00 and 3:00. And rotation angle between first and second measurement must be equal to rotation angle between the second and third measurement.

The electronics inclinometer does not work at the alignment of vertical mounted machine. In this case, the possibility of manual input of the shaft position is provided for.

Correspondence between position and angle:

6 o'clock - 0º
9 o'clock - 90º
12 o'clock - 180º
3 o'clock - 270º

3.2 Set-up the Device

Before the beginning of the work, check the battery voltage and charge it if necessary.

Battery voltage is indicated on the display of the device in the main menu.

The device is automatically turned off when the voltage is lower than 4.6 V.

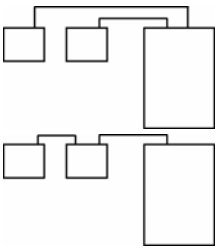
Check and clean if necessary the surface of detectors and aperture of laser.

Use soft tampons, moistened with alcohol, for the cleaning. Solvents must not be used!

Check and setup if necessary, date and time of the system clock.

3.3 Connecting the Measuring Units

There are two connectors in the Control Display unit and each Measuring transducer units. Connection to the Control Display unit is arbitrary, i.e. the units can be connected either in parallel or in series (Fig. 5) with any of the two cables contained in the set, to any of the connectors in the Control Display unit and the Measuring transducer units.



Connecting the measuring units in parallel

Connecting the measuring units in series

Fig. 5

3.4 Input of Dimension

To enable the AVV-701 to carry out accurate calculations it is necessary to input the distances between the measuring transducer units, the coupling and the machine feet. Fig. 6 shows the dimensions input for the horizontal plane alignment. Fig. 7 shows the dimensions input for the alignment of vertical flange mount machine.

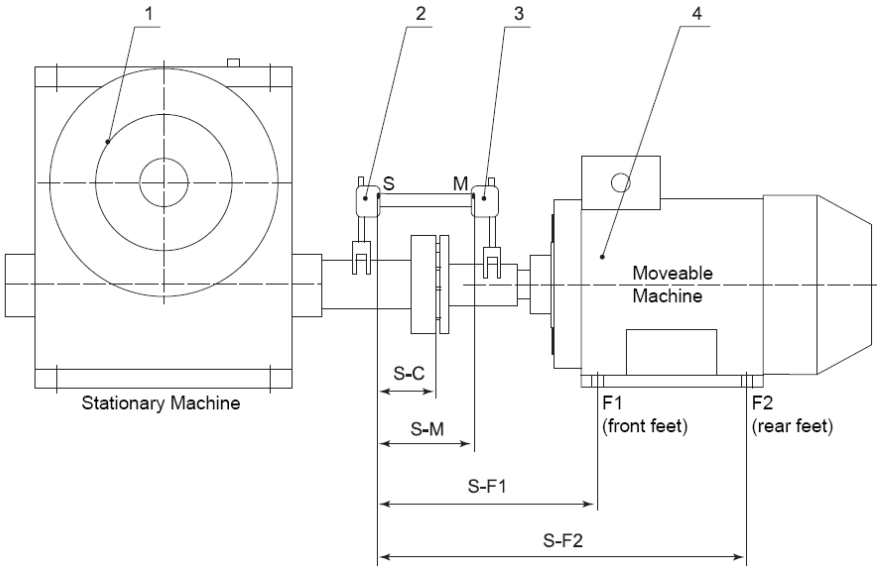


Fig 6.

S-M distance between measuring transducer units.

S-C distance between S and center of coupling.

S-F1 distance between stationary detector (S) and the feet pair 1 (F1).

S-F2 distance between S and F2 (must be longer than S-F1). *If the machine has three pairs of feet, you can change this distance after finished measurement, and then repeat the calculation and get a new adjustment value for this pair.*

