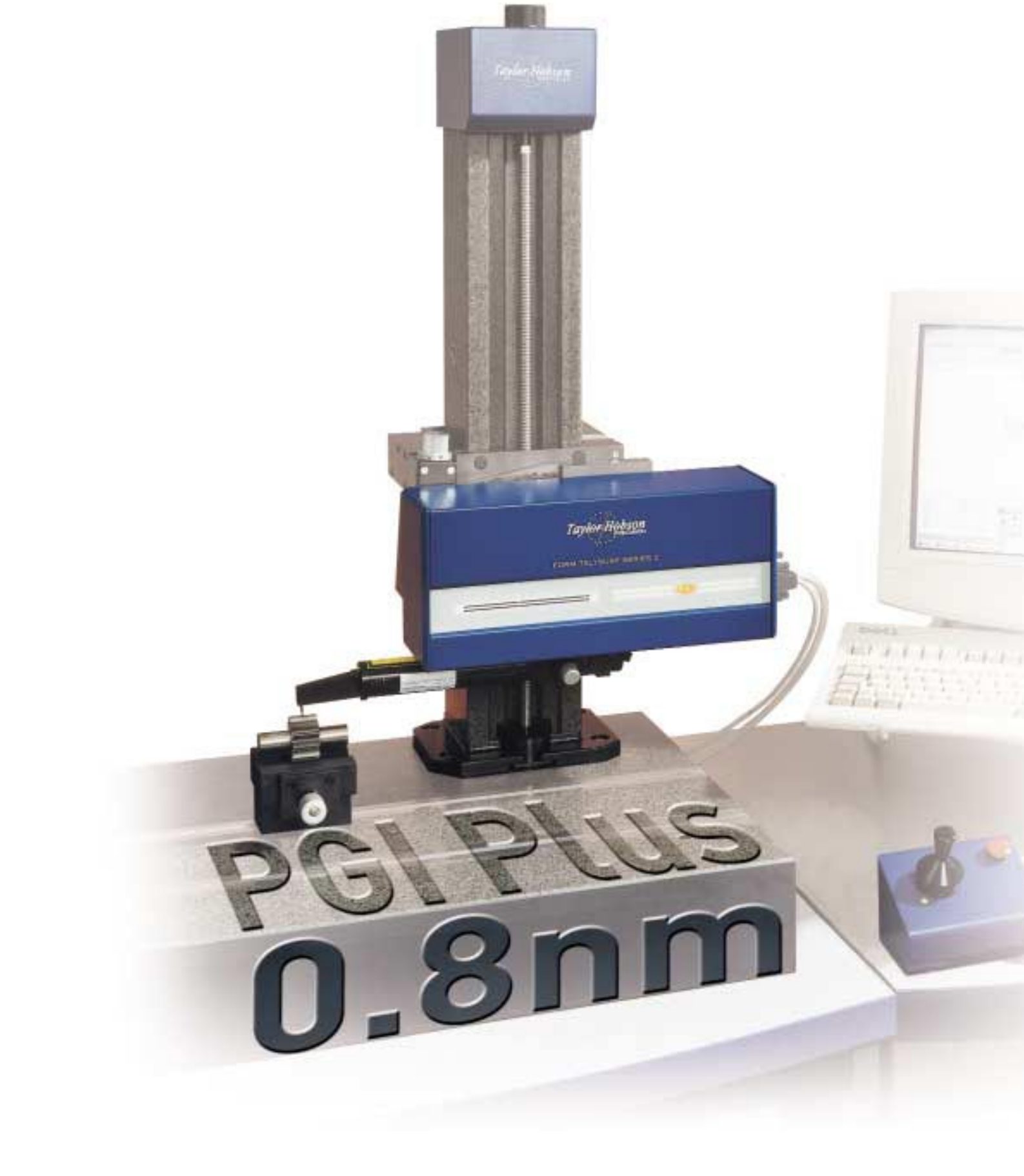
Taylor Hobson PRECISION

Form Talysurf
Series 2



K505/9

The Form Talysurf Series 2

Operator's Handbook

Taylor Hobson PNEUMO

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Software Version 06.xx

This handbook can also be used with previous versions of Form Talysurf Series software. However, some of the facilities described will not be available.

CONTENTS

IMPORTANT USER INFORMATION

Software running under Windows 95

The PC supplied with this instrument has been pre-loaded with Microsoft Windows 95, but has been configured such that on switch on the PC "boots" directly into "DOS MODE".

The user can access Windows 95 by typing 'win' at the DOS prompt.

NOTE (for Advanced PC users)

In order to "Boot" the PC into DOS mode, the attribute "BootGUI=1" in the MSDOS.sys file has been modified to "BootGUI=O"

Mouse Drivers

As this THP software runs in DOS mode, a DOS mouse driver has been supplied

The mouse driver is not installed as part of the THP software but the relevant driver is located in the MOUSE directory on the C:\ drive. The user is recommended to back up this directory, so that in the future he can, if required, re-create it.

PC Bios

In the PC Bios, the Parallel Port has been enabled as "Output only". This is to ensure compatibility with any Software Options Dongle that is plugged into the parallel port.

CHAPTER 1
INTRODUCTION

The Form Talysurf series of instruments for surface analysis, comprises a range of compatible, interchangeable modules and accessories which can be combined to form the system most suited to a particular application.

Surface texture can be measured over a wide gauging range, which, with the appropriate software package, also allows the measurement of Form deviations from simple Radius and Angular relationships to complex mathematical forms.

The 'SERIES' comprises several modules which can be configured together in different ways to achieve a particular application requirement. The exception to this, is the Form Talysurf Series E instrument. This comprises a system of fixed configuration (based on a free standing 50mm traverse unit) with a restricted function software set.

The modules are as follows:

- 50mm Traverse Unit (Inductive Transducer)
- 120mm Traverse Unit (Inductive Transducer)
- 120mm Traverse Unit (Laser Transducer)
- 120mm Traverse Unit (P.G.I gauge)
- Electronic Interface Module
- Personal Computer.
- Terminal Module 2.
- 450mm & 700mm Motorised Columns
- Inductive gauge unit with Interchangeable Styli
- Contour gauge unit with Interchangeable Styli
- Wide Range gauge unit with Interchangeable Styli.

The wide measuring range/resolution enables a variety of measurements to be made with minimum set-up. The ability to program all measurement functions, including axis motions,

facilitates automatic component measurement and results presentation.

The programming facility is not available with the Form Talysurf Series E instrument. However, programs created on a Form Talysurf Series instrument or by Taylor Hobson Limited can be run on this instrument.

All results are computed to international standards for parameters and filters (both current and proposed), including Gaussian filter characteristics and choice of bandwidth used for assessment of data.

This operator's manual provides a detailed description of all hardware functions as well as the function of each menu option. Although some functions are dependent of the particular version of software purchased, all options are explained but with notification where restricted to particular software versions.

It is recommended that the operator makes full use of the reference section, to obtain a full understanding of the power and flexibility that is offered by Form Talysurf Series.

IMPORTANT In order to provide protection for all essential and required software, in the event of an unrecoverable computer failure, it is important that the Form Talysurf Series program disks and any product specific data (e.g. files of measurement programs and results data which the user wishes to retain) are 'backed up' onto floppy disks (or, other storage media).

A description of a method of making copies of the Form Talysurf Series program disks is given in Chapter 2. Files generated by the user (e.g. files of measurement programs and results data) can be saved onto floppy disk via the File Manipulation Menu of the Form Talysurf Series program.

Note The user must be aware that the computer manufacturer is **not** responsible for loading application specific software on any occasion (i.e warranty replacement).

CHAPTER 2
INSTALLATION

CONTENTS OF THIS CHAPTER

SITING The siting of the instrument depends on the application requirement, however to ensure the optimum performance is achieved the following should be considered wherever possible.

DRAUGHTS Draughts and airborne vibration should be avoided particularly when measuring in the skidless mode. Avoid placing the instrument in draughts or directly under air conditioning vents.

For particularly critical applications it is often beneficial to cover the instrument to minimise the effects of air movement and airborne vibration, a suitable cover is available from Taylor Hobson Ltd.

TEMPERATURE GRADIENTS Areas which suffer from temperature gradients of over 2°C/hour are not ideally suited to the measurement of precise form. For the measurement of surface texture parameters a higher value can be tolerated (in the order of 5°C/hour).

Avoid siting the instrument in areas which have a very rapid temperature gradient as in the case of being near windows or skylights where sunlight may be able shine on the instrument.

VIBRATION Vibration is particularly detrimental for the measurement of surface texture. It is essential that a good solid table with anti-vibration mountings is provided for applications in potentially 'noisy' environments.

POWER SUPPLY It is important that a clean power supply should be provided to the instrument.

If in doubt many computer peripheral dealers can supply a suitable U.P.S (uninterruptible power supply). A complete U.P.S system for the instrument can be obtained from Taylor Hobson Limited

WARNINGS

THE FOLLOWING MUST BE OBSERVED

- IT IS ESSENTIAL THAT THE ELECTRICAL SUPPLY TO THIS INSTRUMENT CONSISTS OF A THREE WIRE SYSTEM IN WHICH ONE WIRE IS THE EARTH. THE INSTRUMENT MUST NEVER BE CONNECTED TO A TWO WIRE SYSTEM WITH OR WITHOUT A SEPARATE EARTH.
- THE ELECTRICAL SUPPLY TO THE INSTRUMENT SHOULD BE CONNECTED VIA A SEPARATE MAINS ISOLATING SWITCH AND THAT PRIOR TO CONNECTION THIS SWITCH IS SET TO THE "OFF" POSITION.
- THE MAINS LEAD MUST BE DISCONNECTED BEFORE MAKING ANY SYSTEM INTERCONNECTIONS OR ATTEMPTING TO CHANGE A FUSE.
- ON SYSTEMS WITH A LASER TRAVERSE UNIT, THE POWER MUST NOT BE SWITCHED ON IF THE LASER TRAVERSE UNIT LEADS ARE NOT CONNECTED, AS A HIGH VOLTAGE WILL EXIST ON THE CONNECTOR . DAMAGE TO THE SUPPLY COULD ALSO OCCUR.
- KEEP CLEAR OF THE INSTRUMENT DURING OPERATION. THIS IS BOTH GOOD METROLOGY PRACTICE AND WILL AVOID THE RISK OF INJURY CAUSED BY CONTACT WITH MOVING COMPONENTS OF THE SYSTEM.
- THE INSTRUMENT CAN BE OPERATED UNDER THE CONTROL OF A COMPUTER PROGRAM AND CAN, THEREFORE, MOVE WITHOUT WARNING. KEEP CLEAR OF THE INSTRUMENT WHEN IT IS OPERATING IN THIS MODE.

CAUTION

- ON SYSTEMS THAT HAVE MULTIPLE GAUGES, i.e. INDUCTIVE, INTERFEROMETRIC (P.G.I.), LASER, ONLY ONE GAUGE MUST BE CONNECTED TO THE ELECTRONIC INTERFACE UNIT AT ANY TIME.

HARDWARE INSTALLATION

TABLE A strong stable mounting, such as an instrument desk, is required to support the instrument (particularly when a column and stand is included as these have a combined weight of 173kg 362llbs). With the instrument desk in the required position, use the adjustable feet to bring the table level. A bubble level should be used to assist the operation and check the result.

BASE Clean the protective grease from the base unit and fit the four screw-in carrying handles provided for lifting the base, which weighs 120kg (246 lbs). These handles must be fully screwed into the threaded holes in the ends of the base (two handles at each end). The user must decide whether to use manual or mechanical lifting, depending on the environment and the distance to be moved. The threaded holes on the top of the base MUST NOT be used for lifting.

COLUMN Clean all protective grease from the column then screw the two lifting handles fully into the holes provided. Using two persons, locate the column on the base. Secure the column in position by tightening the bolts through the column flange into the base. Remove the lifting handles and store in a safe place.

TRAVERSE UNIT Clean protective grease from the unit and remove transit clamp. Engage the dovetail fitted to the back of the traverse unit with the mating part in the carriage attached to the column. Lower the traverse unit slowly until it is located. Tilt the unit 5° down (manually) to expose the socket head locking screw. Tighten this screw to lock the dovetail in position.

INTERCONNECTIONS

Connect up the units as shown in the following diagrams. Ensure that a good earth is available for the instrument, this is essential for both safety and correct operation. Ensure that the values of the fuses, fitted above the mains connector of the Electronic Interface Module, correspond to the following:

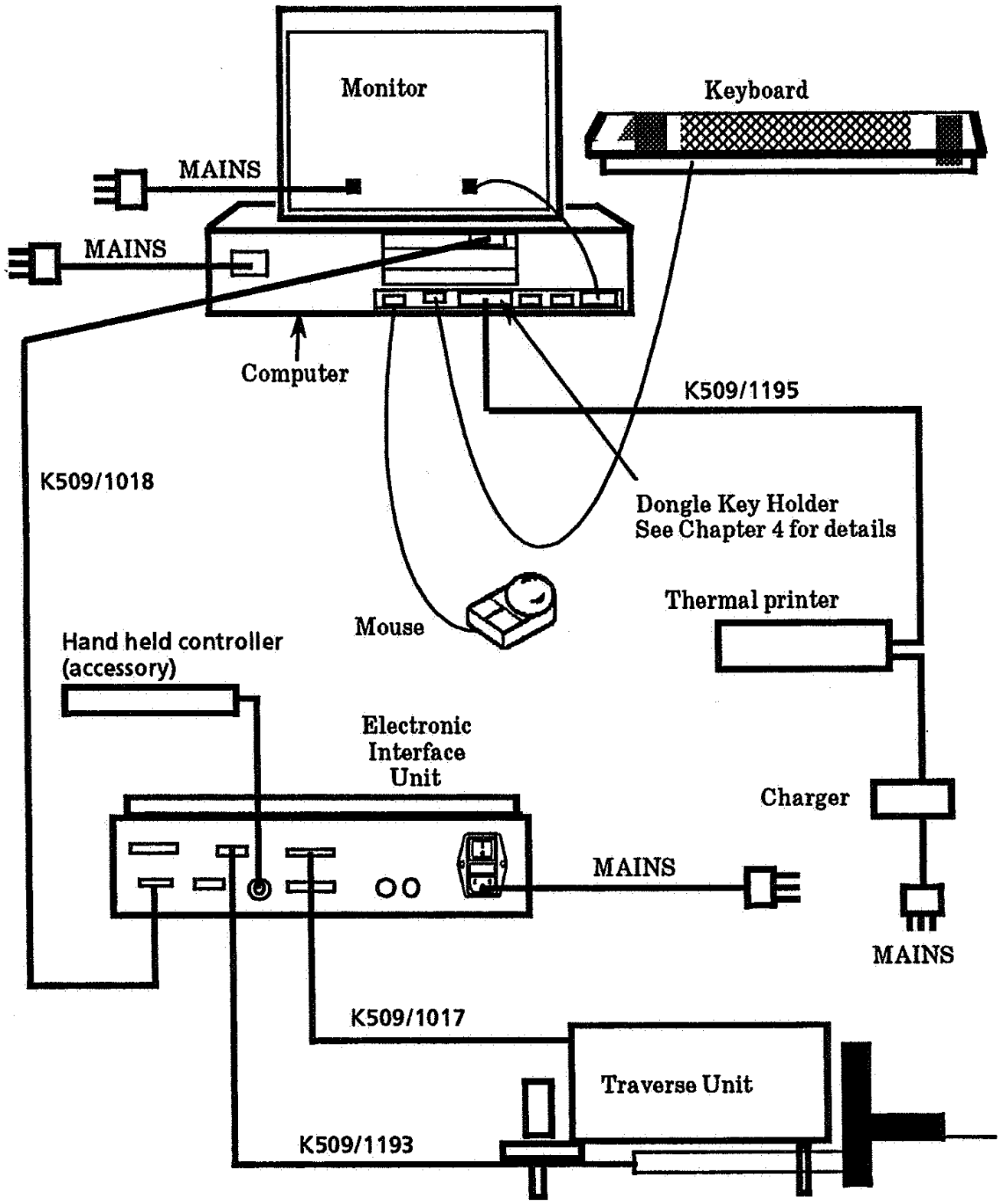
100-130V ac 2 fuses T2A

200-240V ac 2 fuses T1A

T = Time lag (Slow blow)

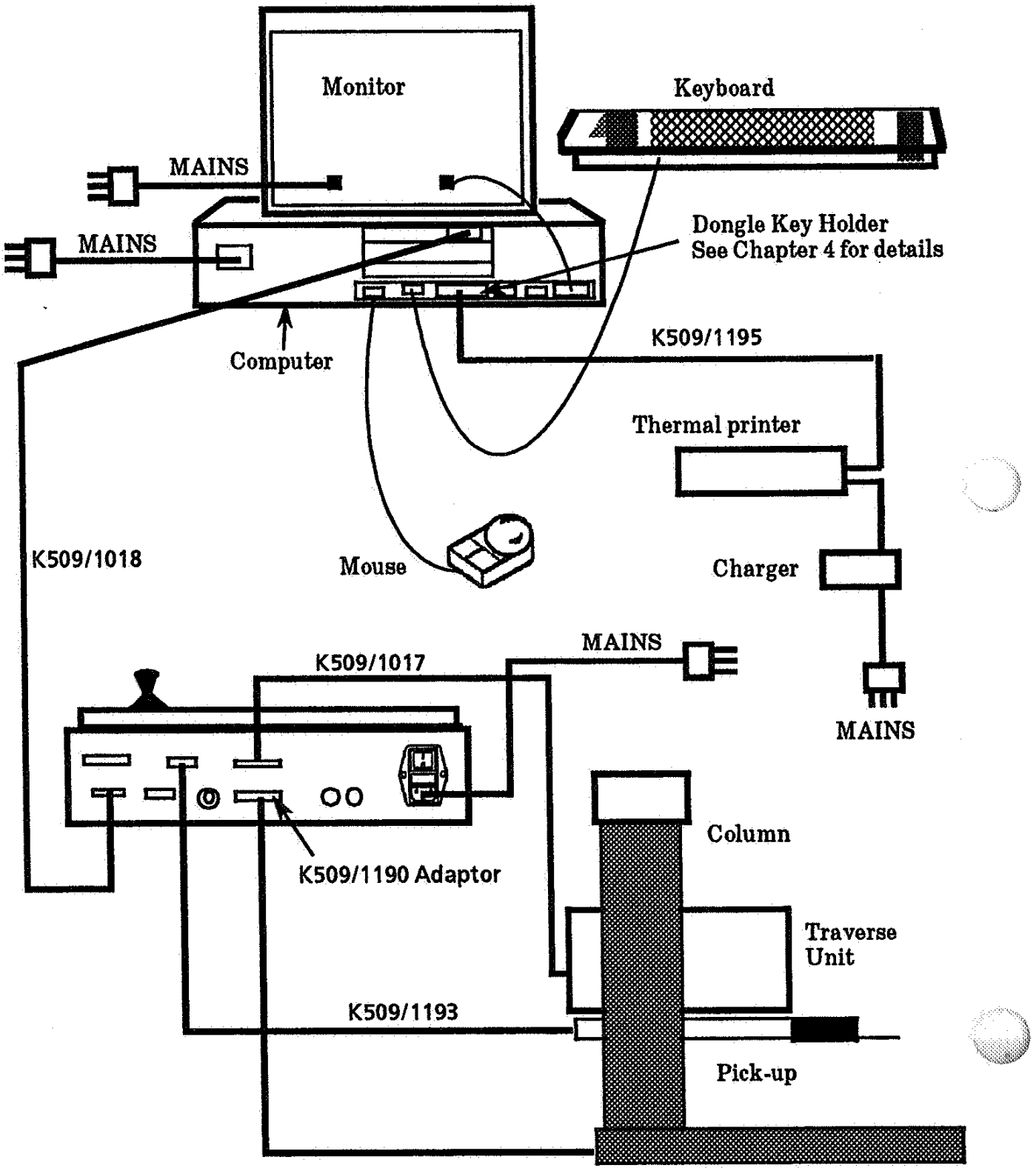
WARNING: ALL CONNECTIONS AND DISCONNECTIONS MUST BE MADE WITH THE POWER SWITCHED OFF.

For free standing systems, make the inter connections as follows. If Terminal Module 2 is used instead of a standard PC, see section 3 for details of the Terminal Module and its connections.



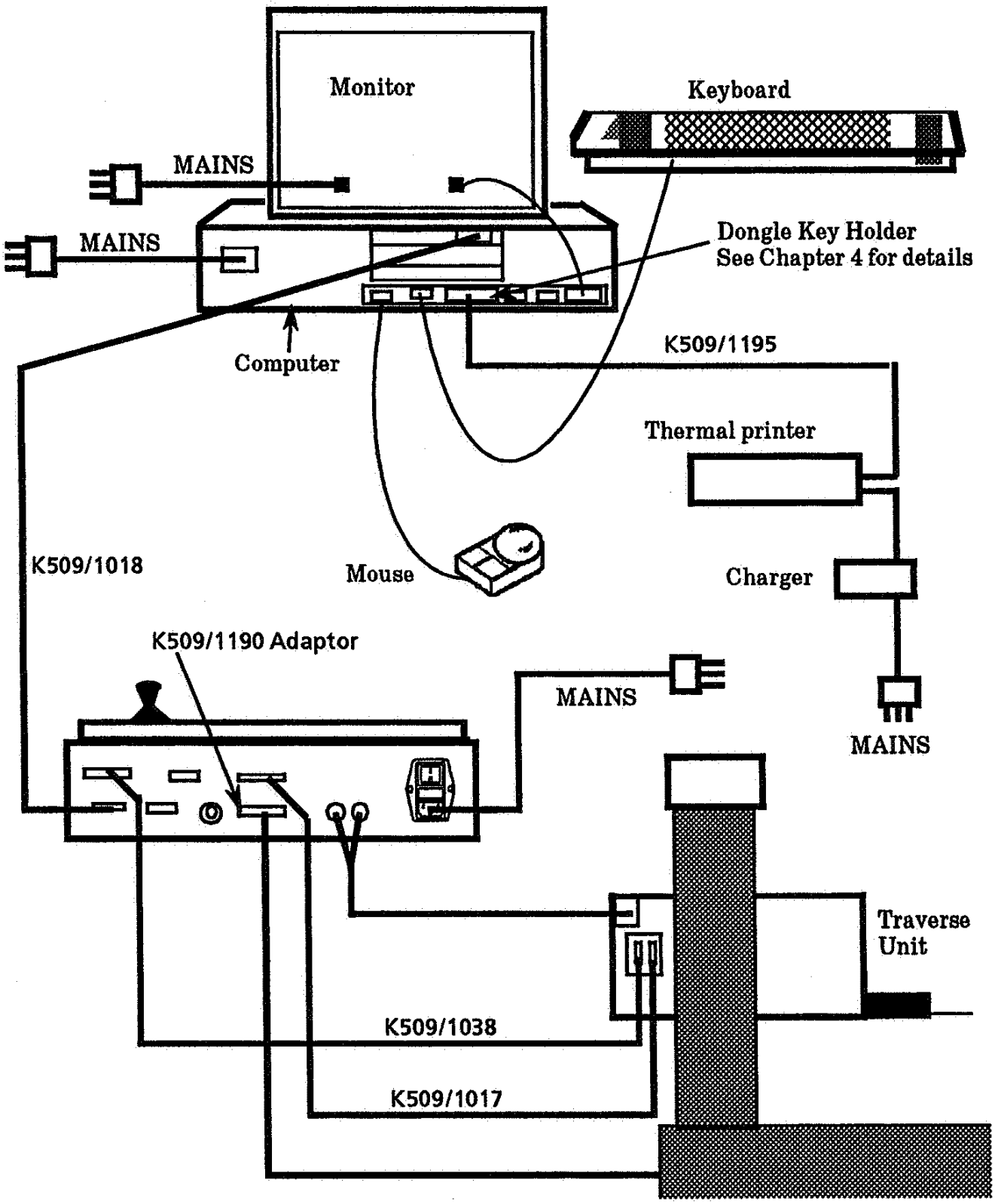
WARNING: ALL CONNECTIONS AND DISCONNECTIONS MUST BE MADE WITH THE POWER SWITCHED OFF.