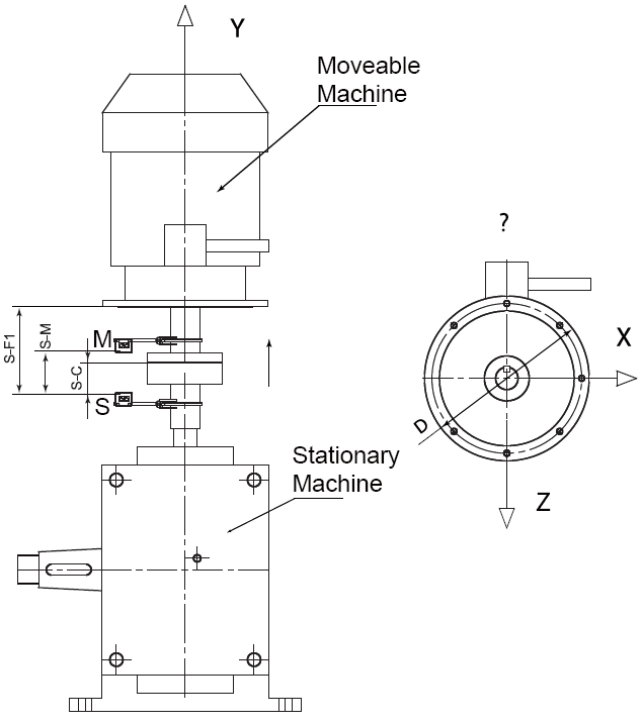


Fig 7.

S-M distance between measuring transducer units.
S-C distance between S and center of coupling.
S-F1 distance between stationary detector (S) and the plane of alignment (F1).

3.5 Rough Alignment Procedure

Rough alignment should be applied only when the alignment is extremely poor, the laser beams may travel outside the detectors during rotation of the shafts with the Measuring units mounted. If this happen it is necessary to do a rough alignment first.

Rough alignment procedure (variant 1), (Fig. 8):

Turn shafts with measuring units to the 9 o'clock position. Aim the laser beams at the centre of the closed detectors.

Turn shafts with measuring units to the 3 o'clock position.

Check where the laser hits, then using the laser adjustment screws, adjust the beam half the travel in direction to the centre of the target (Fig. 8).

Adjust the movable machine so that the laser beam hits the centers of both the targets, (S) and (M).

Follow the regular procedure to continue.

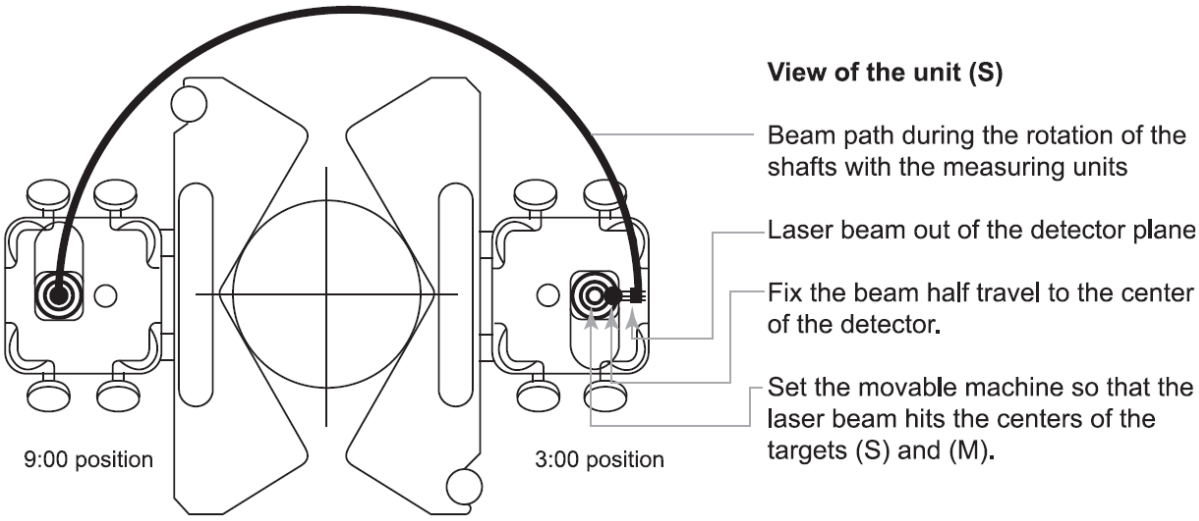


Fig 8.

Rough alignment procedure (Variant 2):

Turn the shafts with measuring units to the 9 o'clock. Apply the targets in the view of scaled paper sized 50 x 50 mm to the detector surface. Aim the laser beams at the centre of these targets.

Switch the display unit into the mode of manual data input.

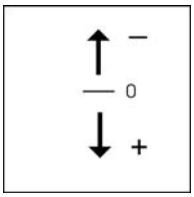
Turn the shafts with measuring units to the 12 o'clock position and enter the values of laser beam at the 12 o'clock position, then turn the shafts to the 3 o'clock and enter the values of laser beams at the target marking.