For column mounted inductive systems, make the inter connections as follows. If Terminal Module 2 is used instead of a standard PC, see section 3 for details of the Terminal Module and its connections.



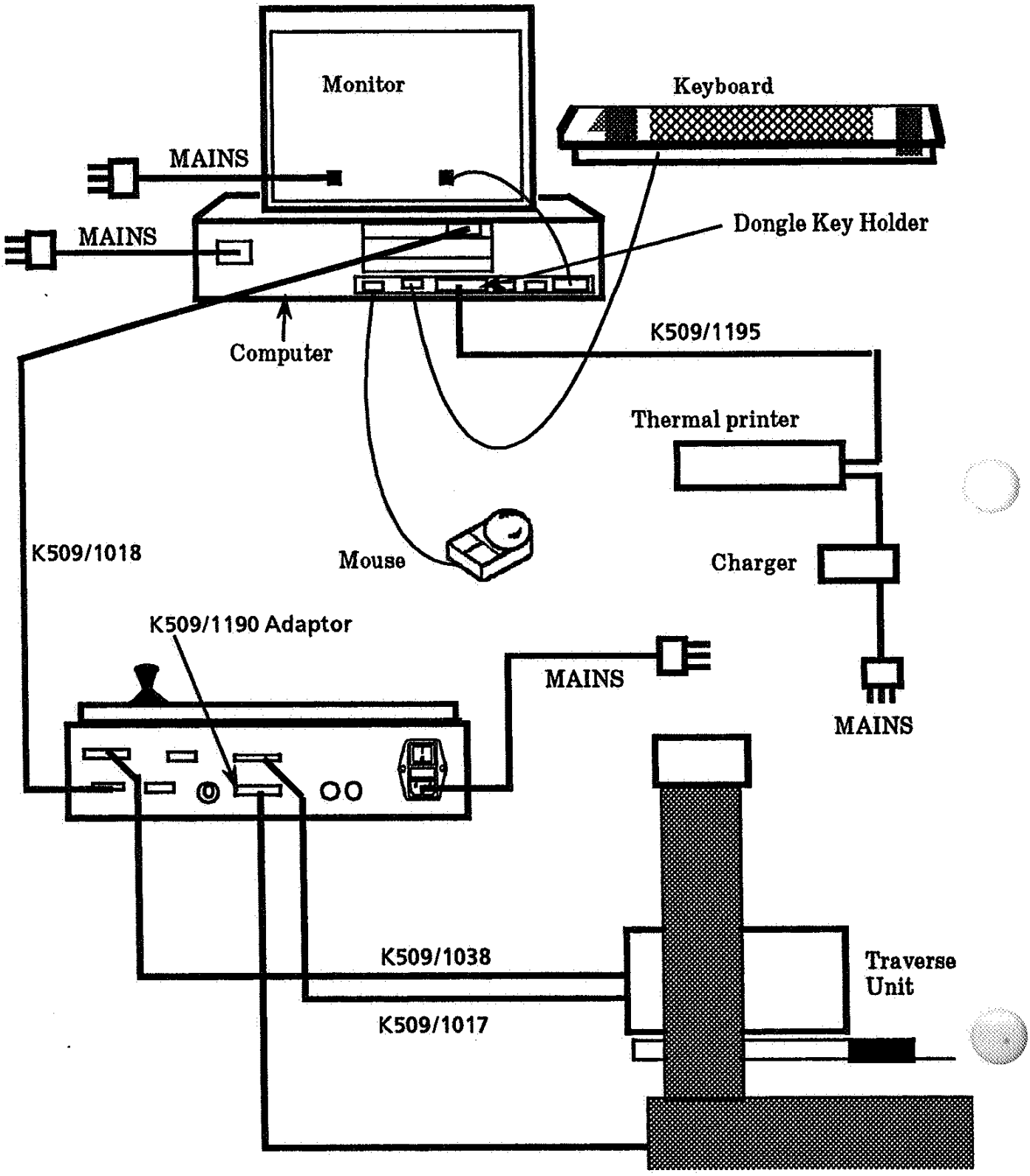
WARNING: ALL CONNECTIONS AND DISCONNECTIONS MUST BE MADE WITH THE POWER SWITCHED OFF.

For Column Mounted laser systems, make the inter connections as follows: If Terminal Module 2 is used instead of a standard PC, see section 3 for details of the Terminal Module and its connections.



WARNING: ALL CONNECTIONS AND DISCONNECTIONS MUST BE MADE WITH THE POWER SWITCHED OFF.

For Column Mounted systems with P.G.I traverse unit, make the inter connections as follows: If Terminal Module 2 is used instead of a standard PC, see section 3 for details of the Terminal Module and its connections.



SOFTWARE INSTALLATION

The installation of the software is a semi-automatic procedure, the operation being controlled by displayed commands to the operator from the VDU of the computer. It is **IMPORTANT** that the original diskettes are not used for the purposes of installation, backup working copies should be made and subsequently used for installation.

1) Switch the system on and wait for the prompt C:> to be displayed.
2) Insert diskette Number 1 (Installation Diskette) into disk drive A:
3) Type **A:** and press the Enter key.
4) Type **Install** and press the Enter key
5) Follow the commands given via the display.

When the installation is complete the backup working copies can be stored and the system should automatically load from the hard disk each time the system is switched on.

INSTALLATION OF SOFTWARE UPDATES

The following procedure is used prior to installing updated software onto a computer which is already running the Form Talysurf Series software. The procedure is used to delete environment files which the user has created previously.

The DOS directory structure for the Form Talysurf Series program includes the following directories:

\fts	(includes main program files).
\fts\rth	(user programs, profiles and fts_info.env).
\fts\user_dir1	(user programs, profiles and fts_info.env).
\fts\user_dir2	(user programs, profiles and fts_info.env).

The sub directories user_dir1, user_dir2, etc. refer to any sub directories of \fts created by the user

from the filing menu. These contain similar information to \fts\rth.

When an updated version of the Form Talysurf Series program is to be installed using the `install' sequence, the user should first delete the environment files (fts_info.env) from any sub directories which the user has created. This can be done with the DOS command `del' (delete) e.g.
del \fts\user_dir1\fts_info.env

The environment file fts_info.env in the sub directory \fts\rth is automatically deleted by the `install' sequence.

IMPORTANT **Re-installing the software on Instruments with Terminal Module 2**

Before re-installing the software on Terminal Module 2, it is important that the existing AUTOEXEC.BAT file is modified to delete the line: **\b.** This is normally the last line of the file.

The AUTOEXEC.BAT file can be modified using the EDIT facility in the following manner:

Obtain the DOS prompt (this can be accessed from the menu page displayed after switching on the computer or after exiting the Form Talysurf program).

At the prompt enter:

CD then press the ENTER key.

Then enter

EDIT AUTOEXEC.BAT and press the ENTER key.

This will cause the EDITOR program, with the AUTOEXEC.BAT file already loaded, to be displayed.

Repeatedly press the down arrow (↓) to move the cursor to the start of the line that reads **\b (this is normally the last line).**

Use the delete key to delete the text \b.

Finish the edit by closing and saving the modified file. This is done by pressing the ALT key to highlight the FILE menu option. Press the ENTER key to pull down the menu. Press x (or X) to exit. When prompted to save the changes, press the enter key again. This will cause the Editor to exit and save the changes.

The edit can be confirmed by entering the command **TYPE AUTOEXEC.BAT** at the DOS prompt. This will cause the file to be displayed on the screen.

When the edit has been performed correctly, the software installation can be carried out.

MAKING BACKUP COPIES OF DISKS

The software is normally installed on the hard disk of the computer before shipment and a set of program disks is included for use only in the event that reinstallation is required.

It is essential that the original program disks supplied are 'backed up' to form a copy set of working program disks.

This can be done from the DOS prompt C:>.

1) Type **Diskcopy A: A:** and press the Enter key. The system will then ask for the 'SOURCE DISKETTE' to be placed in drive A:, and STRIKE ANY KEY WHEN READY'

2) Place the disk to be copied into disk drive A: and press any alphanumeric key.

3) The computer then reads the data on the disk and then asks for the TARGET DISKETTE to be placed in drive A:, and STRIKE ANY KEY WHEN READY:

   Place a new formatted or unformatted diskette into drive A: and then press any alphanumeric key.

4) Further messages may be given to insert the source and target disks in drive A:, these commands should be followed.

5) Repeat the above for each diskette supplied with the system.

When this has been completed the original diskettes should be stored in a safe place and only used to make further working copies if necessary.

INITIAL CHECKS

1. Use the joystick to drive the carriage to the top and bottom of the column, to check the automatic end stops.

2. Repeat the above check driving the carriage under computer control (see the MOVE COLUMN MENU section of this handbook).

   Ensure the column moves at all the selectable speeds.

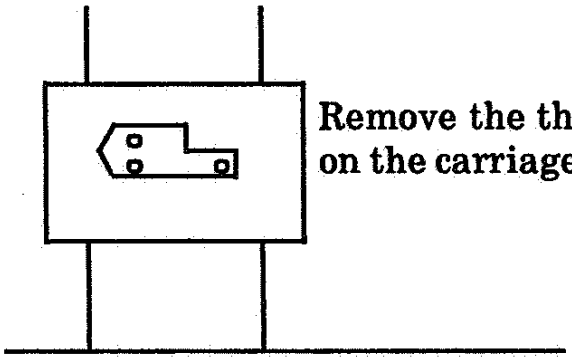
3. The tilt mechanism should have a full movement of ±9.0 degrees. Check this by using the tilt switch on the base unit and also under computer control. (see the MOVE TILT MENU section of this handbook).

4. Check that the traverse unit has the full movement of 120mm or 50mm. Check that both end stops of the traverse unit are functioning.

5. Ensure that the vertical height adjustment of the hinge unit is working (50mm traverse unit and free standing 120mm traverse unit).

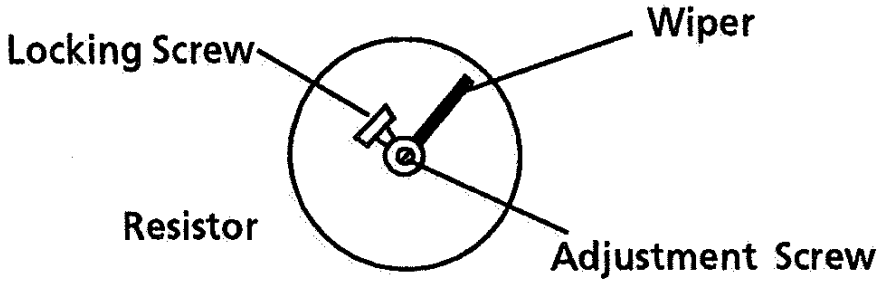
6. Before any measurements are made, the procedure described under MATCHING THE GAUGE, in Section 5 of this handbook should be carried out (inductive gauge only).

7. Refer to LEVELLING THE TRAVERSE UNIT in the SELECTED TOPICS section of this handbook, and carry out an autolevel operation. Use an optical glass flat mounted directly on the base and traverse over a 10mm length. On the screen, the traverse unit tilt icon should show between - 0.2° and 0.2°. If this is not the case, proceed with the following adjustment;



Remove the three screws from the rear cover on the carriage.

Release the locking screw and turn the adjustment screw to give a 0° reading on the display. Re-tighten the locking screw and re-fit the cover.



8. Check the satisfactory operation of the printer by pressing key F8. This will cause a print-out of the current screen display to be produced.

GAUGE CALIBRATION Refer to the relevant calibration section in this handbook and obtain peak to valley readings over either 12.5mm, 22mm calibration ball or 80mm radius glass standard, as appropriate. Then check the straightness of traverse by making an unfiltered full length measurement over an optical glass flat, using 4000 data points and MZ reference with gauge range 1 selected (see SET GAUGE MENU).

Inductive 50 mm

1mm Stylus range, max. Form error:

Ball Calibration (P_{Rt}) 0.25µm

Straight line (P_{Rt}) 0.4µm

Inductive 120 mm

1mm Stylus range, max. Form error:
Ball Calibration (P_{Rt}) 0.25µm
Straight line (P_{Rt}) 0.5µm

P.G.I.

10mm Stylus range, max. Form error:
Ball Calibration,with std. 60mm stylus arm, (P_{Rt}) 0.75µm
Straight line (P_{Rt}) 0.5µm

Laser

6mm Stylus range, max. Form error:
Ball Calibration (P_{Rt}) 0.15µm
Straight line (P_{Rt}) 0.5µm

Contour Pick-up

20mm Stylus range, max. Form error:
Ball Calibration (P_{Rt}) 15µm
Straight line (P_{Rt}) 15µm

GRAPH CHECK With a skid (if supplied) fitted to the stylus, measure a 3 line standard using a 60mm stylus (0.2mm range). Graph the modified profile at an adequate magnification and confirm that the centre step height is that indicated on the standard.

SYSTEM SPECIFICATION

The specifications of the individual modules are given in the parts of this handbook that relate to those modules. The following data relates to the whole system.

ELECTRICAL SUPPLY TO THE ELECTRONIC INTERFACE MODULE:

Mains Supply Voltage 100V - 240V 50/60Hz

Max . power requirement: 70VA

This equipment is intended for installation category (overvoltage category) II, in accordance with IEC 1010 (1990) and EN 61010-1 (1993).

NOTE: For details of the power requirements for the computer and any accessories that do not derive their power from the E.I.M., refer to the manufacturer's documentation.

ENVIRONMENTAL CONDITIONS

For operation within performance specifications

Ambient Temperature Range	
Inductive systems:	15°C to 30°C
Laser systems:	18°C to 22°C
Ambient Relative Humidity	
Inductive systems:	10% to 80%
Laser systems:	45% to 75%

SAFETY

The system is designed to be safe when the following conditions apply:

The system is located indoors in dry conditions.

Fluctuations in the mains supply voltage do not exceed ±10%

The altitude does not exceed 2000m

The ambient temperatures is between 5°C and 40°C

The ambient relative humidity does not exceed 80% for temperatures up to 31°C, decreasing linearly to 50% at 40 °C.

CHAPTER 3
THE MODULES

This chapter covers the modules which are available to provide the system most suited to an application

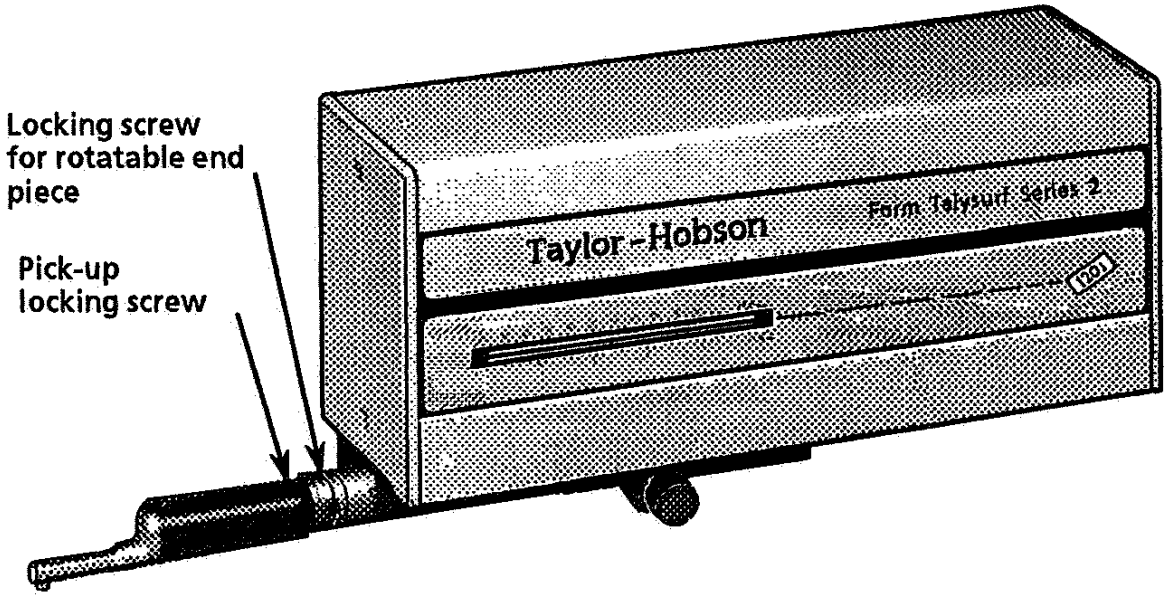
Not all of the modules are required for a functional system

CONTENTS OF THIS CHAPTER

THE 120mm TRAVERSE UNIT

DESCRIPTION The traverse unit houses the motor, gearbox and associated circuits for traversing the pick-up across the surface to be measured. A straightness datum is incorporated enabling measurements, of up to 120mm long, to be made without reference to an external straight line datum.

A pick-up is plugged into the end of a stem that is then clamped to the traverse unit drive bracket. During a traverse operation, the drive bracket (which is referenced to the straightness datum) is driven at the appropriate speed for the move or measurement being made.



The unit can be used either column mounted or free standing. Four screw-in feet (painted red) are fitted prior to despatch. These are intended for transit purposes only and should be removed before making measurements.

For measurements which require a free-standing traverse unit, an optional tilt accessory is available. This is used in conjunction with the hinge unit accessory,

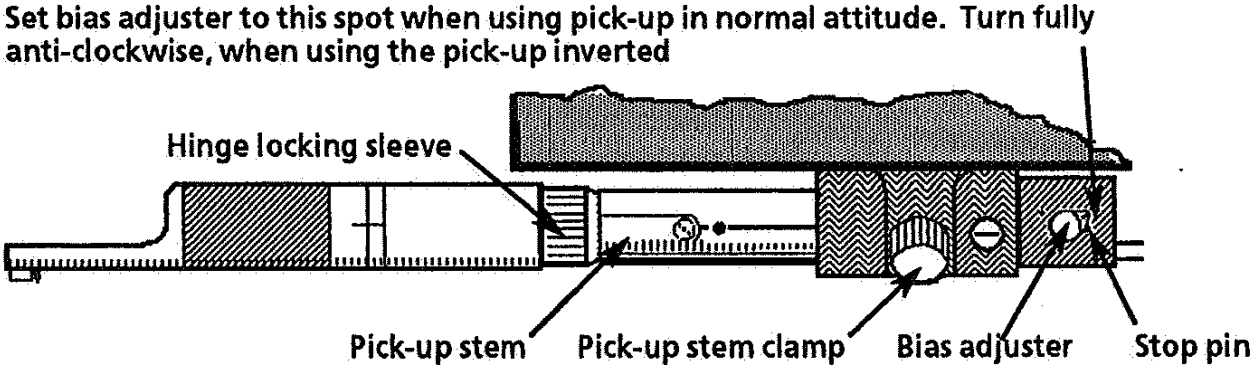
The back panel of the traverse unit carries a

dovetail slide for mounting the traverse unit onto the column carriage. For traverse unit installation, see the Column details later in this section.

TRAVERSE INDEX This can be seen through the transparent panel in the side of the traverse unit and indicates the position of the pick-up within the traverse length (the scale is graduated in mm and inches).

PICK-UP STEM The pick-up is plugged into the end of a pick-up stem which can be clamped to the traverse unit drive bracket in any position. This enables the projection of the pick-up beyond the traverse unit to be altered.

There are two pick-up stems : the solid stem, which is used for skidless measurements only, and the hinged stem. The hinged stem incorporates a hinge unit and adjustable bias spring. The pick-up with skid nosepiece, normally rests on the surface being measured under its own weight. When used with various accessories (e.g. the right angle attachment), an upward bias is required to compensate for the additional load at the end of the stem. This is obtained by rotating the bias adjuster. The hinge can be locked by turning the locking sleeve. The pick-up must then be used skidless.



For maximum straightness accuracy, the stem should be inserted into the traverse unit drive bracket to bring the pick-up as close to the drive bracket as is practical. The solid stem can be

inserted into the bracket up to the rotatable end into which the pick-up is plugged. The Hinged stem can be inserted into the bracket up to the hinge locking sleeve.

INVERTED PICK-UP For measurement of an under surface, the pick-up is rotated and locked in the inverted position. For skidless measurements either the solid or the hinged stem (with hinge locked) can be used. For measurements using a skid nose piece, the hinged stem must be used with the bias adjuster set to provide an upward bias.

The pick-up stem incorporates a rotatable endpiece. This enables the pick-up to be rotated and set to any angle. A set screw locks the pick-up in position.

The block which carries the pick-up stem bias adjuster also carries the connector for the pick-up lead.

CAUTIONS:

Pick-up stem endpiece position

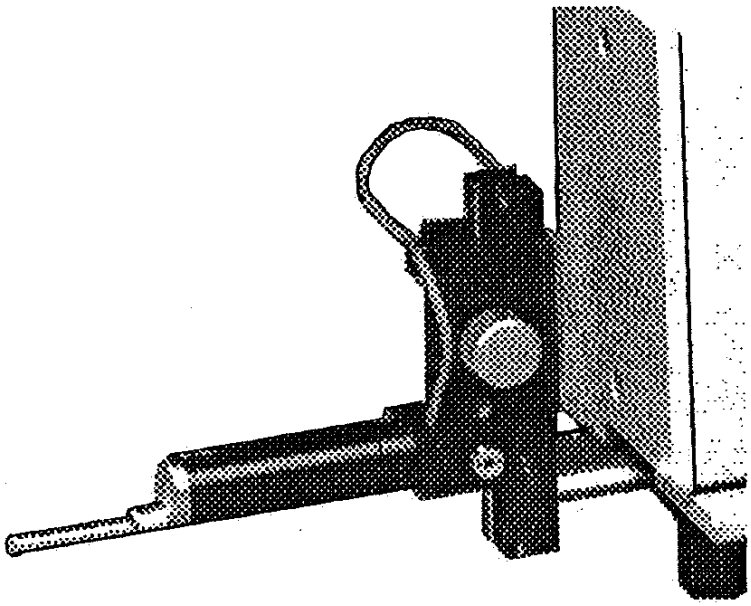
Do not attempt to make a measurement, or place the pick-up in contact with a surface, when the pick-up stem endpiece is rotated to any angle other than for vertically upwards or downwards operation of the stylus arm. Damage to the instrument and/or workpiece may result.