The system will calculate roughly the offset value and adjustment value for movable machine (M).

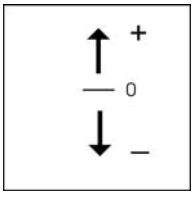
Adjust the movable machine according to the results of calculations.

Follow the regular procedure to continue.

While entering manually the values of the position of laser beam at the target, take into account the sign (Fig. 9)



View of a target (M) at the 12 o'clock position



View of a target (S) at the 12 o'clock position

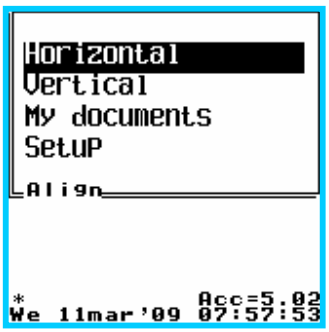
Fig 9.

4.0 Getting Started

To start AVV-701:

- In Main Menu by using the arrow keys move the selection bar to “Alignment” then press START.

The display shows alignment menu screen with four programs option as in Fig.10.
The lower section display the day, date and time of system clock, and the battery charge power within the device.

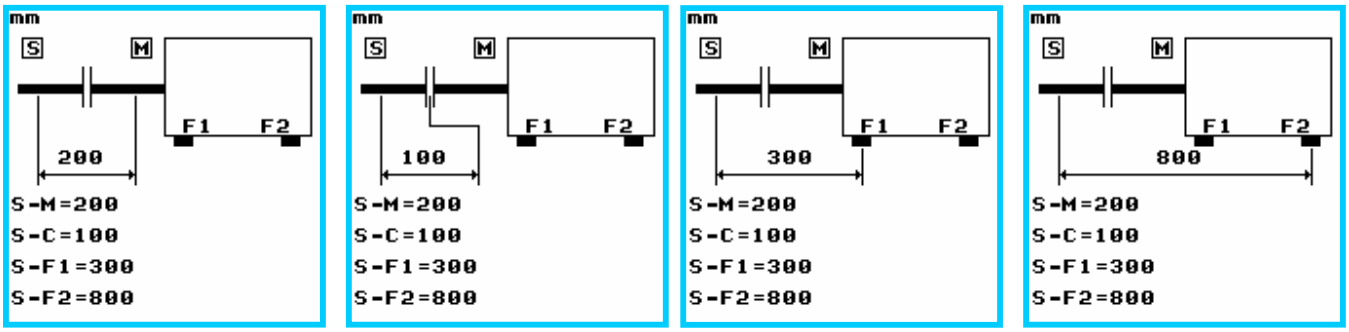


“My documents” and “SetUp” are the same as in main menu.

4.1 Horizontal Machine Alignment

Mount the Measuring transducer marked with (S) on the shafts of the stationary machine and Measuring transducer marked (M) on the moveable machine. Connect the cables as per section 3.3, between the Measuring transducer units and Control Display unit.

Select “Horizontal” to enter horizontal alignment program, then press START.



Input the first dimension between the two transducers using numeric input pad, see Fig.13a. Press key to clear cursor data if any. Then input the new dimensions follow by ENTER to confirm input data.

Use or ENTER to move to 2nd dimension input, distance from Measuring transducer (S) unit to coupling center, Fig.13b and input the new dimension.
Move to 3nd dimension input, distance from Measuring transducer (S) unit to machine front feet center, Fig.13c and input the new dimension.

Move to last dimension input, distance from Measuring transducer (S) unit to the machine rear feet center, Fig.13d and input the new dimension.

Use or to move from dimension to dimension to reconfirm all input data.

Once all dimensions have been input, press , display will shows information of the serial number on both Measuring transducer units as Fig.14 to identify device is properly connected. Next press again to enter sub-menu program to ready for new measurement task “1”, “2” or “3” as Fig .15.

ATTENTION! Before starting new alignment task “1” :

Press to select the first shaft position to start. Start position can be either 9, 6, 3 or 12 o’clock under “Turn 180º” or “Turn <120º” shaft rotation measurement mode when toggle on key .

Note: “<120º “ – if it is impossible to carry out machine alignment with rotation of the shafts up to 180º, turn the shafts to the equal angle on both sides from any of the four 90º position.

Press to select clockwise or anti-clockwise of shaft rotation (recommended to follow machine usual rotating direction).

In case the measurements and the calculation are done and the procedure of adjustment of movable machine was cut off for some reason, the device provides you with the capability to continue (resume function) to use the device without repeating the measurements, see Fig.15. There is no need to enter the distances since they are always stored.

Press : “Continue…” function and the device will show the menu of the results of the last calculations.

Important! During alignment measuement:

DO NOT change the positions of measuring units at the time of interruption of the work;
DO NOT move the movable machine when the device is turned on.

4.3.1 Sub-program option 1: New Task

Select program option  to begin new alignment task. The laser beams turned on now. Using fine adjusting screws on the Measuring transducers, adjust the laser beams to the centers of detectors shutter cover one at a time, refer Fig. 1a & 1b. Once laser is centered on both transducer, open the shutters. The screen starts display detectors X & Y coordinate position readings for both transducers (S) & (M), see Fig.16 .
Turn the shaft to the 1st position as per display, to in-line the blinking indicator with fix line indicator on screen and press  to record the reading for 9 o'clock position Fig 16.

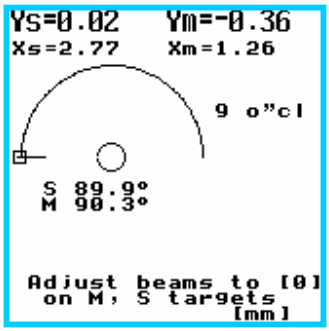


Fig 16.

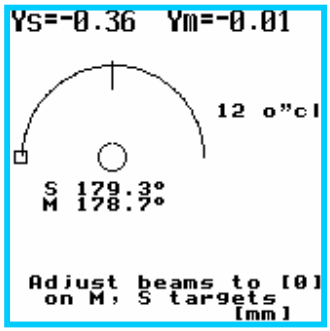


Fig 17.

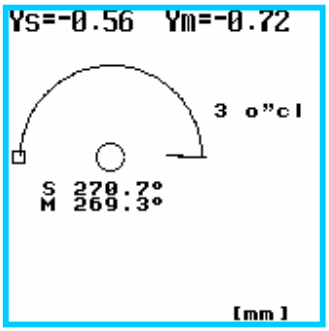
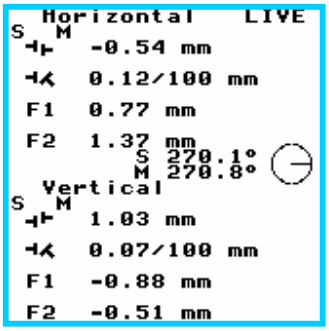


Fig 18.

Turn the shaft to 2nd clock (12 o'cl) position to in-line the blinking indicator with fix line indicator on screen and press  to record the reading for 12 o'clock position. Fig.17
Turn the shaft to last clock (3 o'cl) position to in-line the blinking indicator with fix line indicator on screen and press  to record the last reading for 3 o'clock position. Fig.18.
When all readings are taken, the system will make calculation automatically for correction.

Note: Screen message show ***"Do not turn shaft while aligning"***

The alignment measurement result of calculations shows the values of the angular “Gap” and parallel “Offset” misalignment in the plane of the coupling (in Horizontal and Vertical planes) as well as the correction values for the machine feet F1 (machine front feet) & F2 (machine rear feet) on the movable (M) machine that are necessary for eliminate the horizontal and vertical misalignment.

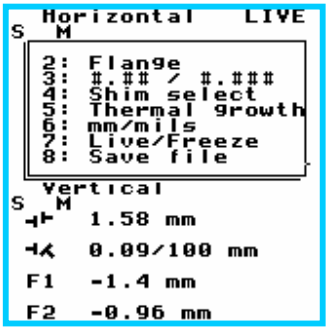


Note:
For the purpose of clarity the values of parallel Offset and angular Gap misalignment in the plane of the coupling are shown in the view of the symbols of half-couplings.
The adjustment values of the position of the feet F1 and F2 of the machine (M) in the horizontal plane indicate the value of horizontal shift. The positive values mean that the feet must be pushed, the negative values – the feet must be pulled.
The adjustment values of the position of the front feet F1 and F2 of the machine (M) in the vertical plane indicate the value of vertical shift. The positive values mean that the feet must be lifted, the negative values – the feet must be lower.

Press 7 PQRS to freeze the alignment result on screen to temporary jot down of coupling results, Fig 19a, while prepare for live adjustment.