Measurements using a pick-up with skid nosepiece

When making measurements when a skid nosepiece is fitted, the pick-up stem hinge must never be locked. Ignoring this instruction may result in damage to the instrument and/or the workpiece.

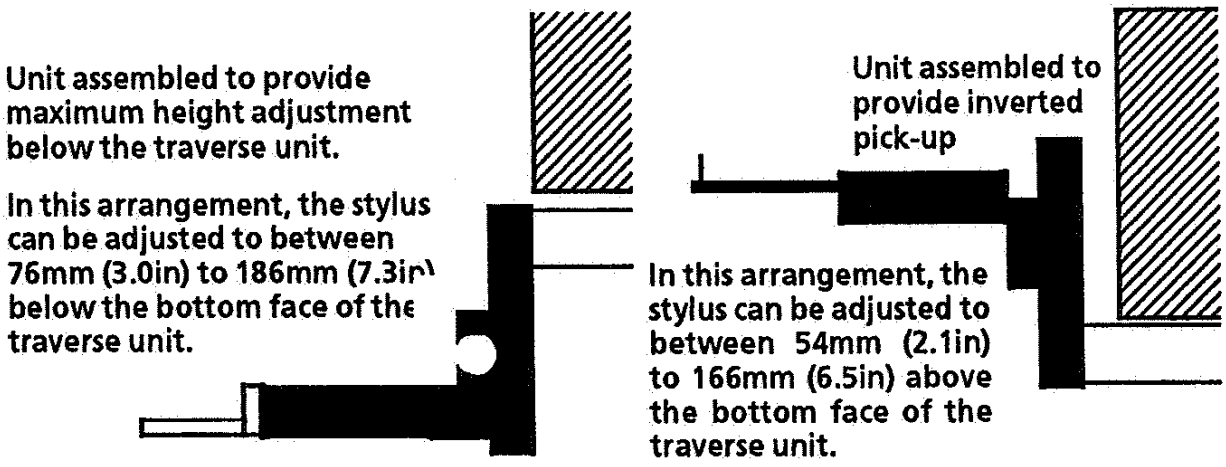
THE HINGE UNIT The hinge unit provides 110mm (4.3in) of vertical adjustment for the pick-up and is an essential requirement for a free standing unit. It is mounted on the end of its own pick-up stem, which is inserted into the pick-up stem clamp of the traverse unit.

The hinge assembly, complete with pick-up, can be raised and lowered by rotating the knurled knob on the side of the unit (clockwise to raise the pick-up, anti-clockwise to lower it).



When the hinge assembly is configured in its normal operating position (as shown above), the stylus height can be adjusted to between 28mm (1.1in) above to 82mm (3.2in) below the bottom face of the traverse unit.

Stop pins at each end of the vertical traverse guide bar limit the travel of the hinge block. One of the stop pins is retractable, enabling the hinge unit to be removed and be refitted in an inverted position. In this condition, the pick-up can be used in the inverted mode. Alternatively, the unit can be assembled to the traverse unit with the entire unit inverted. This will bring the pick-up back to a normal mode of operation but the major part of the height adjustment is now below the traverse unit base line.

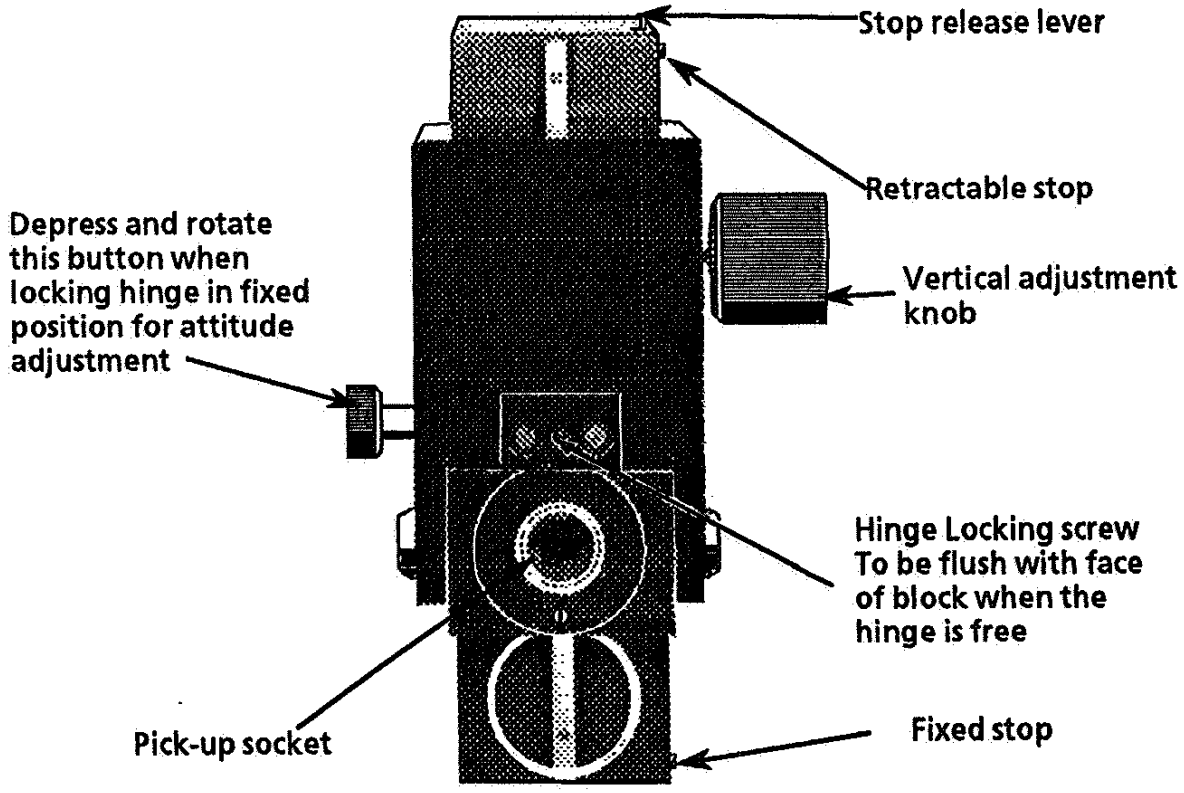


To remove the hinge unit, turn the vertical adjustment knob to bring the hinge unit into contact with the end stop which has the small release lever.

Use a small screwdriver to push the release lever and retract the end stop. Continue to turn the vertical adjustment knob and bring the hinge unit off of the guide. To refit the hinge unit, place the hinge unit up to the guide end stop, push back the release lever and retract the end stop, engaging the hinge unit with the guide. Turn the vertical adjustment knob to move the hinge unit fully onto the guide.

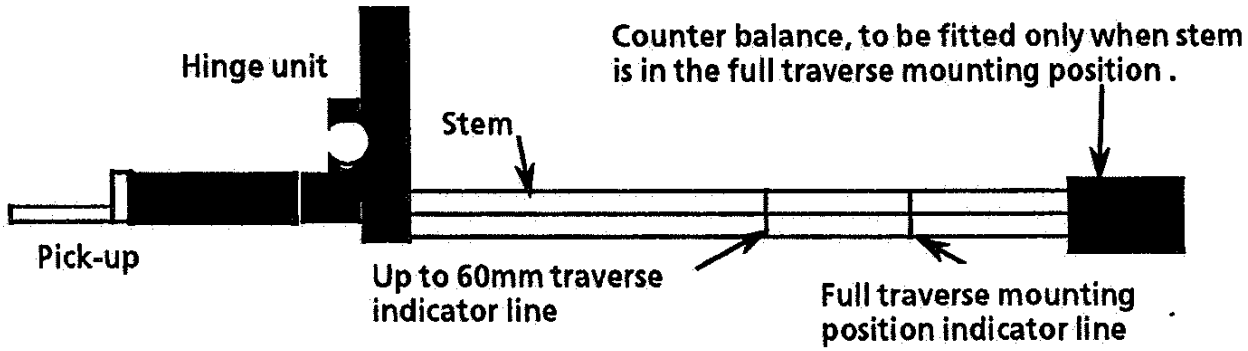
The hinge can be either free (when a skid nosepiece is attached to the pick-up), or locked (when the pick-up is used without a nosepiece, i.e. skidless.

When set in the inverted position, the hinge must be locked and the pick-up used skidless.



SETTING THE HINGE UNIT The stem of the hinge unit is clamped in the drive bracket of the traverse unit. in one of two positions. The mounting positions are marked on

the stem. One position is for use when the full traverse is required, the other is used when traverse lengths not exceeding 60mm are sufficient. When the full traverse position is used, a counterbalance weight must be fitted to the end of the stem. When the short traverse position is used, the counter balance is not required.



The pick-up cable is in the form of a flying lead and cable clips are included on the back panel of the traverse unit for this lead. When fitting these clips, it is essential that sufficient cable is allowed to accommodate the maximum traverse without the cable pulling tight. Severe degradation of measurement results will occur if this cable obstructs the free movement of the traverse unit.

CAUTIONS **Measurements using a pick-up with skid nosepiece**

N.B. The hinge unit must be free when a skid nosepiece is used.

Do not attempt to make a measurement or even lower the pick-up onto a surface when the hinge is locked and the skid nosepiece is in position. Damage to the instrument and/or workpiece may result.

Measurements using a skidless pick-up

When making measurements with a skidless pick-up, the pick-up body should be set nominally parallel to the traverse datum and the hinge must be LOCKED (see SETTING THE PICK-UP AND LOCKING THE HINGE on the following page).

Do not attempt to make a measurement or even lower the pick-up onto a surface when the hinge is free. Damage to the instrument may result.

SETTING THE PICK-UP AND LOCKING THE HINGE

To set the pick-up body nominally parallel with the traverse datum, the procedure is as follows:

1. Drive the pick-up away from the traverse unit until approximately 25mm (1 inch) or more of the datum shaft is visible.
2. Depress the knurled button on the side of the hinge unit (opposite side to the vertical traversing knob), and raise the pick-up against the stops. By eye, check that the body of the pick-up is parallel with the datum shaft.

   If it is not parallel, adjust the attitude by rotating the (still depressed) knurled button, and with it depressed, rotating it. When carrying out this adjustment gently hold the pick-up against its top stops.

   Do not resist the movement of the pick-up body as the knurled button is rotated.
3. When depressed and rotated, the knurled button will remain in the depressed position until it is rotated (in either direction) back to its start position.
4. Lock the stop screw, located immediately above the pick-up socket.

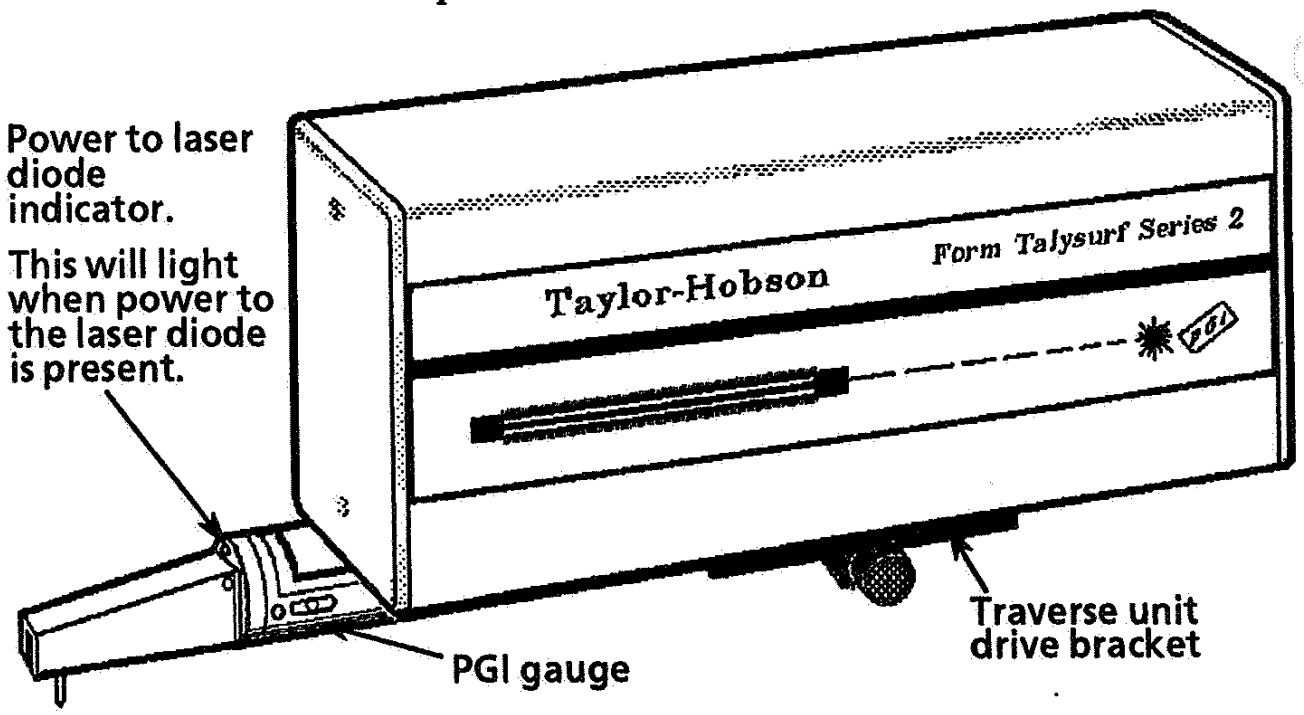
SPECIFICATION

Traverse length:	120mm (4.72in) O/travel 1.0mm (0.04in) at either end)
Straightness of Traverse (Column mounted)	Within 2 parallel lines spaced 0.5µm over 120mm (20µin over 4.72in), and 0.25µm (10µin) over any 60mm (2.36in). traverse.
Straightness of Traverse (Free standing)	Within 2 parallel lines spaced 1.0µm over 120mm (40µin over 4.72in), and 0.5µm (20µin) over any 60mm (2.36in). traverse .
Traverse speeds -	
Distance to achieve stable measuring speed:	0.3mm (0.008in) max
Measuring speeds:	1.0 and 0.5mm/sec ± 5% (0.04 and 0.02in ± 5%)
Instantaneous speed fluctuation:	± 20%
Reverse speed:	10mm/sec (0.4in/sec) max.
Movement speeds (± 15%):	0.5mm/sec (0.0197in/sec) 1.0mm/sec (0.0394in/sec) 2.5mm/sec (0.0984in/sec) 5.0mm/sec (0.1969in/sec) 10mm/sec (0.3937in/sec)
Horizontal stylus position (along "Y" axis) relative to mounting face of carriages	52.5mm (2.06in) nominal
Traverse end stops :	Fixed optical switches
Simple traverse position scale:	1mm and 0.05in divs
Overall dimensions (W x D x H)	365mm x120mm x160mm (14.4 x 4.7 x 6.3in)
Clearance under tip of standard stylus and the plane of the feet of a free standing unit:	75mm
Computer I/O:	EIM or Terminal module
Weight approx.	11.5 kg (25.3 lb).

THE 120mm PGI TRAVERSE UNIT

DESCRIPTION This traverse unit carries a PGI gauge (Phase Grating Interferometric transducer) with interchangeable stylus arms. The traverse unit houses the motor, gearbox and associated circuits for traversing the stylus of the P.G.I gauge across the surface of the component to be measured. A straightness datum is incorporated enabling measurements, of up to 120mm long, to be made without reference to an external straight line datum. The back panel carries a dovetail slide for mounting the traverse unit onto the column carriage. This unit is not used in a free standing condition.

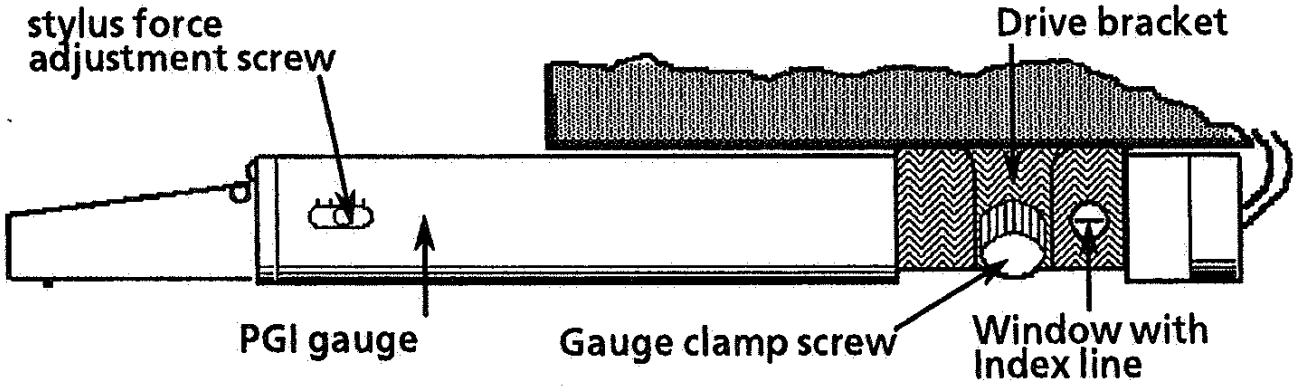
NOTE: All measurements are made with a **skidless** pick-up.



TRAVERSE INDEX AND SCALE A traverse index, which can be seen through the transparent panel in the side of the traverse unit, indicates the position of the pick-up within the traverse length (the scale is graduated in both mm and inches).

GAUGE ORIENTATION The gauge is clamped in the drive bracket of the traverse unit. During operation, the drive bracket (which is referenced to the straightness datum) is driven at the appropriate speed for the move or measurement being made. After releasing the gauge clamp screw of the drive bracket, the gauge can be rotated through 180°.

To assist with setting the gauge orientation, index lines are marked at 90° intervals on the body of the gauge. These can be seen through the window in the drive bracket and related to the index line of the window.

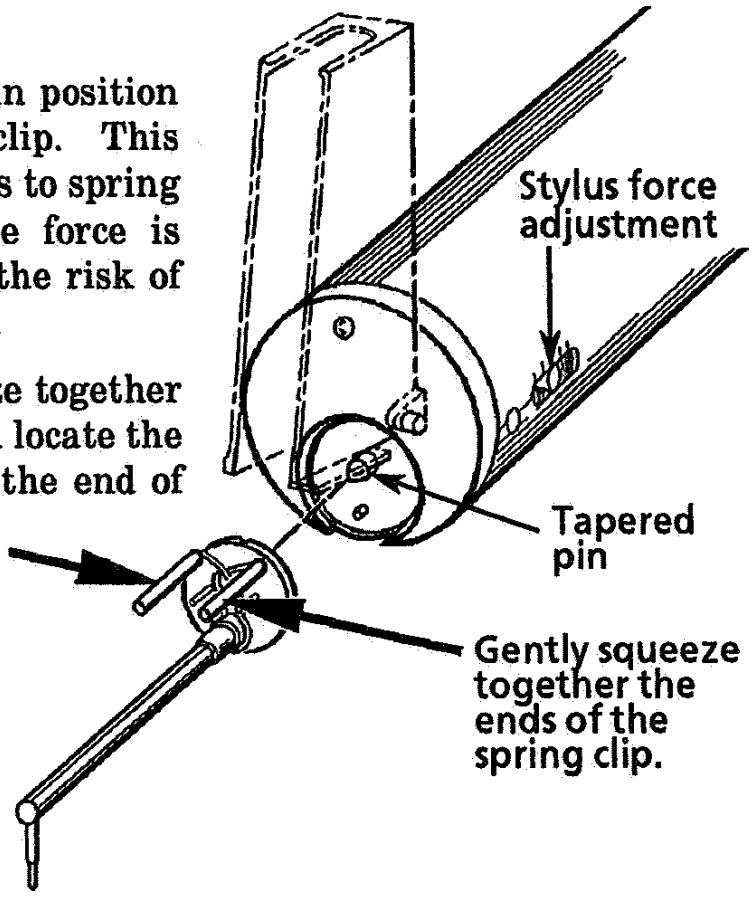


THE STYLUS

The stylus beam is retained in position on the gauge, via a spring clip. This arrangement allows the stylus to spring off of the gauge if excessive force is applied, thereby minimising the risk of damage to the stylus or gauge.

To fit a stylus, gently squeeze together the ends of the spring clip and locate the hole in the circular plate on the end of the stylus beam over the tapered pin on the end face of the gauge. Release the spring clip.

To remove a stylus, gently squeeze together the ends of the spring clip and pull the stylus away from the gauge.

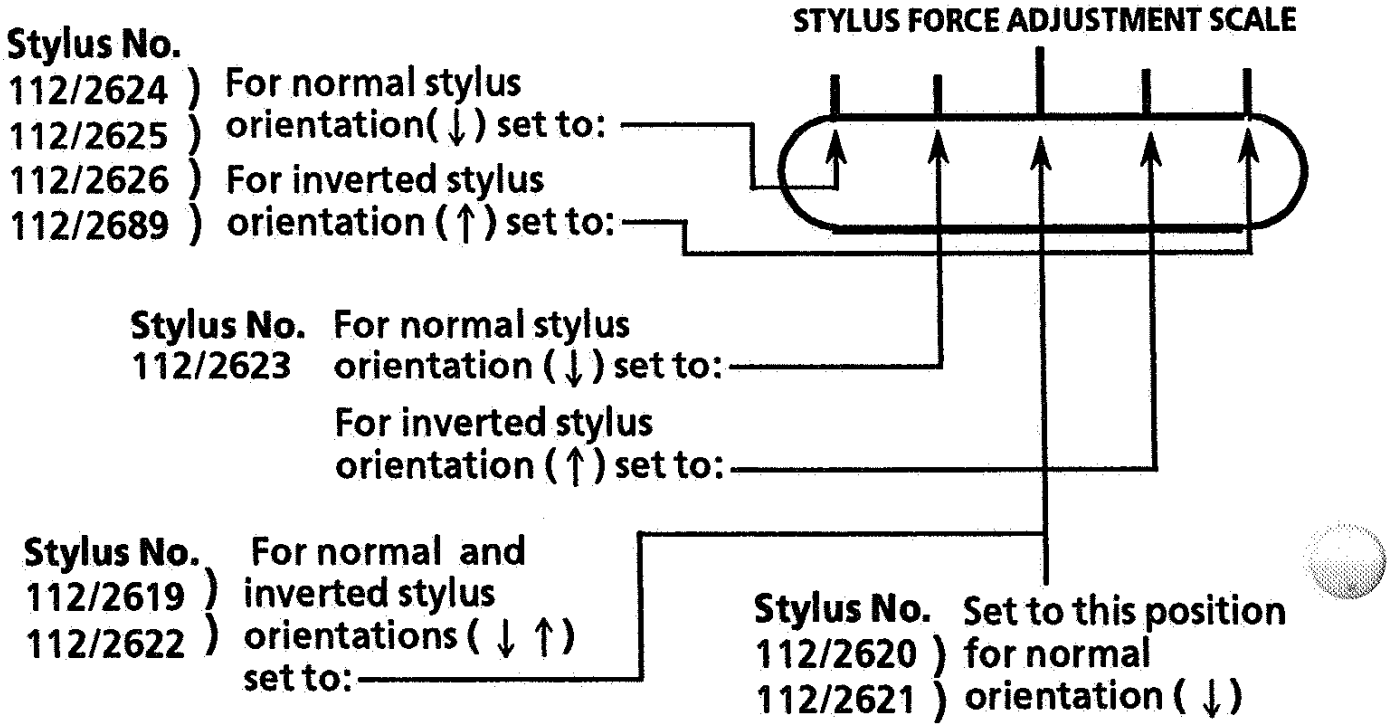


CAUTIONS To prevent accidental damage to the stylus beam, a hinged cover is provided. With the cover raised, visibility of the point of contact between the stylus tip and the component is improved. However, with the cover in this position, the stylus should not be traversed such that the cover contacts the side of the traverse unit, as this will adversely affect the accuracy of the measurement. The cover may be removed by withdrawing the headed hinge pin.

The pivot of the pick-up is a delicate mechanism. Therefore, care must be taken, when changing the stylus, to not impart a sideways or twisting movement.

STYLUS FORCE Adjustment to the stylus force is made by setting the position of the M2 screw that is located through the slot in the side of the gauge. A hexagonal wrench is supplied for this adjustment. **Do not over tighten this screw.**

Scale markings are provided for positioning the stylus force adjustment screw. The scale positions to which the screw should be set in order to achieve the nominal force required for the various stylus arms with respect to gauge orientation are as follows:



If the stylus force adjustment screw is set to the scale markings, as indicated on the previous page, then the stylus force will be nominally within the optimum range required for the particular stylus (see the styli specifications list for the forces recommended). If it required to set a specific force value, then an instrument for measuring the actual stylus force will be required (such as a Correx gauge or a precision balance).

The scale above the stylus force adjustment screw is marked in 3mm divisions. The stylus force is at its lowest when the adjusting screw is set fully to the left side of the slot. Moving the stylus force adjustment screw to the right increases the stylus force as follows:

Stylus force (in milligrams) = the distance (in mm) of the screw from Left side of the slot x 850 divided by the stylus length.

For example, if the screw is set to the central scale mark (which is 6mm from the left side of the slot) and the stylus arm is 60mm long, then the increase in stylus force (F) is given by:

$$F = \frac{6 \times 850}{60} = 85mg$$

NOTE When using stylus arms of lengths **greater** than **60mm**, the gauge should be used in the **normal attitude only.**

STYLUS TYPES The stylus types available with this system are diamond tipped styli with an effective beam length of 60mm (standard and minimum bore) and Sapphire ball tipped styli with an effective beam length of either 120mm or 150mm.

The measurement range is dependent on the length of the stylus beam i.e. a 60mm beam gives a range of 10mm, a 120 mm beam gives a range of 20mm and a 150mm gives a range of 25mm..

The type of assessment required determines the

stylus to be used. Surface texture assessments are only valid when a diamond tipped stylus is fitted. Form assessment is available with all styli and the vertical range required to trace the component profile will determine the length of stylus beam to be used.

LASER SAFETY

Under normal operating conditions the P.G.I gauge, which houses a 5mW max. laser diode, conforms to class 1 laser product specifications, as defined in:

British Standard: BS EN 60825-1: 1994

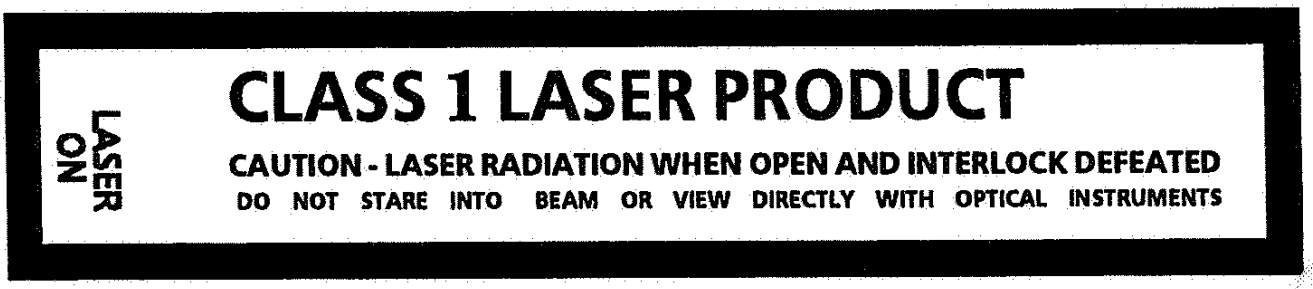
DHHS REGULATION 21,CFR ch.1

U.S. Standard: F.D.A. Laser Performance Standard 21 CFR 1040.10 and 1040.11).

The PGI gauge meets the requirements of a class 1 laser when operating normally in conjunction with the associated hardware and computer software supplied. Any variation of this configuration may affect the hazard of the laser.

Service equipment designed to override the interlock mechanisms of the gauge must carry a warning that it may be operating at a laser class IIIB hazard level.

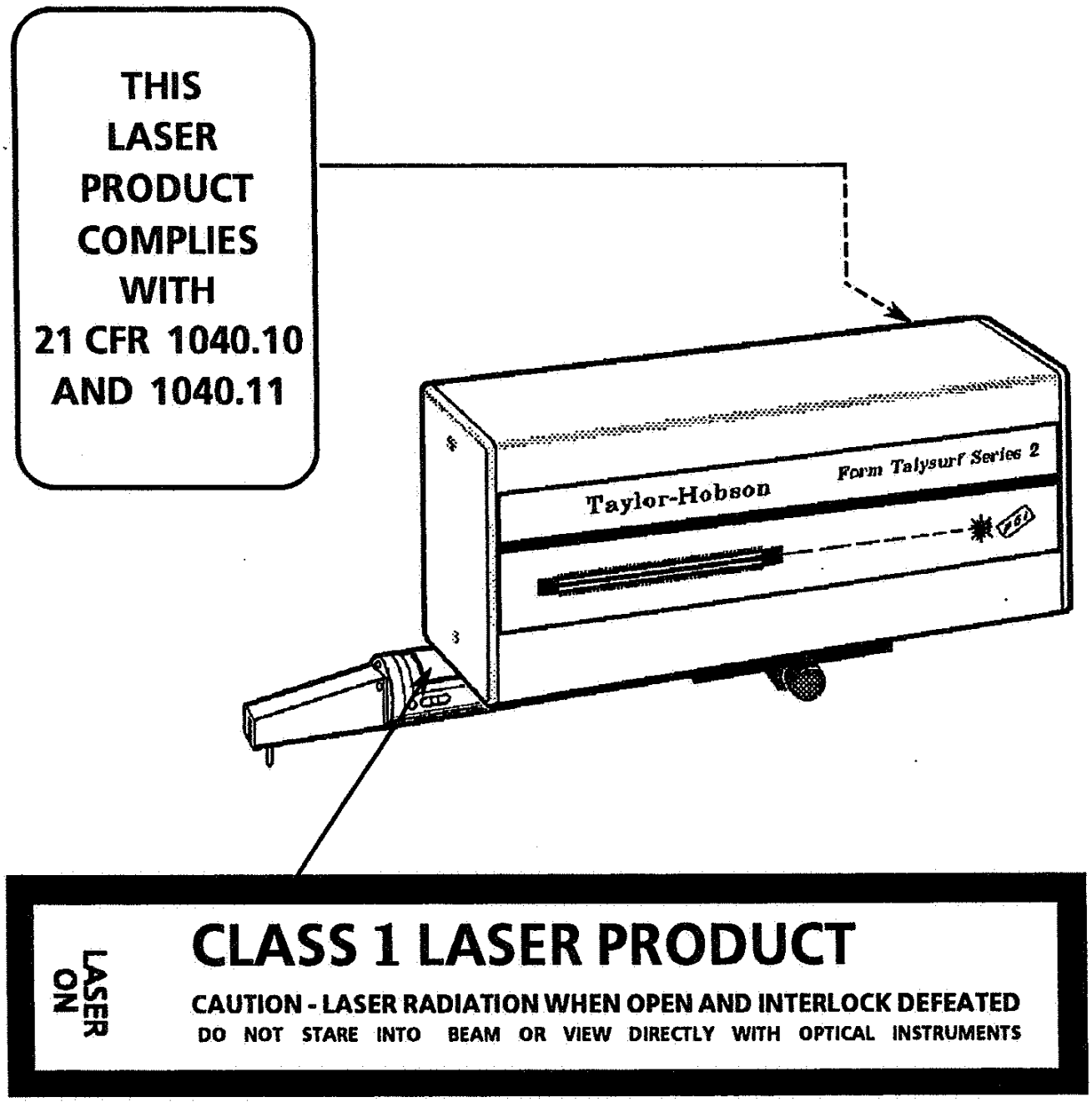
The main cover of the gauge carries a Caution label.



If this cover is removed, then a shutter is activated to screen access to radiation from the laser diode and power to the diode is switched off.

IMPORTANT **The covers on the PGI gauge, must only be removed by a Taylor Hobson service engineer.** Removal of a cover or any unauthorised modifications made to the gauge may result in its reclassification to a class IIIB laser product.

LOCATION OF LASER PRODUCT LABELS



SPECIFICATION

TRAVERSE UNIT

Traverse length:	120mm (4.72in)
Straightness of Traverse:	Within 2 parallel lines spaced 0.5µm (20µin) over 120mm (4.72in) and Within 2 parallel lines spaced 0.25µm (10µin) over any 60mm (2.36in),
Traverse speeds :	
Distance to achieve stable measuring speed:	0.3mm (0.012in) max
Measuring speed (±5%):	0.5mm/sec and 1mm/sec (0.02in/sec and 0.04in/sec)
Instantaneous speed fluctuation:	± 20%
Reverse speed:	5mm/sec (0.2in/sec) max.
Movement speeds (± 15%):	0.5mm/sec (0.02in/sec) 1.0mm/sec (0.04in/sec) 2.5mm/sec (0.1in/sec) 5.0mm/sec (0.2in/sec) 10mm/sec (0.4in/sec)
Simple traverse position scale:	1mm (0.05in) divs
Overall dimensions (W x D x H)	365mm x 120mm x160mm (14.4in x 4.7in x 6.3in)
Weight	11.5Kg (25.3lbs.) approx.
Computer I/O	Through EIM

PGI GAUGE

With pivoted (60mm long) balanced beam for any attitude operation.

Stylus motion:	Arcuate (pivoted beam).
Measurement range (60mm stylus arm):	±5mm

Resolution:	12nm at 10mm range (0.47µin at 0.39in range) 24nm at 20mm range (0.94µin at 0.79in range). 30nm at 25mm range (1.18µin at 0.98in).
Pick-up tube diameter:	36mm max.
Stylus position relative to LH side of traverse unit, with carriage at zero traverse position:	160mm (6.3in)
Laser diode set to:	0.6mW at 670nm wavelength.
Laser diode supply:	50mA 9V d.c. max.
Preamp and laser diode drive PCB supply:	±12V d.c.

STYLI

10mm (0.39in) range stylus arms

Standard 90° Conisphere Diamond 112/2619

Tip radius:	1.5 - 2.5µm (60 - 100µin)
Stylus force over full range:	70 - 100mgf (0.7 - 1mN)
Penetration:	16mm bore to 20mm (0.63in bore to 0.79in)
Depth of recess measurable:	10mm (0.39in).

Small Bore 90° Conisphere Diamond 112/2622

Tip radius:	1.5 - 2.5µm (60 - 100µin)
Stylus force over full range:	70 - 100mgf (0.7 - 1mN)
Penetration:	4mm bore to 14mm (0.15in bore to 0.55in).

Miniature Bore 90° Conisphere Diamond 112/2623

Tip radius:	1.5 - 2.5µm (60 - 100µin)
Stylus force over full range:	70 - 100mgf (0.7 - 1mN)
Penetration:	2mm bore to 5mm. (0.08in bore to 0.2in).

Recess Bore 90° Conisphere Diamond 112/2624

Tip radius:	1.5 - 2.5µm (60 - 100µin)
Stylus force over full range:	70 - 100mgf (0.7 - 1mN)
Depth of recess measurable	24mm (0.94in).

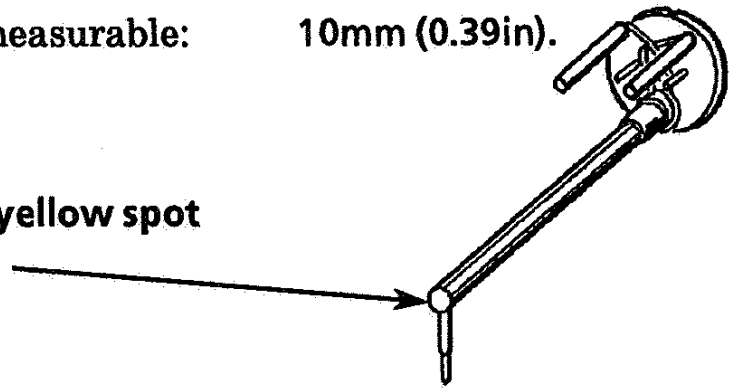
Right Angle 90° Conisphere Diamond
Forward facing 112/2625
Rear facing 112/2626

Stylus offset:	15mm (0.6in)
Tip radius:	1.5 - 2.5µm (60 - 100µin)
Stylus force over full range:	70 - 100mgf (0.7 - 1mN)
Penetration:	10mm (0.39in) deep recess.

Special 60° Conisphere Diamond 112/2689

Tip radius:	1.5 - 2.5µm (60 - 100µin)
Stylus force over full range:	70 - 100mgf (0.7 - 1mN)
Penetration:	16mm bore to 20m (0.63in bore to 0.79in)
Depth of recess measurable:	10mm (0.39in).

This stylus is identified by a yellow spot on the end of the stylus arm



20mm (0.78in) range stylus arm

Sapphire Ball Stylus 112/2620

Ball radius:	0.5mm (0.02in)
Stylus force over full range:	1.5 - 2.0gf (15 - 20mN)
Depth of recess measurable:	21mm (0.82in)

25mm (0.98in) range stylus arm

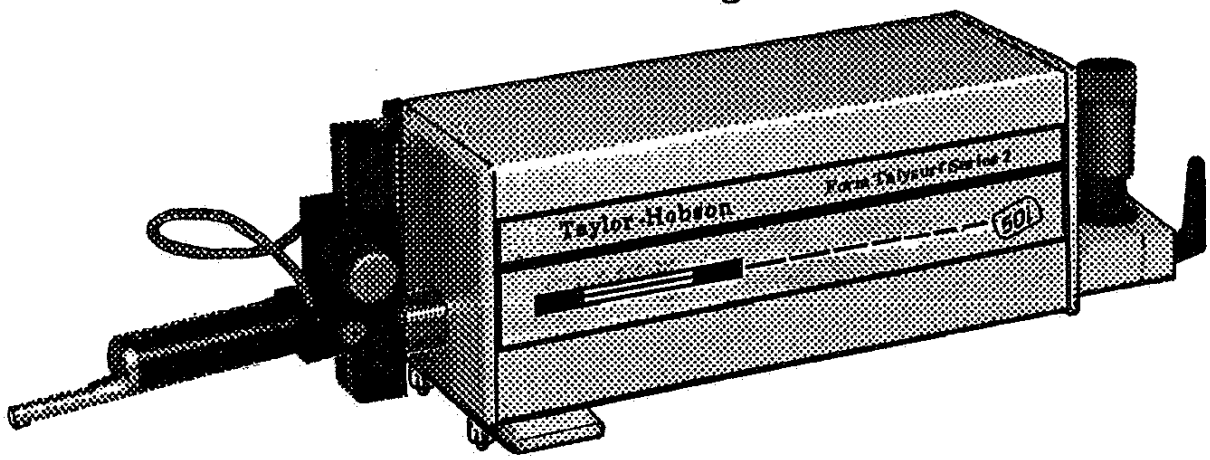
Sapphire Ball Stylus 112/2621

Ball radius:	0.5mm (0.02in)
Stylus force over full range:	1.9 - 2.4gf (19 - 24mN)
Depth of recess measurable:	26mm (1in)

THE 50mm TRAVERSE UNIT

DESCRIPTION This traverse unit houses the motor, gearbox and associated circuits for traversing the pick-up across the surface to be measured. A straightness datum is incorporated enabling measurements, of up to 50mm long, to be made without reference to an external straight line datum.

A pick-up is plugged into a hinged height unit which is clamped to the traverse unit datum shaft. During a traverse operation, the datum shaft is driven at the appropriate speed for the move or measurement being made.



The unit can be used either column mounted or free standing. Four screw-in feet (painted red) are fitted prior to despatch, for transit purposes only. These should be removed before making any measurements, either free standing or column mounted.

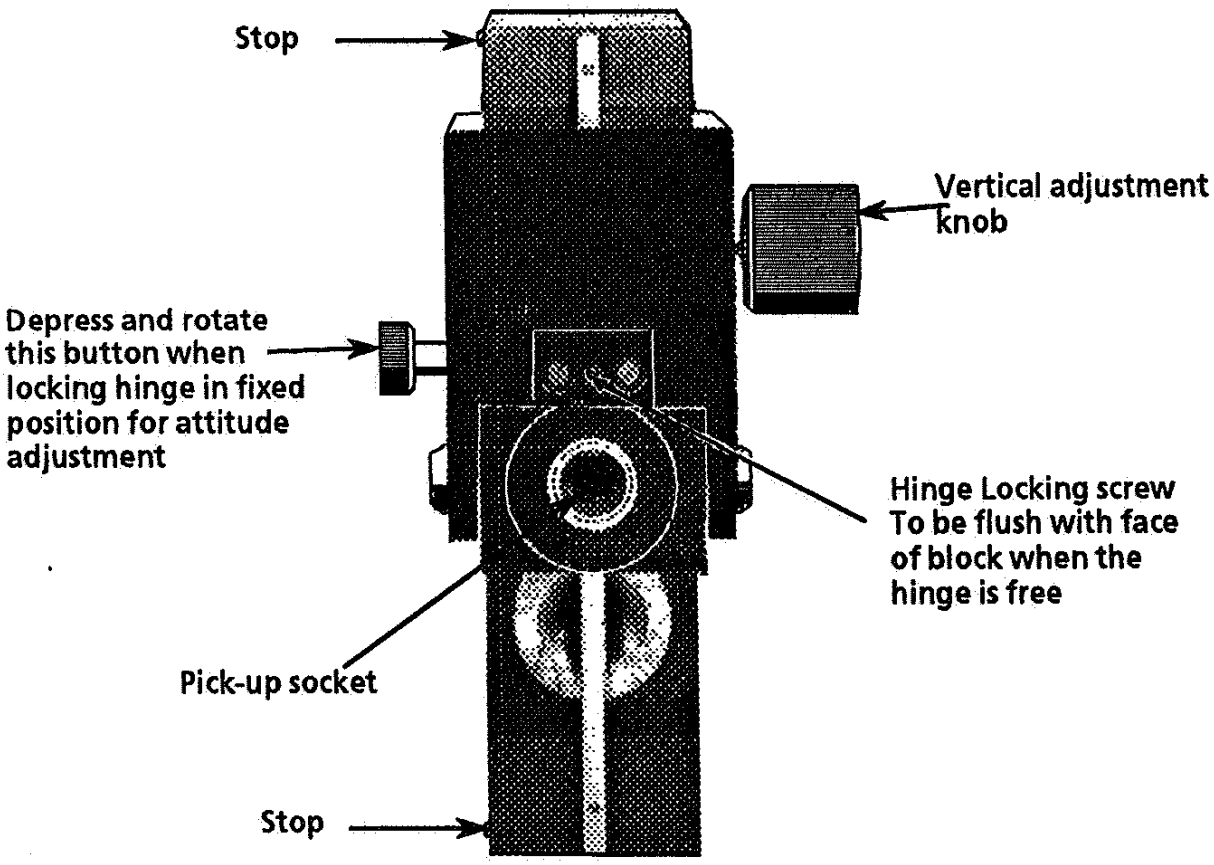
For measurements which require a free-standing traverse unit, an optional tilt accessory is available.

The back panel of the traverse unit carries a dovetail slide for mounting the traverse unit onto the column carriage.

TRAVERSE INDEX A traverse index, which can be seen through the transparent panel in the side of the traverse unit, indicates the position of the pick-up within the traverse length (the scale is graduated in mm and inches)

HINGE UNIT Mounted on the end of the datum shaft is a hinge unit into which the pick-up is plugged. The hinge assembly, complete with pick-up, can be raised and lowered by rotating the knurled knob on the side of the unit (clockwise to raise the pick-up, anti-clockwise to lower it). Stop pins at each end of the vertical traverse guide bar limit the travel of the hinge block.

The hinge can be either free (when a skid nosepiece is attached to the pick-up), or locked (when the pick-up is used without a nosepiece, i.e. skidless.



LOCKING THE HINGE

The hinge is locked by depressing the knurled button on the side of the hinge (opposite side to the vertical traversing knob) and with it depressed, tightening the locking screw positioned directly above the pick-up socket. The procedure is the reverse to unlock (when the hinge is free, the locking screw should be flush with the block).

CAUTIONS

Measurements using a pick-up with skid nosepiece

When making measurements when a skid nosepiece is fitted, the pick-up stem hinge must never be locked. Ignoring this instruction may result in damage to the instrument and/or workpiece.

Measurements using a skidless pick-up

When making measurements with a skidless pick-up, the pick-up body should be set nominally parallel to the traverse datum and the hinge must be LOCKED (see SETTING THE PICK-UP following).

SETTING THE PICK-UP

To set the pick-up body nominally parallel with the traverse datum, the procedure is as follows:

1. Drive the pick-up away from the traverse unit until approximately 25mm (1 inch) or more of the datum shaft is visible.
2. Depress the knurled button on the side of the hinge unit (opposite side to the vertical traversing knob), and raise the pick-up against the stops. By eye, check that the body of the pick-up is parallel with the datum shaft.

If it is not parallel, adjust the attitude by depressing the knurled button, and with it depressed, rotating it. When carrying out this

adjustment gently hold the pick-up against its top stops.

Do not resist the movement of the pick-up body as the knurled button is rotated.