To resume “live” measuring mode, Fig 19b, on machine, press 7 PQRS again and start shimming and adjust horizontal movement with under the live adjustment mode.

Note: *To view option features in Fig.19e, press and hold* 1 ⓘ



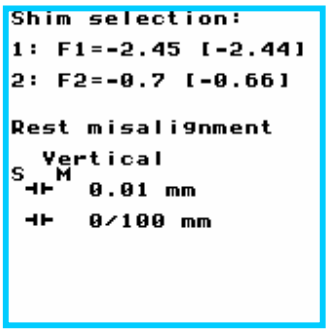
For prompts screen message on the function key, press for show following info:

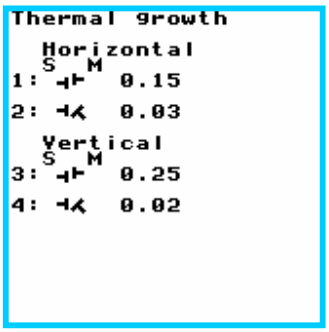
3 DEF – to toggle resolution 0.01mm or 0.001mm

4 GHI – «Shim selection» – to check the shimming which size is different from the results of calculation (Fig.19c).

5 JKL – “Thermal growth” – to enter compensation values to thermal growth (Fig.19d).

8 TUV – to save the result. Enter «My Documents》. You may save this file in the old folder or create a new folder.





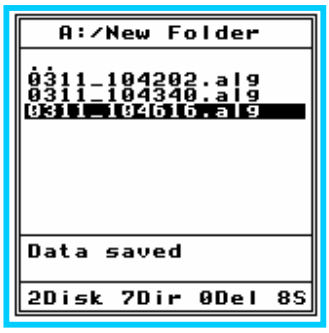
4.3.2 To start correction for the misalignment

Important!
To correct the horizontal and vertical plane as per obtained coupling result in Fig.19a, press 7 PQRS *to return freeze result screen to "LIVE" mode as Fig.19b with shaft remain at last recording clock position. Loosen moveable machine feet and start adjust the feet correction values (add or remove shims) according to Fig.19a, and at the same time adjust the machine horizontal movement at feet (push or pull using jacking bolt if any) according to "LIVE" horizontal correction reading.*

Note: There is NO NEED to turn shaft to 12 o'clock to correct the vertical plane or turn shafts to 3 o'clock position to correct the horizontal plane or turn shaft to 45 degree angle to perform misalignment adjustment.

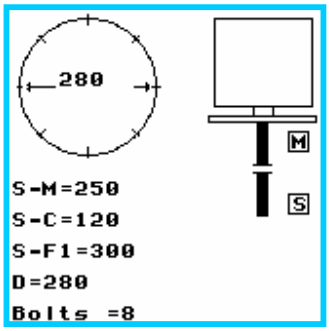
4.3.3 To save alignment measurement data

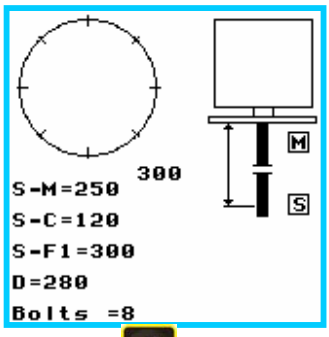
When measurement finish, press 8 TUV to enter file save display. Press 8 TUV again to save the alignment result main directory or 7 PQRS to make new directory or select the exisiting directory to save.

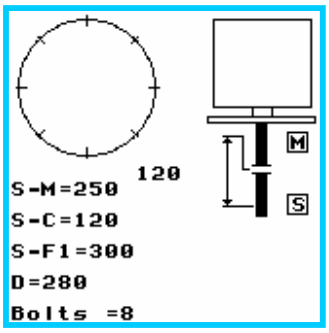


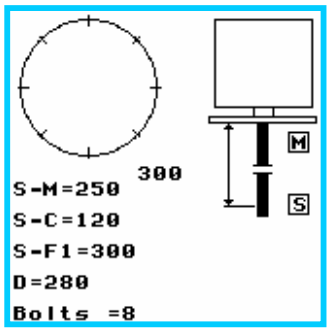
4.4 Vertical Machine Alignment

Mount the Measuring transducer units on the shafts of the machines (S) and (M) as shown in Fig. 20a.
Note: Mark the clock positions 9-12-3-6 at the flange.
Using the connecting cables, connect Measuring transducer units and Control Display









Input the first dimension between the two transducer units, Fig.20a. Press any key to clear display data if any. Then input the new dimensions follow by ENTER to confirm input data.

Use ↓ ↑ or ENTER to move to 2nd dimension input, distance from Measuring transducer (S) unit to coupling center, Fig 20b.

Use ↓ ↑ or ENTER to move to 3nd dimension input, distance from Measuring transducer (S) unit to flange face, Fig 20c.

Use ↓ ↑ or ENTER to move to 4th dimension input, flange bolt center distance.

Use ↓ ↑ or ENTER to move to last dimension input, number of bolts.

Press START when you enter all distances. The display shows information of the serial number on both Measuring transducer units, as Fig 14 to identify device is connected properly.
Next press again to enter measurement sub-menu program to begin new task or call back last stop function, as Fig .21.

Same like horizontal measurement, before starting new alignment task:

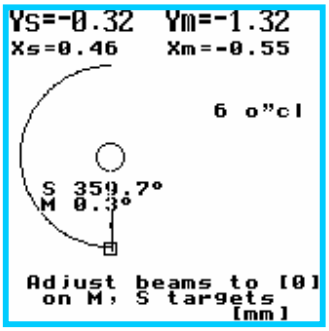
Press 4 GHI to select the first clock's position to start 180o shaft rotation measurement mode.

Next press 5 JKL to select clockwise or anti-clockwise of shaft rotation (recommended to follow machine usual rotation direction).

Next press 6 MNO to select the 180º rotation measurement or less than 120º rotation measurement mode.

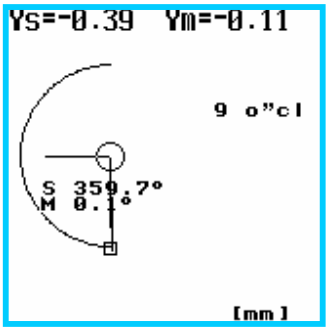
Note: *"Turn <120º " mode– if it is impossible to carry out machine alignment with rotation of the shafts up to 180º, turn the shafts to the equal angle on both sides from the 12 o'clock position.*

Press  to begin new vertical measurement task. The laser beams will be turned on now. Using fine adjusting screws at Measuring transducer, adjust the laser beams to the centers of detectors shutter cover one at a time. Once center on both units, open the shutters. The screen start display the X & Y coordinate position readings for both transducers (S) & (M), see Fig.22
Turn the shafts to the 6 o'clock as position marked on the flange as per default position by device for 1st value. Press  System will record 1st values for the 6 o'clock position (Fig. 22).



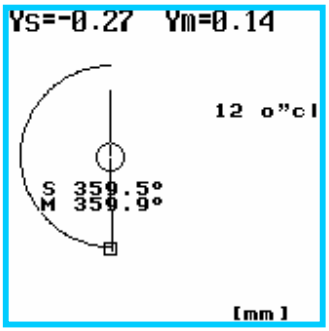
Note: *The electronics inclinometer does not work at the alignment of vertical mounted machine. In this case, the possibility of manual input of the shaft position is provided for.*

Turn the shafts to the 9 o'clock as position marked on the for 2nd value. Press  System will record 2nd values for the 9 o'clock position (Fig. 23).

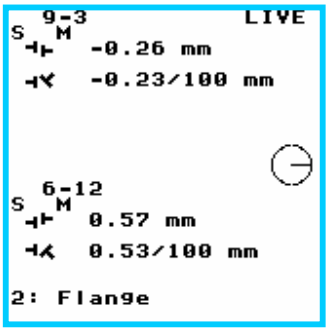


Turn the shafts to the 12 o'clock as position marked on the flange.

Press  System will record last values for the 12 o'clock position (Fig. 24). When all values are taken, the system will make calculations.