3. When depressed and rotated, the knurled button will remain in the depressed position until it is rotated (in either direction) back to its start position.
4. Lock the stop screw, located immediately above the pick-up socket

SPECIFICATION

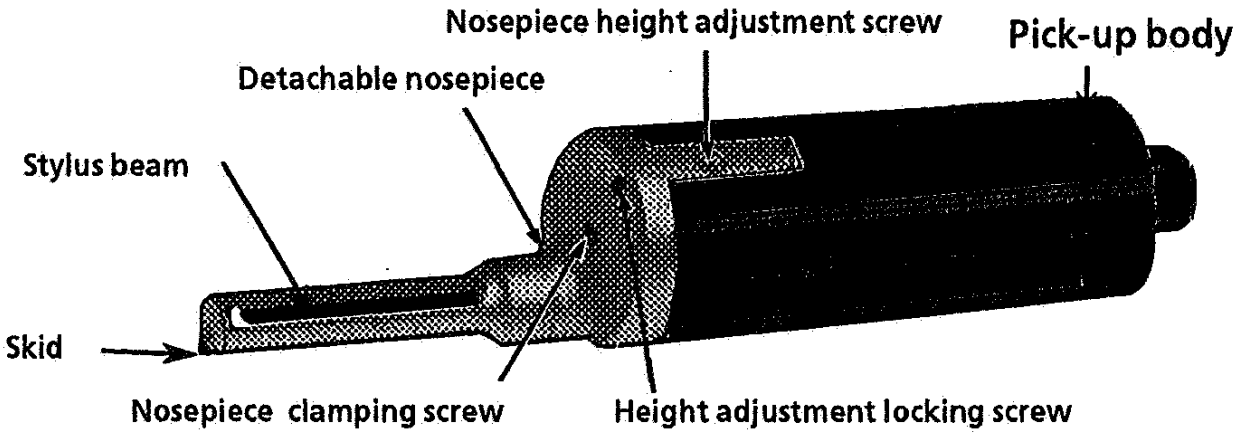
Traverse length:	50mm (1.97in) O/travel 1.0mm (0.04in) at either end)
Straightness of Traverse	Contained within 2 parallel lines spaced 0.4µm (16µin) over 50mm (1.97in) traverse, and 0.2µm (8µin) over any 20mm (0.78in) traverse.
Traverse speeds:	
Distance to achieve stable measuring speed:	0.3mm (0.012in) max
Measuring speeds:	1.0 and 0.5mm/sec ± 5% (0.04 and 0.02in ± 5%)
Instantaneous speed fluctuation:	± 20%
Reverse speed:	10mm/sec (0.4in/sec) max.
Movement speeds (± 15%):	0.5mm/sec (0.2in/sec) 1.0mm/sec (0.04in/sec) 2.5mm/sec (0.1in/sec) 5.0mm/sec (0.2in/sec) 10mm/sec (0.4in/sec)
Horizontal stylus position (along "Y" axis) relative to mounting face of traverse unit:	52.5mm (2.06in) nominal
Traverse end stops -	Fixed optical switches
Simple traverse position scale:	1mm and 0.05in divs
Manual fine levelling of datum	+3°/-1·5° from mean position.

Overall dimensions (W x D x H)	310mm x103mm x123mm (12.2 x 4.1 x 4.84in)
Clearance under tip of standard stylus and the plane of the feet of a free standing unit:	85mm (3.35in)
Manual vertical adjustment of stylus:	96mm (3.78in)
Computer I/O:	EIM
Weight	approx.7 kg (15.4 lb).

THE INDUCTIVE PICK-UP

DESCRIPTION The pick-up is in the form of an interchangeable cartridge which is plugged into the pick-up stem, or hinge unit, of the traverse unit. The stylus, (which is replaceable) is carried on the end of a balanced beam and is kept in contact with the surface being measured by a light spring..

IMPORTANT Before fitting a pick-up, power to the instrument must be switched **off.**



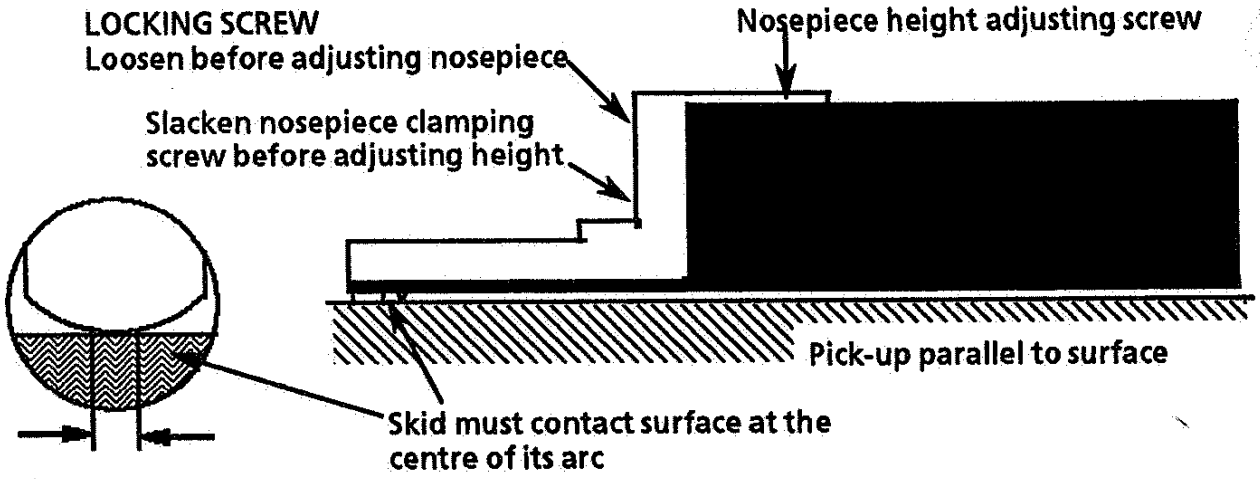
The pick-up can be used either with a skid nosepiece fitted or, without a nose piece, in the skidless condition. When a nosepiece is used, the skid is located adjacent to the stylus and supports the pick-up on the surface being measured causing it to follow the general shape of the surface. Therefore, the surface itself is the datum relative to which the stylus displacements are measured. When used without the nosepiece, the pick-up must be supported from the traverse unit, by locking the the hinge unit or the pick-up stem hinge, as appropriate.

SKID HEIGHT The height of the skid relative to the stylus is very important. This can be checked and set as follows:

1. Fit the nosepiece to the pick-up body, by placing the nosepiece over the recess on the top

of the body and engaging the spigot of the nosepiece with the hole in the recess. Fully engage the nosepiece with the body and use the hexagonal wrench supplied to lightly tighten the nosepiece clamping screw.

2. Ensure that the hinge is free.
3. Lower the pick-up to bring the stylus into contact on any suitable flat surface or on to the crest of a cylinder mounted in a vee block.
4. Continue lowering until the stylus displacement display indicates approximately zero.
5. The skid should now contact the surface at the centre of its arc and the pick-up should be nominally horizontal (see Sketch). The contact point can be more easily checked by using a magnifying glass to examine it.



6. If the position is wrong, raise or lower the pick-up until the skid contacts the surface at the centre of its arc (see Sketch). Adjust the nosepiece until the stylus displacement display indicates approximately zero.

CAUTIONS **Measurements using a pick-up with skid nosepiece.**

The hinge unit must be FREE when a skid nosepiece is used. Do not attempt to make a

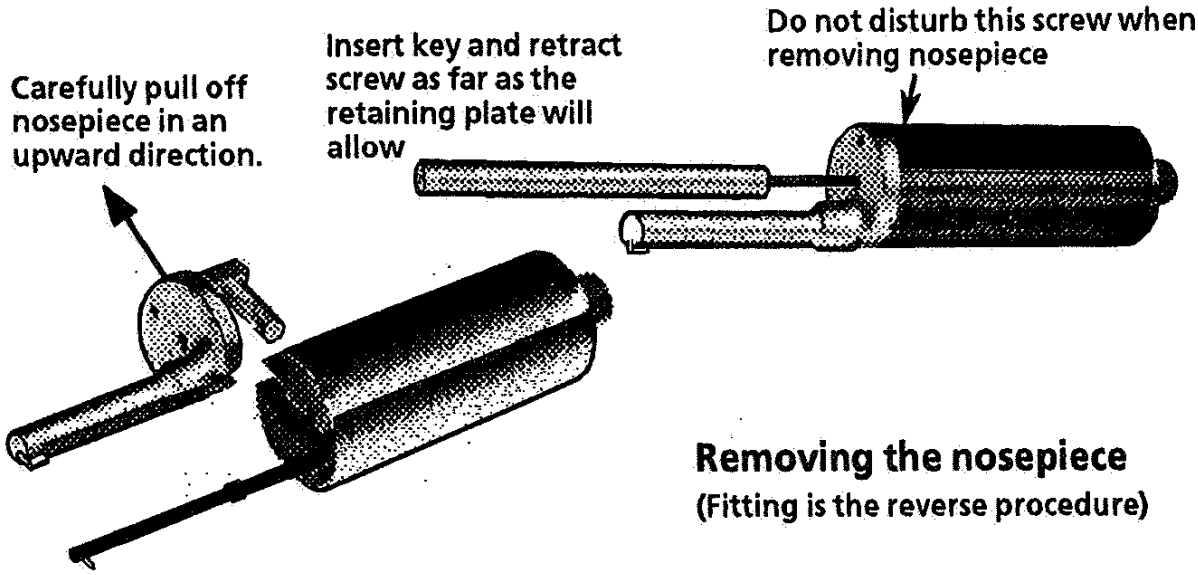
measurement or even lower the pick-up onto a surface when the hinge is locked and the skid nosepiece is in position. Damage to the instrument and/or workpiece may result.

Measurements using a skidless pick-up

When making measurements with a skidless pick-up, the hinge must be LOCKED. Do not attempt to make a measurement or even lower the pick-up onto a surface when the hinge is free. Damage to the instrument may result.

REMOVING THE NOSEPIECE

The nosepiece is removed by inserting the supplied hexagonal wrench into the nosepiece bore and unscrewing 2-3 turns. The nosepiece can then be carefully lifted off the body.



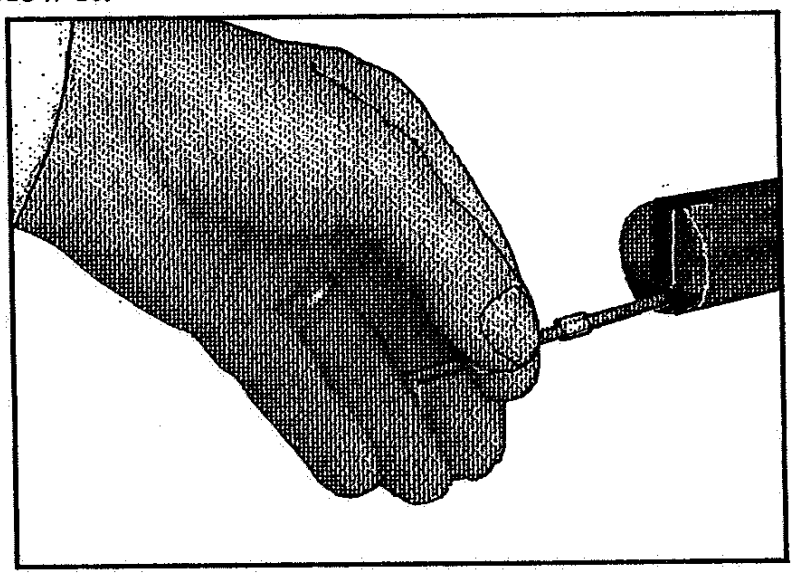
Removing the nosepiece
(Fitting is the reverse procedure)

THE STYLUS

The standard stylus type supplied with the system is a diamond tipped stylus with 60mm beam length

The stylus beams are a push fit into the pick-up cartridge of the traverse unit. Fitting or changing a stylus is therefore, a matter of pulling out the stylus fitted and gently pushing in the one

required. The beam end is shaped to fit its socket and must be fitted with the flat uppermost, when the gauge is set for measurement on a surface below it.



CAUTION **The pivot of the pick-up is a delicate mechanism. Therefore, care must be taken, when changing the stylus, not to force the beam into its socket or to impart a sideways or twisting movement.**

The stylus force is determined by balancing the beam with a small collar. When fitting or removing a stylus, do not pull or push on this collar and disturb its position.

Note After fitting the stylus, or when fitting the gauge in a different orientation (e.g. when fitting the gauge to the accessory right angled attachment), the gauge should be calibrated before making measurements.

IMPORTANT Before valid measurements can be made, the gauge balances must be set and the system then calibrated. See **Matching the Gauge**, in Section 5.

SPECIFICATION

Variable Inductance Pick-Up (Common Body + Selection of Interchangeable Stylus Arms and skid Nosepieces)
Interchangeable pick-up body with pivoted and balanced beam for any attitude use.

Measuring range of transducer (min) at coil.	0.5mm
Resolution using 1mm range stylus arm:	
At 1.00mm (0.039in) range:	16nm (0.63µin)
At 0.2mm (0.079in) range:	3.2nm (0.13µin)
At 0.04mm (0.0018in) range:	0.64nm (0.025µin)
Outside Diameter	25mm.
Length	70mm
Weight	90g

1mm RANGE STYLUS ARMS.

Standard Conical Diamond 112/2009
(also used in conjunction with Right Angle Accessory)

Tip Radius	1.5 - 2.5µm
Stylus force over full range	70 - 100mgf
Enter 9.5mm bore to depth of:	12.7mm
Measurable depth of recess	4mm

Small Bore Conical Diamond 112/2012

Tip Radius	1.5 - 2.5µm
Stylus force over full range	70 - 100 mgf

The stylus will enter:

6.0mm bore to depth of:	12.5mm	
2.0mm bore to a depth of:	5mm	
2.5mm bore to a depth of:	11mm	
1.4mm wide groove to depth of:	5mm	
2.3mm wide groove to depth of:	11mm	
3.0mm bore to depth of:	25mm	Skidless.

Recess Conical Diamond 112/2011

Tip Radius	1.5 - 2.5µm
Stylus force over full range	70 - 100 mgf
Depth of recess measurable	8mm

Chisel Edge Diamond Stylus Arm 112/2013

Chisel Edge Tip	2.5µm x 0.9mm
Stylus force over full range	70 - 100 mgf
The stylus will enter 8mm bore to a depth of 12.7mm	

2mm RANGE ARM WITH SAPPHIRE BALL STYLUS

(Not supplied with skid or guard nosepieces).

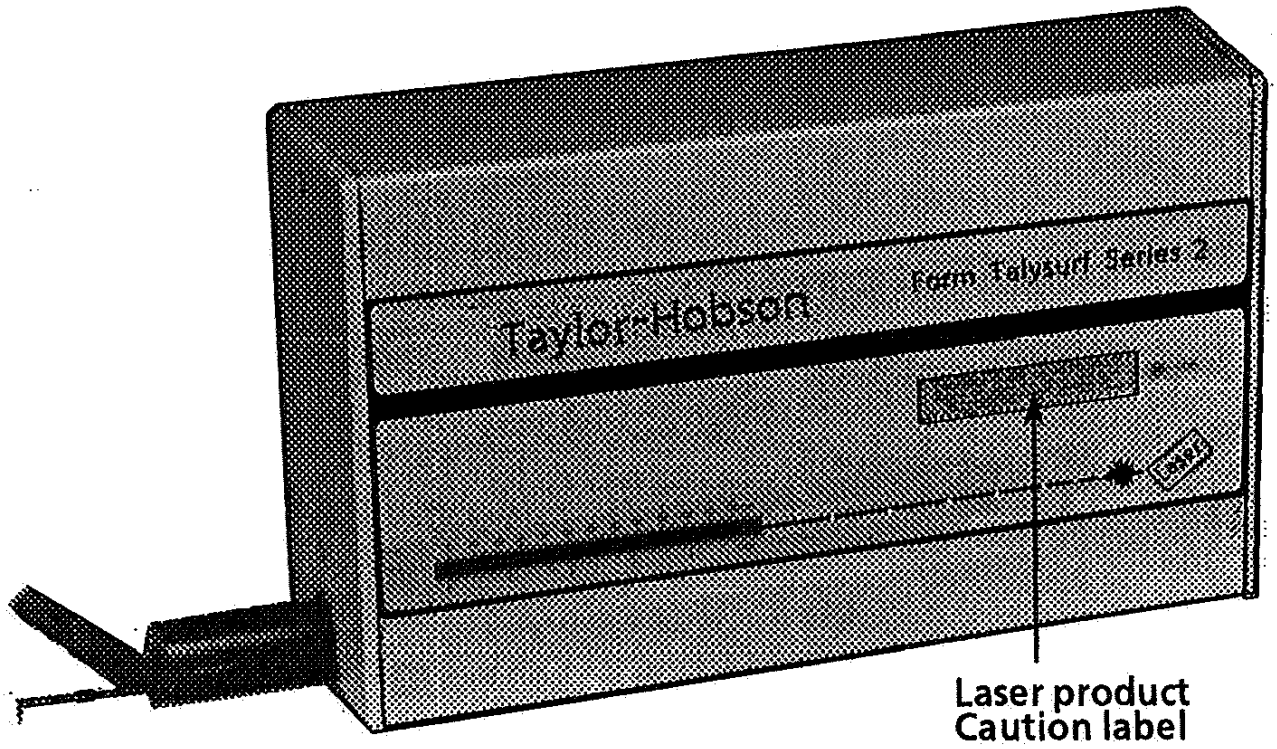
Standard Ball Stylus 112/2010

Ball radius	0.5mm ± 0.125µm
Stylus force over full range	1.5 - 2.0 gf
Measurable depth of recess	8mm

THE LASER TRAVERSE UNIT

DESCRIPTION The traverse unit houses a laser interferometric transducer and the motor and gearbox, for traversing the stylus across the surface of the component to be measured. A straightness datum is incorporated enabling measurements, of up to 120mm long, to be made without reference to an external straight line datum.

The back panel carries a dovetail slide for mounting the traverse unit onto the column carriage. This unit is not used in a free standing condition.



TRAVERSE INDEX AND SCALE A traverse index, which can be seen through the transparent panel in the side of the traverse unit, indicates the position of the pick-up within the traverse length (the scale is graduated in both mm and inches).

LASER SAFETY Under normal operating conditions the traverse unit, which houses a Helium Neon laser, conforms to class 1 laser product specifications, as defined in:

British Standard:	BS 4803: parts 1-3
U.S. Standard:	F.D.A. Laser Performance Standard 21 CFR 1040.10 and 1040.11).,

The front cover of the traverse unit carries a Caution label.

CAUTION - CLASS I LASER PRODUCT
REMOVAL OF COVERS WILL EXPOSE LASER BEAM
SEE HANDBOOK FOR SAFETY INFORMATION

If this cover is removed, it permits access to radiation from the laser which has a maximum output of 0.5mW. This, and any other cover on the traverse unit, must only be removed by a Taylor Hobson service engineer.

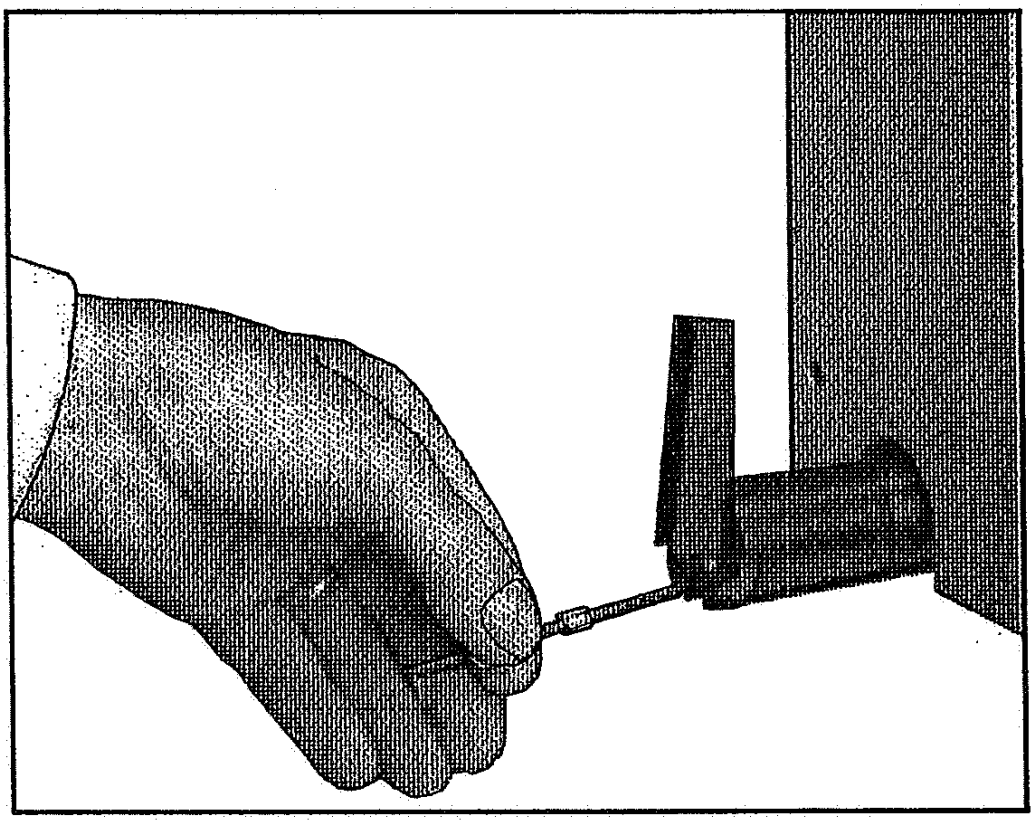
THE STYLUS The standard stylus types available with the system are a diamond tipped styli with an effective beam length of 60mm (standard and minimum bore) and a Sapphire ball tipped stylus with an effective beam length of either 120mm or 150mm.

The measurement range is dependent on the length of the stylus beam i.e. a 60mm beam gives a range of 6mm, a 120 mm beam gives a range of 12mm and a 150mm gives a range of 15mm.

NOTE: All measurements made using this traverse unit are made with a **skidless** pick-up.

The type of assessment required determines the stylus to be used. Surface texture assessments are only valid when a diamond tipped stylus is fitted. Form assessment is available with all styli and the vertical range required to trace the component profile will determine the length of stylus beam to be used.

The stylus beams are a push fit into the pick-up cartridge of the traverse unit. Fitting or changing a stylus is therefore, a matter of pulling out the stylus fitted and gently pushing in the one required. The beam end is shaped to fit its socket and must be fitted with the flat uppermost.



CAUTIONS To prevent accidental damage to the stylus beam, a hinged cover is provided. With the cover raised, visibility of the point of contact between the stylus tip and the component is improved. However, with the cover in this position, the stylus should not be traversed such that the cover contacts the side of the traverse unit, as this will adversely affect the accuracy of the measurement. The cover may be removed by withdrawing the headed hinge pin.

The pivot of the pick-up is a delicate mechanism. Therefore, care must be taken, when changing the stylus, not to force the beam into its socket or to impart a sideways or twisting movement.

The stylus force is determined by balancing the beam with a brass collar. When fitting or removing a stylus, do not pull or push on this collar and disturb its position.

Rapid movement of the stylus cannot be detected by the transducer. Therefore, ensure that during measurements the stylus does not fall freely from the component, as this will not be detected. If auto-return has been selected, then on completion of the measurement, the traverse unit will attempt to return to the start position and drive the stylus into the component. This may result in damage to the stylus, pick-up or traverse unit.