The display shows result LIVE of the alignment values of the angular "Gap" and parallel "Offset" misalignment in the plane of the coupling (in 9-3 and 6-12 planes), Fig.26. And the correction

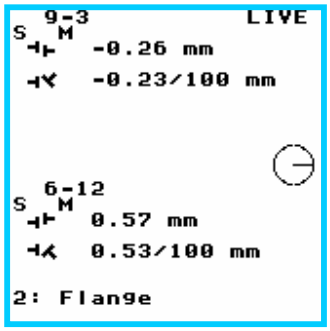


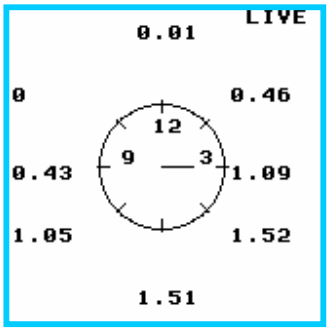
values for the machine offset along 9-3 flange direction & 6-12 direction on the movable (M) machine, and bolt to eliminate the horizontal and vertical angular misalignment as (Fig. 27b).

4.4.1 To start correction for the vertical misalignment

Press 2 ABC *Screen message show* ***"Do not turn shaft while aligning"*** *before display shimming values required for each individual bolts (Fig.27a) and make angular adjustment by adding in or remove shims as per display values.*

To freeze the result screen and LIVE adjustment mode, press 7 PQRS *to toggle. Hand tight all bolts when shims adjustment done.*





Press 2 ABC *to toggle for offset adjustment (in 9-3 and 6-12 planes) and shims adjustment screen. Move the (M) machine along 9-3 and 6-12 direction as per offset adjustment values display on screen.*

Press MENU *to repeat the entire vertical measurement task again to confirm machine alignment has done.*

To save the data when finish. Press 8 TUV *to save the alignment result in memory.*

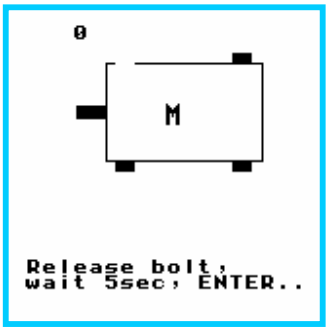
4.5 Program for Soft Foot

Check the machine for the soft foot before fulfilling any alignment adjustments.
Select Horizontal alignment mode
Check and entered all machine dimensions.

Press START display the serials number of the two measuring transducer unit to identify proper connection shown in. Fig14

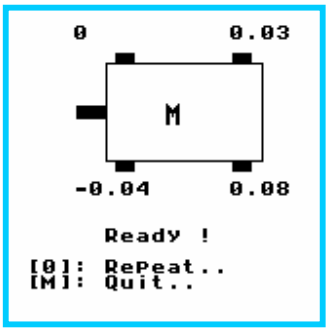
Press START again to enter sub-menu

Press 3 DEF to begin Soft foot check program, Fig 28a
Screen message: **" Wait … shaft should be in pos. 12 O 'cl"** to required shafts to turn to 12 o'clock position to start soft foot measurement.



Follow screen prompts message, release 1st bolt and wait approximately 5 second for soft foot value to measure. Then press ENTER key to record the value.

Tighten the bolt as screen prompts message, and press START to move to next bolt and repeat procedure as per prompts message on the display until all the four individual feet soft foot readings are taken on display. The result shows the difference between the released and tightened bolts of the foot. Set maximum shimming values.



Choose 0 to repeat entire soft foot check after remove the soft foot as per measured result or press 8 TUV to enter data save screen and press 8 TUV again to save soft foot reading.

Press MENU to quit and end soft foot program.

5.0 Standards Tolerance of Shaft Misalignment.

This chapter provides the standards alignment tolerance of misalignment for standard industrial machinery with flexible coupling that can be used under condition only if existing in-house standards or the machine or coupling OEM have not given any blinding values, and must not be exceeded.

Speed, rpm	Good		Acceptable	
	Offset	Angular (Gap)	Offset	Angular (Gap)
Up to 1000	0,08	0,07	0,12	0,10
Up to 2000	0,06	0,05	0,10	0,08
Up to 3000	0,04	0,04	0,07	0,07
Up to 4000	0,03	0,03	0,05	0,05
More than 4000	0,02	0,02	0,04	0,04

6.0 Delivery Set

№	Description	Qty	Note
1.	Control Display Unit	1	
2.	Measuring Transducer Unit	2	
3.	Brackets Fame	2	
4.	Chains assembly	2	
5.	Supporting Rods	4	
6.	Connecting Cable	2	
7.	AC Charger, 220-230Volts	1	
8.	Tape Measure 2m	1	
9.	Carrying Case	1	
10.	Operating Instructions Manual	1	
11.	CD-ROM Software	1	
12.	USB PC Communication Cable	1	