SPECIFICATION
TRAVERSE UNIT

Traverse length:	120mm (4.72in)
Straightness of Traverse	Within 2 parallel lines spaced 0.5µm (20µin) over 120mm (4.72in) and Within 2 parallel lines spaced 0.25µm (10µin) over any 60mm (2.36in),
Traverse speeds :	
Distance to achieve stable measuring speed:	0.3mm (0.012in) max
Measuring speed (±5%):	0.5mm/sec and 1mm/sec (0.02in/sec and 0.04in/sec)
Instantaneous speed fluctuation:	± 20%
Reverse speed:	5mm/sec (0.2in/sec) max.
Movement speeds (± 15%):	0.5mm/sec (0.02in/sec) 1.0mm/sec (0.04in/sec) 2.5mm/sec (0.1in/sec) 5.0mm/sec (0.2in/sec) 10mm/sec (0.4in/sec)
Set-up:	0.5 - 10mm/sec (0.02-0.04in/sec)
Sensitivity of Set-up Traverse (min step):	20µm (0.0008in)
Traverse end stops -	Fixed optical switches
Simple traverse position scale:	1mm (0.05in) divs
Overall dimensions (W x D x H)	397mm x154mm x240mm (15.6in x6in x 9.4in)
Weight	14Kg (30.8lbs.) approx.
Computer I/O	Through EIM

PICK-UP

Laser interferometric transducer:	Helium/Neon laser.
Wavelength:	632.8nm.Linearly polarised.
Coherence length:'	200mm min.
Operating voltage:	1.24 KV d.c..
Output power:	Max. 0.5mW
Range:	6.0mm (0.24in) with 60mm (2.36in) long stylus arm.
	12.0mm (0.47in) with 120mm (4.7in) long stylus. arm.
	15.0mm (0.59in) with 150mm (5.9in) long stylus. arm.
Stylus motion:	Arcuate (pivoted beam).
Resolution:	10nm at 6mm range (0.39µin at 0.23in range)
	20nm at 12mm range (0.78µin at 0.47in range).
	25nm at 15mm range (1.0µin at 0.59in)

STYLI

6mm range stylus arms

Standard Conisphere Diamond 112/1836

Tip radius:	1.5 - 2.5µm (60 - 100µin)
Stylus force over full range:	70 - 100mgf (0.7 - 1mN)
Penetration:	16mm bore to 20mm (0.6in bore to 0.8in)
Depth of recess measurable:	8mm (0.3in)

Small Bore Conisphere Diamond 112/1834

Tip radius:	1.5 - 2.5µm (60 - 100µin)
Stylus force over full range:	70 - 100mgf (0.7 - 1mN)
Penetration:	4mm bore to 11mm (0.15in bore to 0.4in)

Miniature Bore Conisphere Diamond 112/2061

Tip radius:	1.5 - 2.5µm (60 - 100µin)
Stylus force over full range:	70 - 100mgf (0.7 - 1mN)
Penetration:	2mmbore to 5mm. (0.08in bore to 0.2in)

Recess Bore Conisphere Diamond 112/1848

Tip radius:	1.5 - 2.5µm (60 - 100µin)
Stylus force over full range:	70 - 100mgf (0.7 - 1mN)
Depth of recess measurable	25mm (1in)

Right Angle Conisphere Diamond 112/1846

Stylus offset 15mm(0.6in) forward or rear facing (112/1959).

Tip radius:	1.5 - 2.5µm (60 - 100µin)
Stylus force over full range:	70 - 100mgf (0.7 - 1mN)
Penetration:	8mm (0.3in) deep recess

12mm (0.47in) range stylus arm

Sapphire Ball Stylus 112/2042

Ball radius:	0.5mm (0.02in)
Stylus force over full range:	1.5 - 2.0gf (0.015 - 0.02N)
Depth of recess measurable:	15mm (0.6in)

15mm (0.59in) range stylus arm

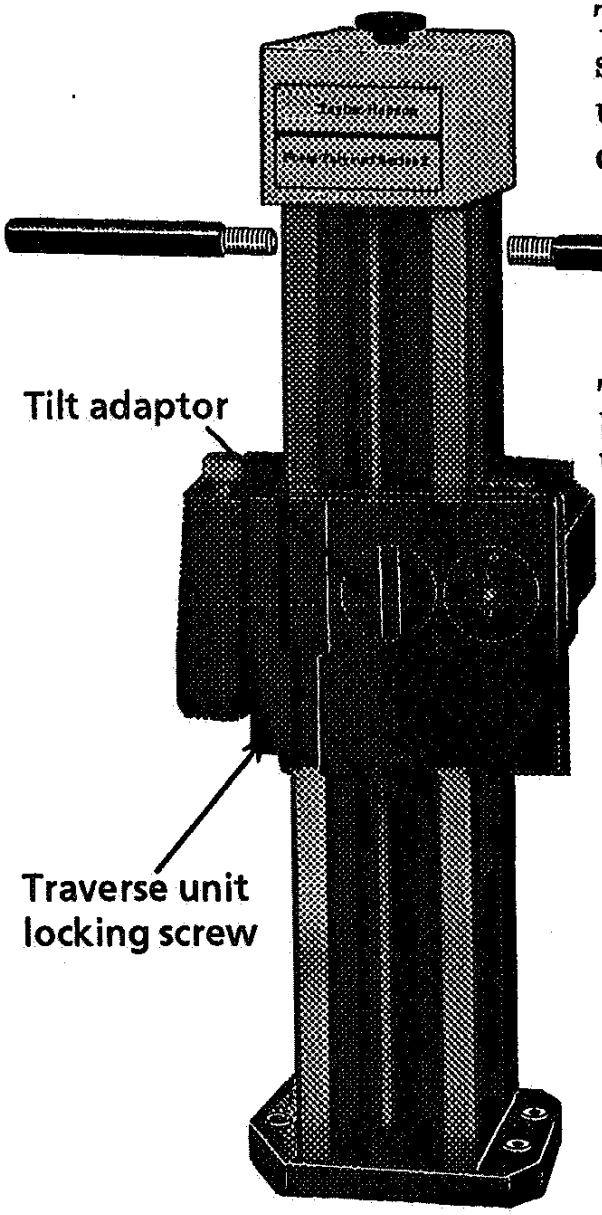
Sapphire Ball Stylus 112/2041

Ball radius:	0.5mm (0.02in)
Stylus force over full range:	1.5 - 2.0gf (0.015 - 0.02N)
Depth of recess measurable:	15mm (0.6in)

THE COLUMN

DESCRIPTION The column is used in conjunction with a suitable base to provide a rigid, stable mounting for the traverse unit, enabling its height and angle of tilt to be easily and precisely adjusted.

THE COLUMN CARRIAGE The column carriage, on which the traverse unit is mounted, is motorised for vertical traverse and angle of tilt. The angle of tilt can also be set manually. The front face of the carriage has a dovetail mounting to accommodate the traverse unit.



Two screw-in carrying handles are supplied and these should be fitted and used whenever it is required to lift the column [the 450mm traverse column weighs 47kg (103.4lbs and the 700mm traverse column weighs 53kg (116lbs)].

The handles must be removed before the carriage is operated under power.

WARNING

KEEP CLEAR OF THE COLUMN DURING OPERATION. THIS IS BOTH GOOD METROLOGY PRACTICE AND WILL AVOID THE RISK OF INJURY CAUSED BY CONTACT WITH THE MOVING COMPONENTS.

WHEN OPERATING UNDER THE CONTROL OF A COMPUTER PROGRAM, THE COLUMN CARRIAGE CAN MOVE WITHOUT WARNING. THEREFORE, KEEP CLEAR OF THE INSTRUMENT WHEN IT IS OPERATING IN THIS MODE

TILT ADAPTOR The accessory tilt adaptor comprises a disc into which a dovetail is cut. The disc can be attached to the column in different attitudes, to tilt the dovetail to an angle of 0°, 15°, 30° and 45° with respect to the column. The traverse unit can then be mounted, at the the dovetail angle, into the dovetail slot, with the 9° of powered tilt available about the selected position. This allows the traverse unit to set between -9° and +54° with respect to the horizontal axis..

Caution The stylus balancing geometry of the laser pick-up causes the stylus force to significantly decrease at angles approaching 45°. This may affect measurement results and care should be taken to establish that the stylus remains fully in contact with the component, with sufficient force, when making measurements at such angles.

FITTING TO A BASE When used with a base unit, the column is attached by 4 M8 socket head screws. The bolt holes in the flange at the foot of the column, are sized to provide sufficient adjustment for the alignment of the front face of the carriage to the nearest tee slot.

Power for the column motors is obtained from the Electronic Interface Module.

INSTALLING THE TRAVERSE UNIT To install the traverse unit, the carriage should be driven to about halfway up its length and the tilt adjustment set to bring the dovetail slot approximately vertical. Engage the dovetail of the traverse unit with that of the carriage and slide the traverse unit down as far as it will go.

Drive the tilt adjuster to cause the traverse unit to tilt far enough in the anti-clockwise direction to be able to access the 3mm socket screw in the side face of carriage (see previous page). Tighten this screw to clamp the traverse unit to the carriage.

When the traverse unit has been installed and all interconnections have been made, then it can be driven horizontally or vertically either from the control panel joystick or from menu selections from the program. Traverse unit tilt is initiated from the tilt control switch on the control panel, from program menu selection or by turning the manual tilt control knob on the carriage. Opto electronic limit switches automatically halt the drive at the extreme ends of movements.

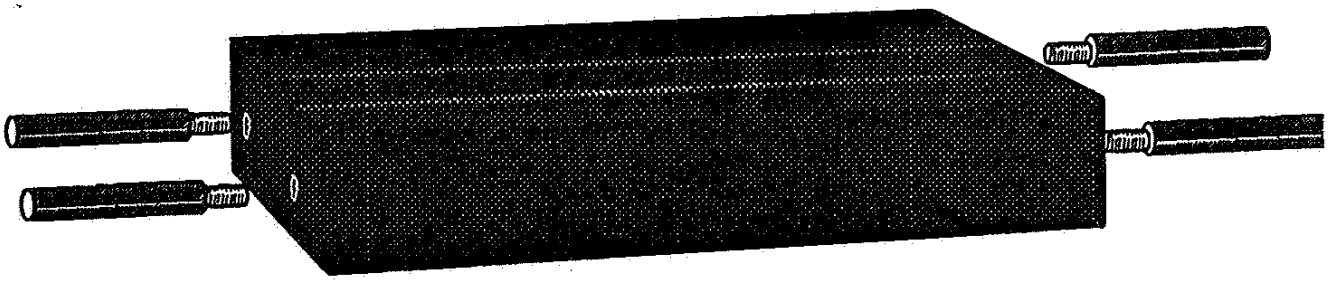
Caution When the traverse unit is tilted in the -ve angle direction care must be taken to avoid a stylus collision when driving downwards. In this attitude, the stylus can contact a surface at an angle such that an end collision is effected. This will not allow the stylus to swing through its normal arc and cause the carriage to be halted by gauge collision detection.

SPECIFICATION

Traverse limit switches:	Optical type - fixed position
Carriage traverse speeds:	0.25mm/sec 0.50mm/sec 1.00mm/sec 2.00mm/sec 5.00mm/sec 10.0mm/sec } ± 15%
Speed of angular rotation of carriage:	15 min/sec 25 min/sec 40 min/sec } Nominal only
Range of carriage tilt adjustment:	±9°
Material:	Epoxy granite
Depth:	125mm (excluding plinth)
Width:	125mm (excluding plinth)
Height:	
450mm traverse:	630mm
700mm traverse:	880mm
Weight:	
450mm traverse:	47kg (103.4lbs)
700mm traverse:	53kg (116lbs)

EPOXY GRANITE BASE

DESCRIPTION The base is an epoxy granite construction on anti-vibration mounts, and provides a firm support for the column and workpieces. The isolation from vibration provided by the base enables the system to be used up to maximum performance level close to normal engineering environments (this does not include high energy activity such as forging, planing, shearing, bending etc). Two tee-slots enable fixtures and base accessories to be secured to the surface.



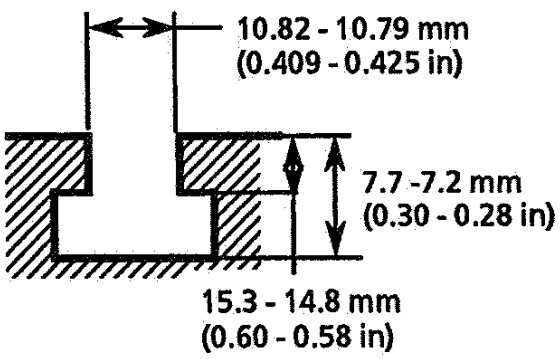
WARNINGS

The column is normally attached to the base, as a complete unit. This assembly is top heavy and unstable when carried. Therefore, when it is required to move location, the column must first be unscrewed from the base and the two components moved separately and reassembled at the new location.

Four handles are provided for lifting the base, which weighs 120kg (246 lbs). These handles must be fully screwed into the threaded holes in the ends of the base (two handles at each end). The user must decide whether to use manual or mechanical lifting, depending on the environment and the distance to be moved. The threaded holes on the top of the base MUST NOT be used for lifting.

SPECIFICATION

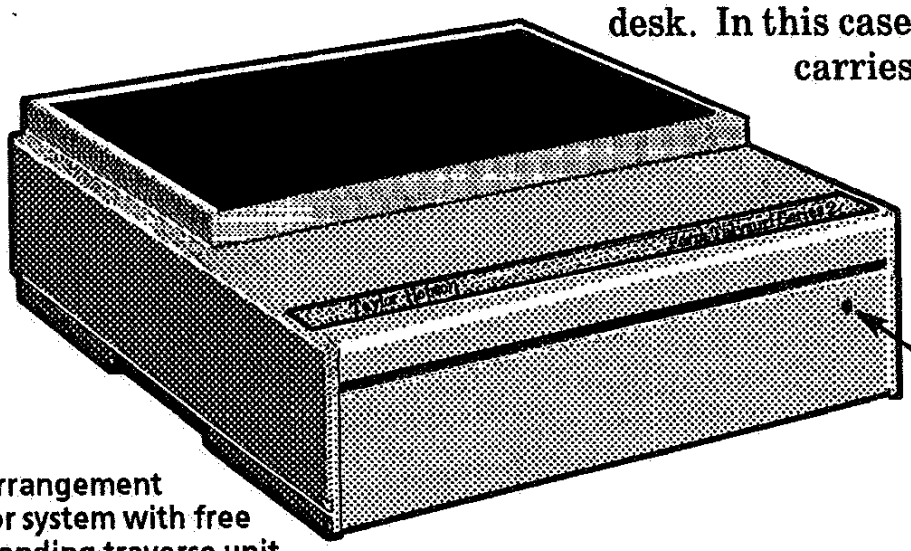
Material:	Epoxy granite
Weight:	120 kg (246 lbs)
WxDxH:	760 x 500 x 120mm
Location features:	2 tee-slots (for slot dimensions see sketch)



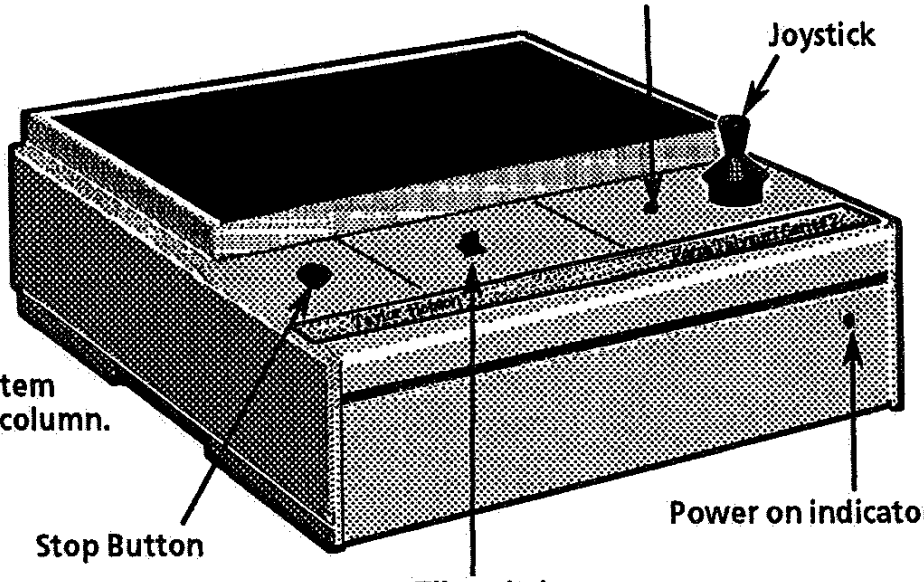
THE ELECTRONIC INTERFACE MODULE

DESCRIPTION This module forms the link between the measuring system and the host computer, providing the interfacing circuits for the particular system and the power supply for the traverse unit and column.

When the system includes a motorised column, then the controls for manual operation are normally mounted on the front top panel of the unit. Alternatively, a panel carrying the manual controls can be mounted on an instrument desk. In this case, the front top panel carries a D type connector to which the cable from the manual controls panel is connected.

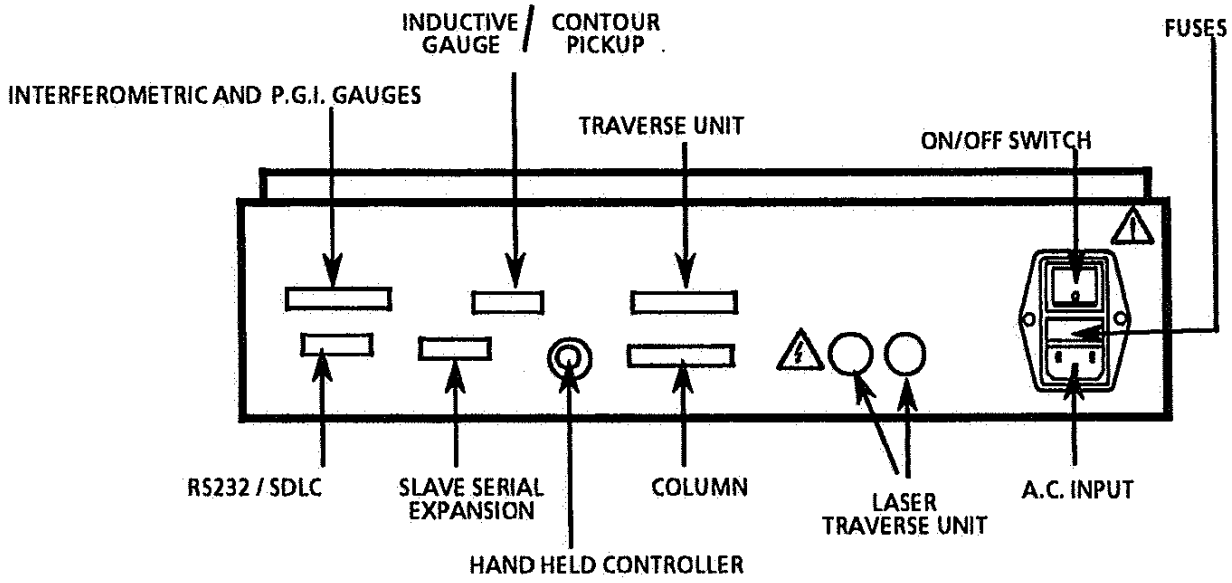


Arrangement for system with free standing traverse unit.



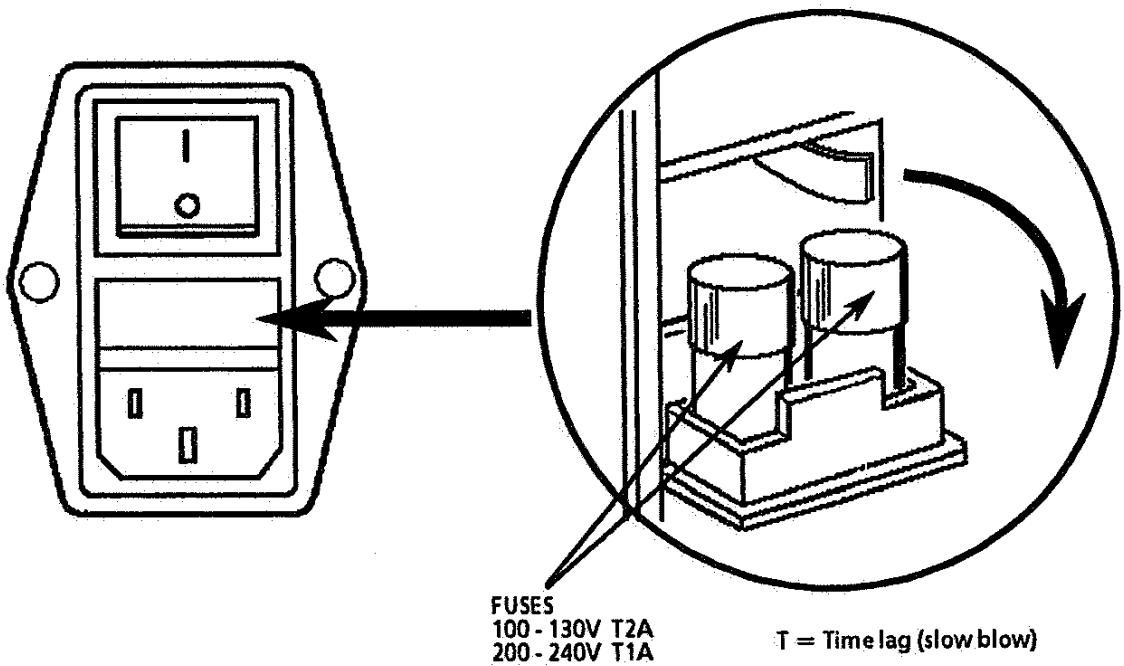
Arrangement for system with motorised column.

REAR PANEL The rear panel includes the ON/OFF switch for the module and the various connectors, as shown in the diagram below.



NOTE: Only connectors relevant to the particular system will be included.

MAINS FUSES The fuses are located above the mains connector and are accessed, **after disconnecting the mains lead**, by pulling the fuse container outwards and allowing it to swing downwards.



STOP BUTTON When the red stop button is pressed, all of the motor drives are inhibited and all traversing operations are stopped.

Note Movements of the accessory Y axis table are not affected by pressing the stop button (see section 10.

After the stop button has been operated, it is recommended that the computer and the EIM are switched off and then back on again, in order to reset the whole system.

TILT Traverse unit tilt can be manually adjusted by operating the centre bias rocker switch.

THE JOYSTICK The joystick enables the stylus to be positioned in both the horizontal and vertical axes.

Moving the joystick from its central position causes the traverse unit to retract or extend the pick-up or the column carriage to be traversed up or down the column, as follows:

Moving the joystick towards the:

left causes the stylus to be traversed away from the traverse unit (until the endstop is reached).

right causes the stylus to be traversed towards the traverse unit (until the endstop is reached).

back of the control panel causes the column carriage to be traversed upwards (until the endstop is reached).

front of the control panel causes the column carriage to be traversed downwards (until the endstop is reached).

Simultaneous movements in both the horizontal and vertical axes are obtained when the joystick is moved to positions between those described above.

The speed of traverse is determined by the amount that the joystick is moved: the speed being progressively increased as the displacement of the joystick is increased. A small movement of the joystick causes the traverse to be made at a slow speed: a large movement of the joystick causes the traverse to be made at a fast speed.

JOYSTICK INDICATOR This indicator will light when the joystick is active. It is, therefore, not lit when the joystick has been deactivated by pressing key F9, when a computer controlled move is taking place and when a gauge overrange condition exists.

WARNINGS

The back panel of the Electronic Interface Unit carries warning labels appropriate to the system configuration. These labels indicate areas of possible hazard where caution must be observed, as follows:

1. **The mains lead must be disconnected before attempting to change a fuse.**

   The fuses are located above the mains connector and are accessed, **after disconnecting the mains lead**, by pulling the fuse container outwards and allowing it to swing downwards.

2. **On systems with a laser traverse unit, if the laser traverse unit leads are not connected, power must NOT be switched on to the Electronic Interface Module as a high voltage will exist on the connector. Damage to the supply could also occur.**

Overall dimensions:

W x D x H: 402x 382 x 142mm

Weight: 8.0 kgs

ELECTRICAL SUPPLY TO THE ELECTRONIC INTERFACE MODULE:

Mains Supply Voltage 100V - 240V 50/60Hz

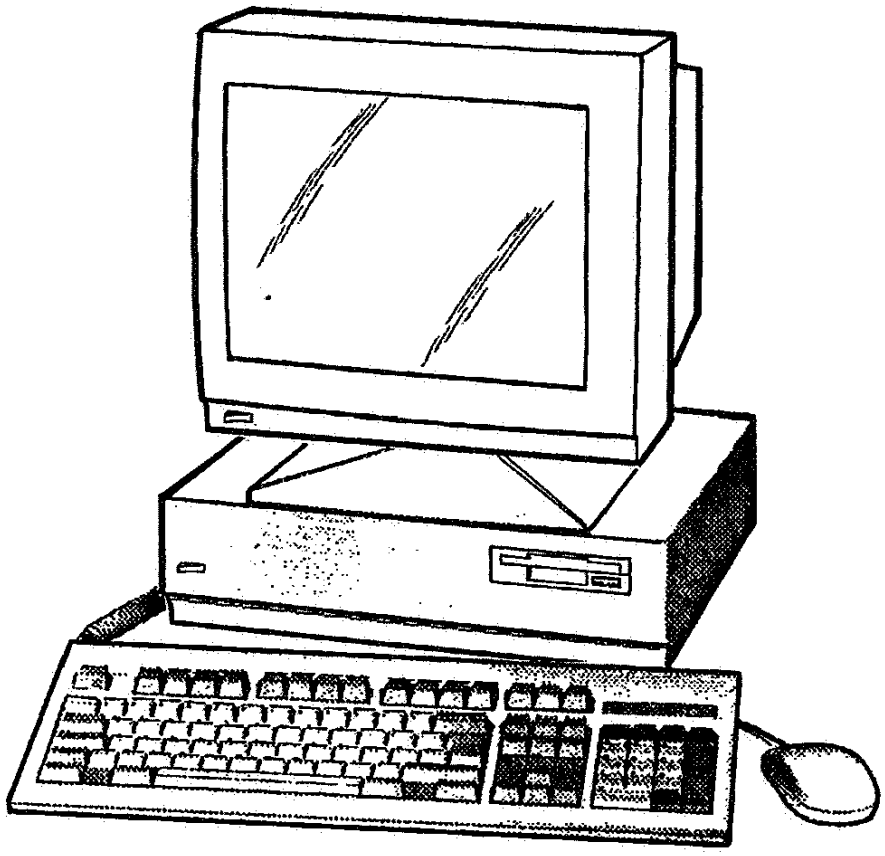
Max . power requirement: 70VA

This equipment is intended for installation category (overvoltage category) II, in accordance with IEC 1010 (1990) and EN 61010-1 (1993).

NOTE: For details of the power requirements for the computer and any accessories that do not derive their power from the E.I.M., refer to the manufacturer's documentation.

THE COMPUTER

DESCRIPTION The computer performs the control and calculation functions.



A standard PC/AT compatible computer with Intel 80386 (or above) processor, is supplied, and the operators manual for its use should also be consulted.

COMPUTATION TIMES Analysis computation times are dependent on the number of data points to be processed and the size of the computer memory. If the computer has one Mbyte of RAM, then when the number of data points being processed exceeds 65535 (see section Bandwidth, Filtering and Data Points), the analysis times are significantly increased over computers with three Mbytes of RAM.

The data points processed exceed 65535 in the following cases:

1. Traverse length<30mm - No Filter - Data length>16.38mm.
2. Traverse length<30mm - 1000:1 Bandwidth - Roughness Filter, Cut-off of 2.5mm - 13 Cut-offs.
3. Traverse length ≥30mm - No Filter - Data length>65.53mm.
4. Traverse length ≥30mm - 1000:1 Bandwidth - Roughness Filter, cut-off 2.0mm - 13 Cut-offs.

The use of Minimum Zone form fit or Gaussian filter will also significantly affect analysis times if greater than 43690 data points are processed.

USING THE SYSTEM OFF LINE

With an appropriate dongle fitted to the computer, the software can be used in the stand alone mode, by switching the computer on without power to the main system. This can then be used for training, program modification or with a skilled operator for creating programs. It can also be used to analyse data 'OFF-LINE'.

OTHER APPLICATIONS

The system can be used for other program applications such as PC/AT compatible word processor & spreadsheet packages. In order to achieve this it is necessary to modify the autoexec.bat file which autoloads the Form Talysurf Series program. To do this reference should be made to the Computer Operator's manual supplied with the system.

Note The computer makes use of the standard expanded memory manager (EMM386.EXE), as may other applications that are also installed (adhering to LIM standard 3.1 or above). Care must be taken regarding the amount of memory used by the other applications: see *COMPUTATION TIMES* on the previous page.

CAUTION Care should be taken if any alternative programs modify the config.sys file. Ensure that a back-up copy is retained.

It is essential, for the running of the Form Talysurf Series, that in the config.sys file:

BUFFERS = 10 and FILES = 20.

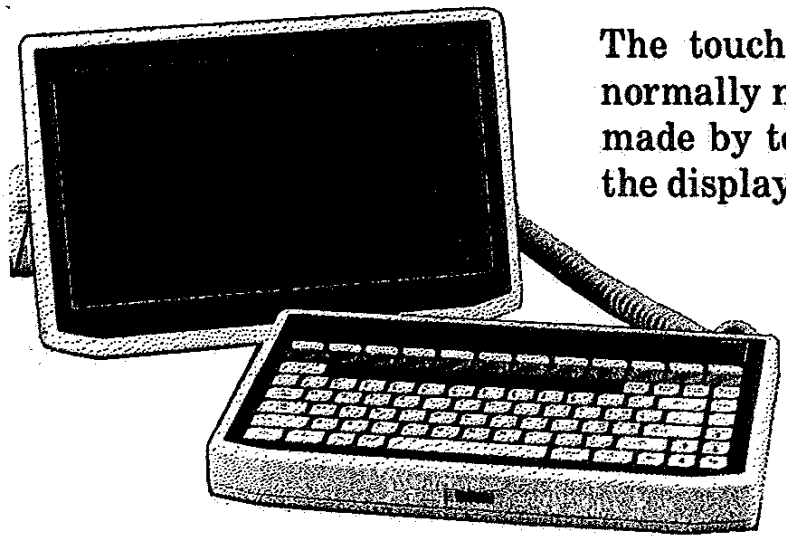
Note If attempting to install an alternative software package causes problems with the operation of the Form Talysurf Software, then the Form Talysurf Software can be re-installed. Suitable advice should then be sought on the correct installation procedure for the particular alternative software package in question.

MOVING THE SYSTEM With some computers is essential that whenever the PC is moved, the Hard Disc is 'PARKED'. **Consult the Computer manufacturer's manual for this information.**

TERMINAL MODULE 2

DESCRIPTION Terminal Module 2 provides an alternative to a standard IBM compatible PC, as the system host computer.

This option comprises a system unit with an integral LCD display, a membrane keyboard and a portable floppy disk drive. The module is of very rugged construction (suitable for industrial use) and has the additional facility of touch screen operation.

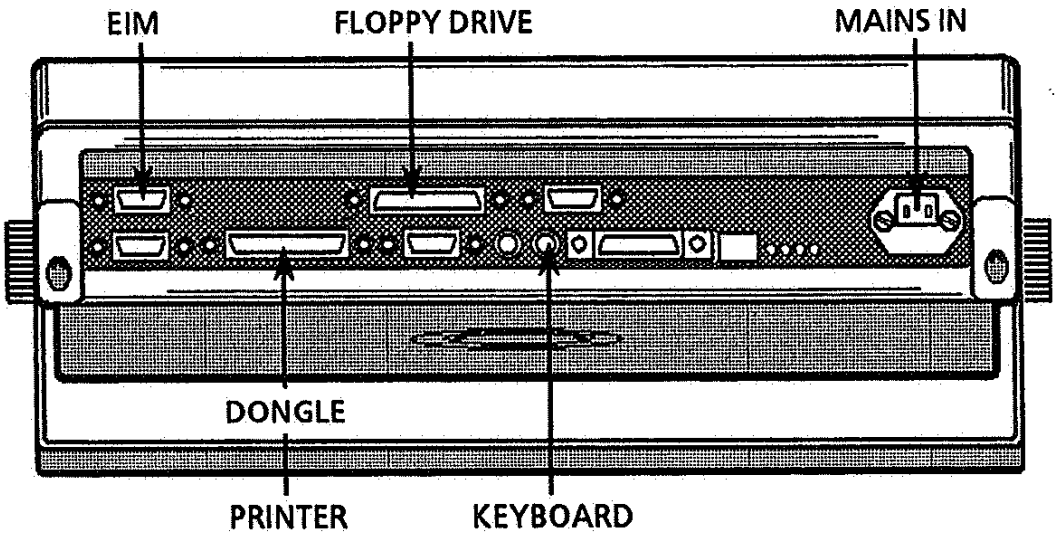


The touch screen facility enables the normally mouse selected functions to be made by touching the required icon on the display.

However, some individual finger actions can be misread by the computer and occasionally, during a *Move Continuous* operation, the computer may not recognise when a finger has been lifted from the screen. If this occurs, then the icon is not cleared and the move continues. Immediately re-touching the screen will correct this action.

LIMITATIONS The **Talymap 3D analyses** and **Contour** software packages are **not** available for use with Terminal Module 2.

INTERCONNECTIONS All of the Terminal Module 2 connectors are carried on the top panel of the system/display unit. The interconnections are as for a standard PC based system (see section 2). The connections to Terminal Module 2 are as shown on the following page.



WARNING **THE PORTABLE FLOPPY DISK DRIVE MUST NOT BE CONNECTED OR DISCONNECTED WHILE THE POWER TO THE TERMINAL MODULE IS SWITCHED ON.**

SCREEN COLOURS The screen comprises a mono liquid crystal display. The Form Talysurf Series software generates displays that are suitable for a colour monitor . Therefore, the selections made on the SCREEN COLOURS menu should be chosen to give the best possible mono display. The factory settings, selected prior to despatch, are as follows:

WINDOW COLOURS:

SCREEN BACKGROUND	Black	Normal
TEXT	White	Bright
BOX BACKGROUND	Black	Normal
BOX BORDER	White	Normal
CONNECTING LINES	White	Normal

GRAPHICS:

GRAPHICS COLOUR	White	Bright
AXES COLOUR	White	Normal
ICON BORDER	White	Normal
ICON BACKGROUND	Black	Normal
GRAPH SHADING	White	Bright

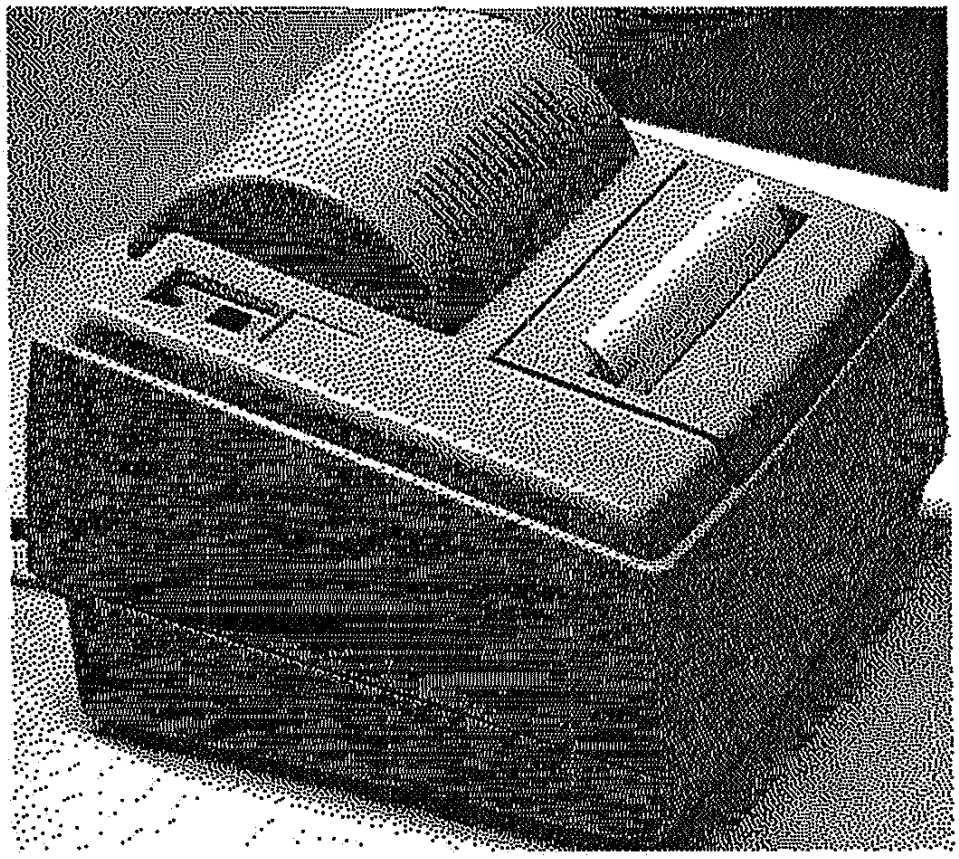
SCREEN CONTRAST The contrast of the image displayed on the LCD screen can be adjusted by holding down the CTRL and the ALT keys and pressing the ↑ and ↓ keys.

SCREEN CALIBRATION Should the cursor position drift away from the indicated finger positions, then the screen must be recalibrated. This procedure is selected from option 3 of the introductory menu.

TEXT AND GRAPHICS PRINTER

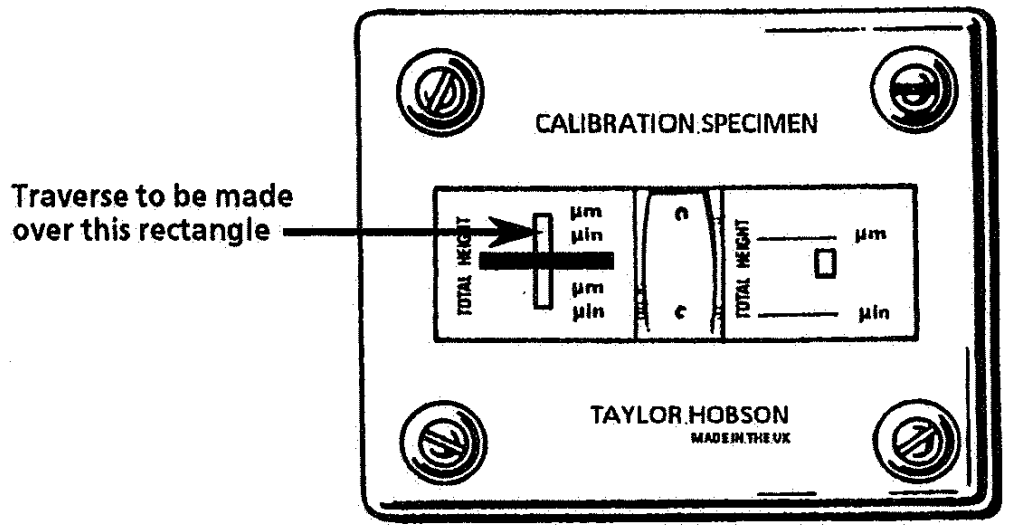
DESCRIPTION A permanent record of both text and graphical results can be obtained when this printer is connected to the parallel port of the computer.

The operating instructions for this printer are not included in this handbook but are supplied separately with the printer.



3 LINE CALIBRATION STANDARD

DESCRIPTION The 3 line calibration standard supplied with the Form Talysurf series of instruments, comprises a frame and base on which are mounted two glass plates.



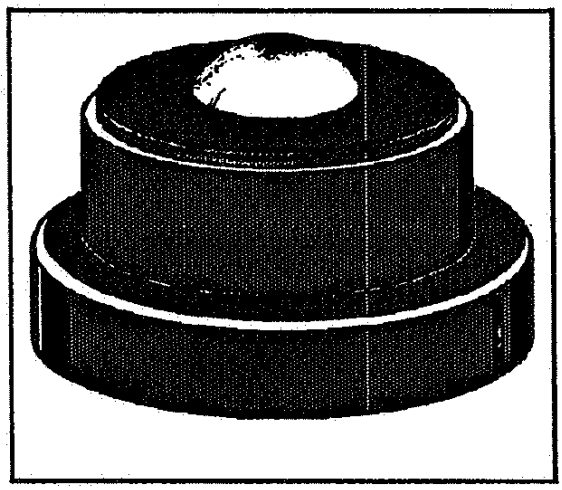
The label below the left hand glass plate (as shown below) has marked on it two rectangles, separated by a black bar. The upper rectangle denotes the area in which three grooves nominally 2.5µm (100µin) deep are located. The value of the middle line is marked on the standard.

Only this section is used for the calibration of the Form Talysurf series of instruments. The other two areas are used with other instruments in the Taylor Hobson product range.

CLEANING Occasional cleaning of the standard is advised. This is best achieved by using a commercially available record cleaning pad.

BALL CALIBRATION STANDARDS

DESCRIPTION The ball calibration standards are an essential requirement for systems equipped with Form or Extended Form analysis software.



The standards comprise a highly polished Tungsten Carbide precision Ball, with housing and screw-on cap.

For systems equipped with the 120L laser based traverse unit and for the P.G.I. traverse unit with certain stylus arms, the 22mm radius ball is required. For inductive gauge based systems, the 12.5mm radius ball is required.

The calibration standard used should be appropriate to the pick-up and stylus type. See the table in CALIBRATION USING THE BALL OR 80mm RADIUS STANDARD, Section 5.

TURNING THE BALL If damage (e.g. scratches etc.) has occurred to the calibration ball and difficulty is experienced in obtaining a suitable calibration, then it is advisable to rotate the ball to present an undamaged surface area. This can be done as follows:

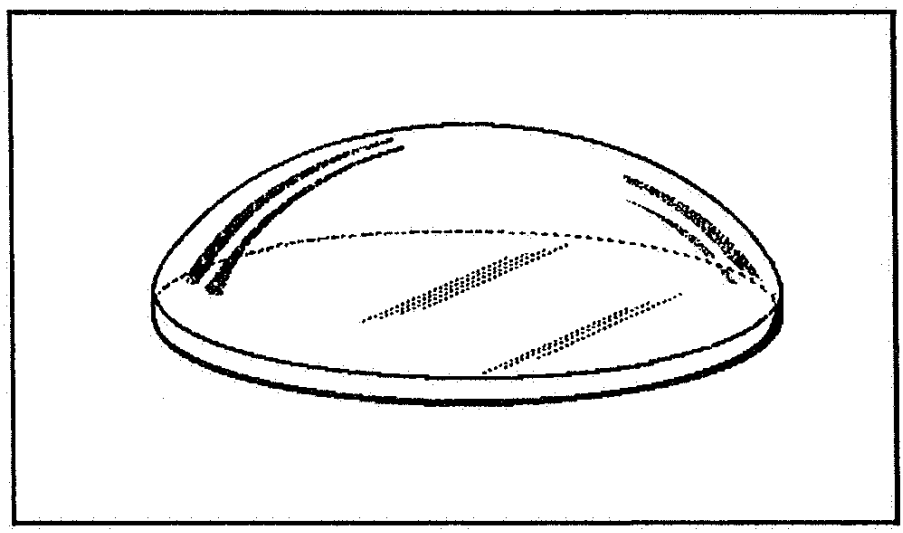
1. Ensure that the cap is firmly screwed in position.
2. Use a small screwdriver, and remove the plastic cover from the base of the housing to reveal three socket head screws (3mm).
3. Loosen the screws but do not remove them.
4. Gently lift up the black housing from its base to break the seal of the 'O' ring on the ball.
5. Turn the ball to a new, undamaged position.
6. Tighten the three socket head screws and replace the plastic cover.

CLEANING The standard should be cleaned using a non-staining solvent such as ethyl alcohol on a lens tissue. Alternatively any commercially available lens cleaning liquid can be used.

NOTE The calibrated size of each individual standard is shown on two labels. One label is located under the base of the standard and the other on the inside of the screw-on cap. Therefore, if more than one standard has been supplied, it is important to ensure that the screw-on caps are not interchanged. This could lead to the use of an incorrect radius when calibrating: in which case, subsequent measurement results would be invalid until the instrument was recalibrated using the correct radius value.

80mm RADIUS CALIBRATION STANDARD

DESCRIPTION Comprising a glass hemisphere of nominally 80mm radius, this calibration standard is the normal requirement for use with a system equipped with a P.G.I. traverse unit or a contour pick-up.



CLEANING The standard should be cleaned using a non-staining solvent such as ethyl alcohol on a lens tissue. Alternatively any commercially available lens cleaning liquid can be used.

CHAPTER 4
SOFTWARE REFERENCE

This chapter provides an overview of the operation of the software and details the individual menus which enable the user to select the operation or functions required.

CONTENTS OF THIS CHAPTER

DONGLES With the exception of the Form Talysurf Series E instrument, all software options are controlled via a hardware dongle that determines the level of software operation. Therefore, some of the options listed in this handbook may not be available on your system. With the exception of the Form Talysurf Series E instrument, if a dongle is not fitted, then the basic measurement software can be operated for 30 minutes, after which the program will automatically terminate.

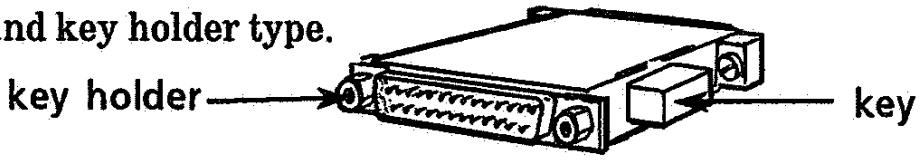
There are four types of dongle in use. Three of these are of the key and key holder type. With the fourth type, the key functions are integrated into the holder and there is no separate key.

The dongle must be connected to the parallel printer port of the computer. The printer can then be connected to the key holder.

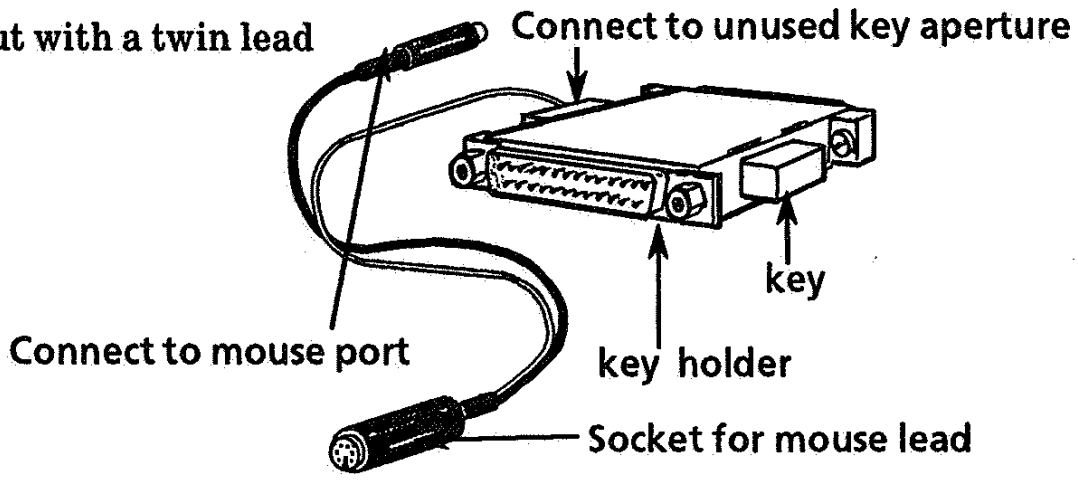
Note When TalyMap software is to be used on the same computer as the Form Talysurf, then the Talymap dongle must be connected to the computer first. The Form Talysurf dongle is then connected to the Talymap Dongle.

The dongles supplied are as follows:

1. Simple key and key holder type.



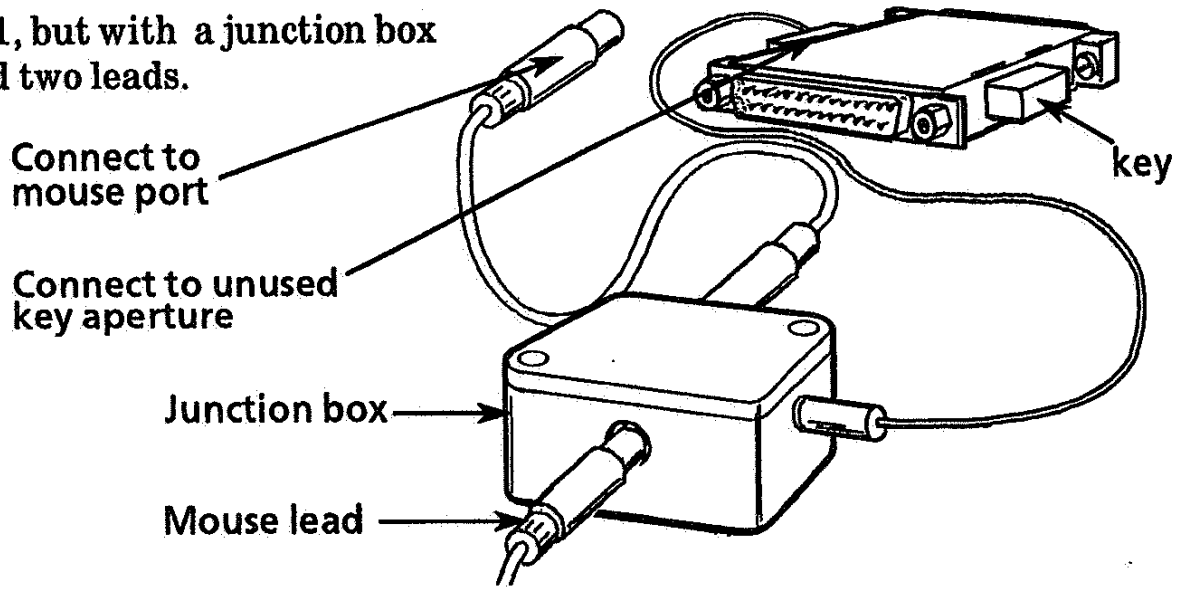
2. As 1, but with a twin lead



With the twin lead dongles, the connector on the

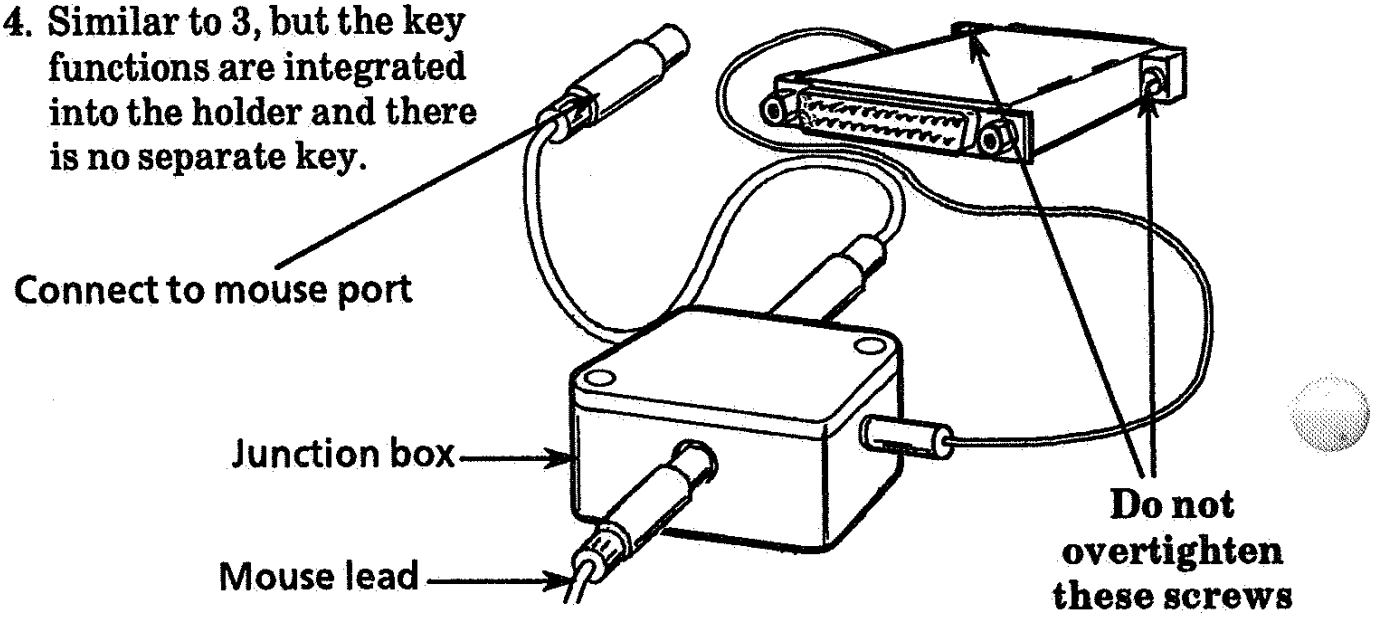
end of the thin lead must be plugged into the unused key aperture of the key holder and the appropriate end of the thick lead must be connected to the mouse port of the computer. The mouse can then be connected to the socket on the other end of of the thick lead.

3. As 1, but with a junction box and two leads.



With these dongles, the rectangular connector on the end of the thin lead must be plugged into the unused key aperture of the key holder and the other end into the connection on the side of the junction box. The thick lead must be connected to the mouse port of the computer and to the junction box. The mouse can then be connected to the free socket on the junction box.

4. Similar to 3, but the key functions are integrated into the holder and there is no separate key.



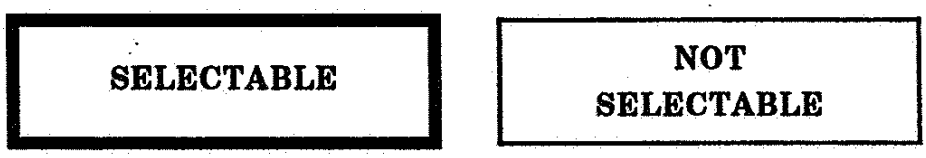
GENERAL The program starts when the system is switched on or by selection from a menu, and is run by making selections from displayed menus. The menus make the following functions available to the operator:

- Control of the instrument's movements (where non- manual control is provided).
- Specification of the measurement that the instrument is to make (traverse length etc.).
- Analysis of the measurement data.
- Presentation of analysis results.
- Analysis of previously recorded measurement data.
- Printing and storage of measurement data and analysis results.
- Automatic control of a measurement sequence using a program (measurement sequence data).
- Creation and Editing of measurement sequence data for automatic control.

NOTE With the exception of the Form Talysurf Series E instrument, all software options are controlled via a hardware dongle that determines the level of software operation. The Form Talysurf Series E software has a fixed level of operation which will remain unchanged even when a dongle allowing a higher level of operation is present. Therefore, some of the options listed in this handbook may not be available on your system.

USER INTERFACE The menu selections are presented in icon form, these comprise options which have a boxed surround, or as a boxed graphic. A heavy lined box indicates that the icon is selectable, a fine lined box indicates that the icon is not selectable.

ie



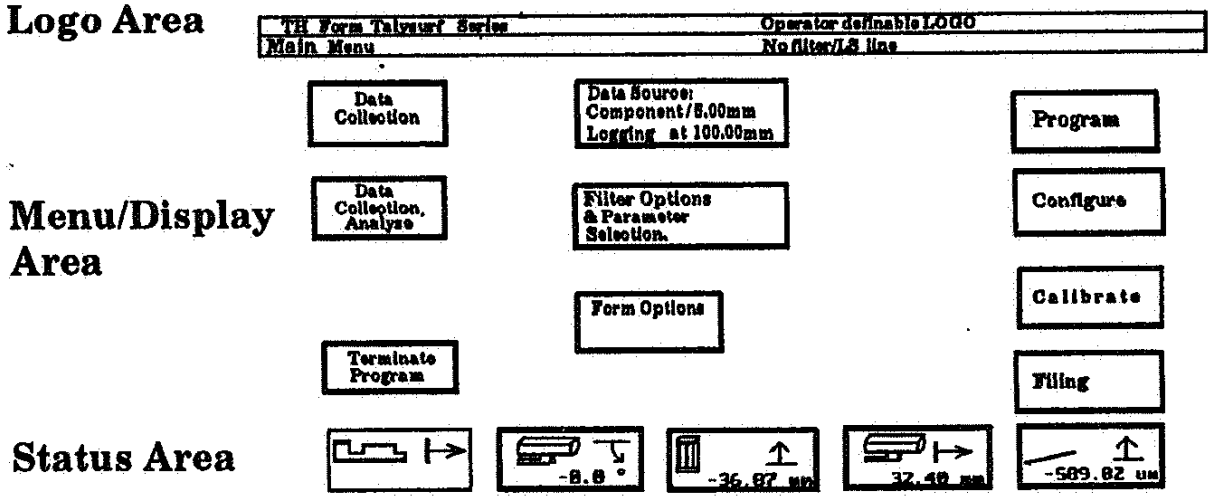
Each selection from a menu may lead to a request for data or to a further menu. These are worked through until the requirements for the analysis or

function are complete. The purpose of each selection is described in this section.

Menu options are selected by moving the mouse until the cursor is on the desired icon and then pressing one of the mouse buttons. Alpha-numerical data is entered via the keyboard.

See **MAKING SELECTIONS AND ENTERING DATA** later in this section.

SCREEN LAYOUT The screen is divided into three areas



i) Logo area (at the top).

ii) Menu/Display area (main central area).

iii) Status area (when this appears it is at the foot of the screen)

LOGO AREA AND SUMMARY INFORMATION The top first line of the logo area carries the instrument system type heading and is not operator selectable. To the right of this is the operator's own logo, which can be entered via the configuration menu. It should be noted however, that this line is also used during program execution for the display of the current step number within the program.

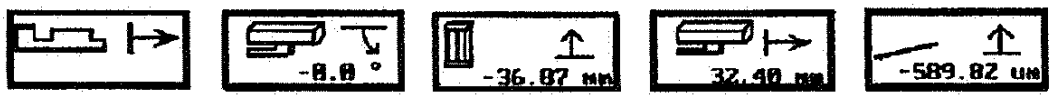
The second line of the logo area displays on the left hand side the reference applicable to the currently displayed menu. e.g. Main Menu, Results page etc. On the right of the second line is the status of

either the current filter and cut-off options (menus only) or the status of the displayed results in terms of the filter and cut-offs used.

Note The filter and cut-off selections shown in the logo area are representative of the current selections on all menus except the Results Page where they represent the status of the calculated results being displayed. Therefore even though new selections may be made they will not be represented unless the data is re-analysed.

MENU/DISPLAY AREA In this area all displays and menu options are presented. The ENTER key or the left key of the mouse must be used to confirm data entry in dialogue boxes (i.e.. input of numerical values or text). The entry of alpha-numerical data is via the keyboard.

STATUS AREA When the status area is displayed it appears at the foot of the screen and shows the positions of each software readable axis. Icons are used to identify the current gauge position and the position of the various axes with arrows indicating the base from which the positions are measured.



The icons represent (from left to right of the screen): Traversing table, Traverse unit Tilt drive, Column drive (up/down movement), Traverse unit drive (left/right movement) and the Gauge position. In addition to being position indicators the status displays are also selectable fields for the initiation of axis movements and to change the gauge range, set the phase and balance of inductive gauges, reset the P.G.I. gauge and to move the stylus arm of the Contour gauge. Only the icons with a thick line box are active. This being dependent upon the current equipment configuration. Selecting an icon causes a list of the various moves available to be displayed. These are **Continuous, Relative, Absolute, and Stop.**

See the appropriate MOVE AXIS menu for further details.

THE FUNCTION KEYS The function keys (the **F** keys) have dedicated operations, these are as follows:

Key F 1 **Main Menu** - Pressing this key returns the display back to the main menu page.

Key F 2 **Help** - Provides help information. Generally the help information will appear in a window in the centre of the screen. Re-selection of the help key will restore the menu.

Key F 3 **Results** - Pressing key F3 will cause the results summary page to be displayed, when relevant.

Key F 4 **Gauge Set Up** - Pressing function key F4 causes the gauge set up screen to be displayed.

Key F 5 **Raw Profile** - Pressing function key F5 will cause the Data Selection Menu and the Raw Profile, if relevant, to be displayed.

Key F 6 **Printer reset** - Pressing this key will cancel the print operation.

Key F 7 **Print** - Key F7 is used to provide a print-out of graphical and tabular information; the content of output being determined by selections made from the PRINTER CONFIGURATION MENU. In non-program mode, learn or edit program mode, the following information can be printed when key F7 is pressed:

Menu	Printout available
Data Selection - Raw Profile Menu	Raw Profile
Data Selection - Modified Profile Menu	Modified Profile
Dual Profile Menu	Dual Profiles (scale as displayed)
Bearing ratio Menu	Bearing ratio and amplitude distribution (fixed scaling).
Rk Bearing ratio Menu	Rk Bearing ratio (fixed scaling).

Menu	Printout available
Edit or View Program Menu	Program listing
All other menus	Calculated analysis results are printed: ie. Modified Profile, Parameter values, Bearing ratio, Amplitude distribution and Rk Bearing ratio.

Key F 8 **Print Screen** - Key F8 is dedicated to printing the contents of the screen onto the printer.

Note The **Print Screen** option should not be selected when a **Print** (F7) is already in progress, or corruption of the print-out may occur. When both **Print** (F7) and **Print Screen** (F8) are required in succession, then the **Print Screen** (F8) must be selected first. This particularly important in program mode, as there is no delay between the programmed instructions.

Key F 9 **Joystick or Hand held Controller Enable** - The joystick and tilt button or Hand held Controller can be turned on or off (toggled) with the F9 key.

Key F 10 **Exit/Save** - Key F10 is used to terminate an automatic sequence or a gauge contact operation, or to exit from the program.

Key F 11 Key F11 provides a display into which user comments, for inclusion in print-outs, can be typed. These comments are only included in print-outs when selected on the FURTHER PRESENTATION SETTINGS MENU. For operation of the text editing facility, see USER HELP MENU.

Key F 12 **Gauge Information** - Pressing Key F12 causes the Gauge Information Menu to be displayed.

MAKING SELECTIONS AND ENTERING DATA

Menu options are selected by using the mouse to move and place the cursor onto the icon required. The selection is then made by pressing either button on the mouse. Numeric values are entered via the keyboard.

When the cursor is in a blank area of the display pressing both keys on the mouse can be used instead of the F1.

Data can be entered in units which are not those currently selected. Such data is automatically converted to the current units.

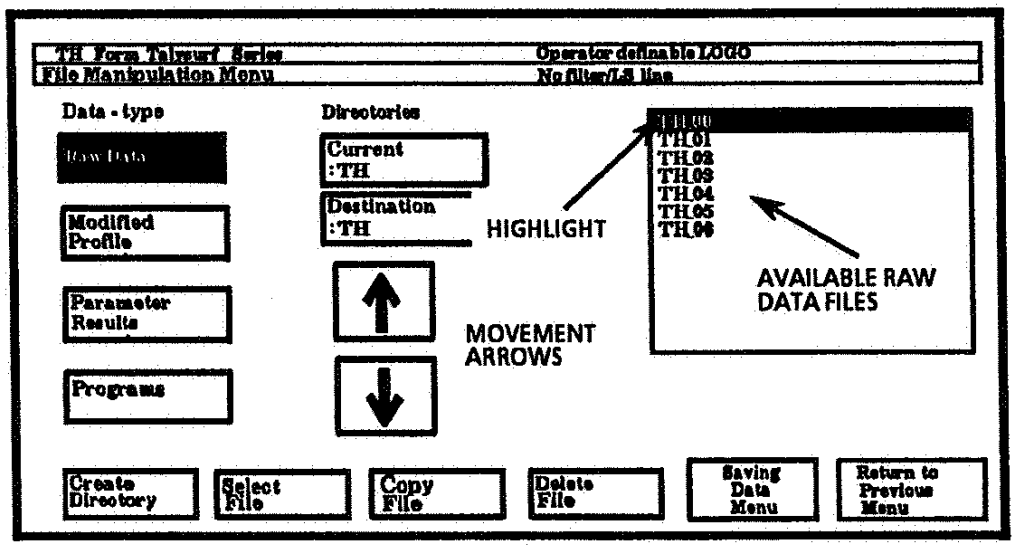
The units in which this data is entered must be specified by entering the standard abbreviation for the units after the numerical value (e.g. 1234nm). Acceptable unit abbreviations are:

Metric units:		**Inch units:**	
metre	m	inch	in
millimetre	mm	milliinch	min
micrometer	µm	microinch	µm
nanometre	nm	nanoinch	nin
picometer	pm	picoinch	pin

MULTIPLE OPTIONS

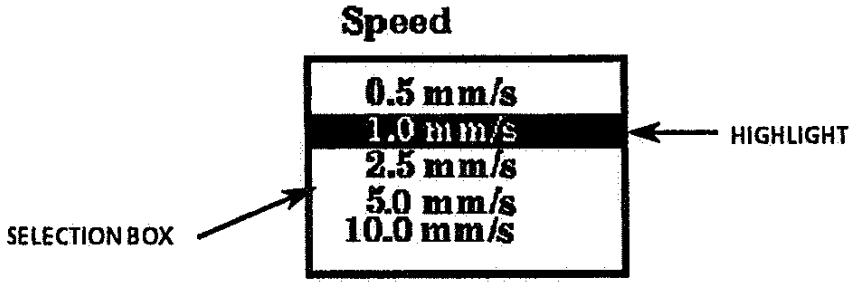
There are two ways in which options are selected from menus with multiple options boxes. On menus with large **UP/DOWN** arrows (e.g. the File Manipulation Menu), the arrow boxes are selected to move the highlight bar up and down. When the appropriate item (e.g a file) is highlighted then the option **SELECT** can be selected.

SELECTION FROM MULTIPLE OPTIONS USING ARROWS



On menus without arrows, then the multiple selection box should be repeatedly selected until the highlight bar is on the required selection. The option to 'SELECT" can then be made.

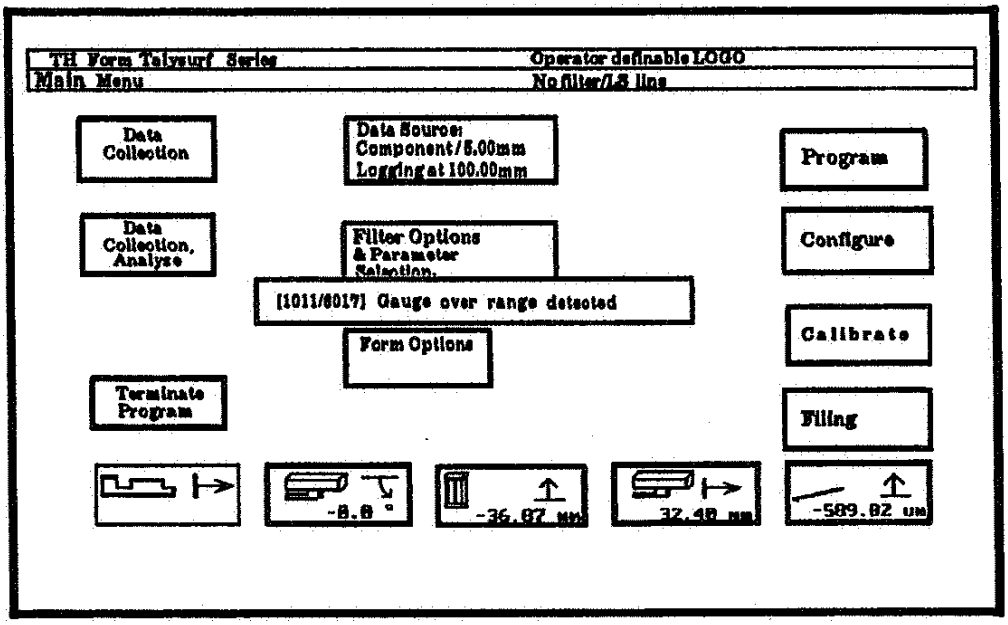
SELECTION FROM MULTIPLE OPTIONS



Each selection of the box will move the highlight bar.

ERROR MESSAGES The system will display appropriate error messages when either an incorrect action is taken or a system status error is detected (e.g. An End Stop).

ERROR MESSAGE WINDOW

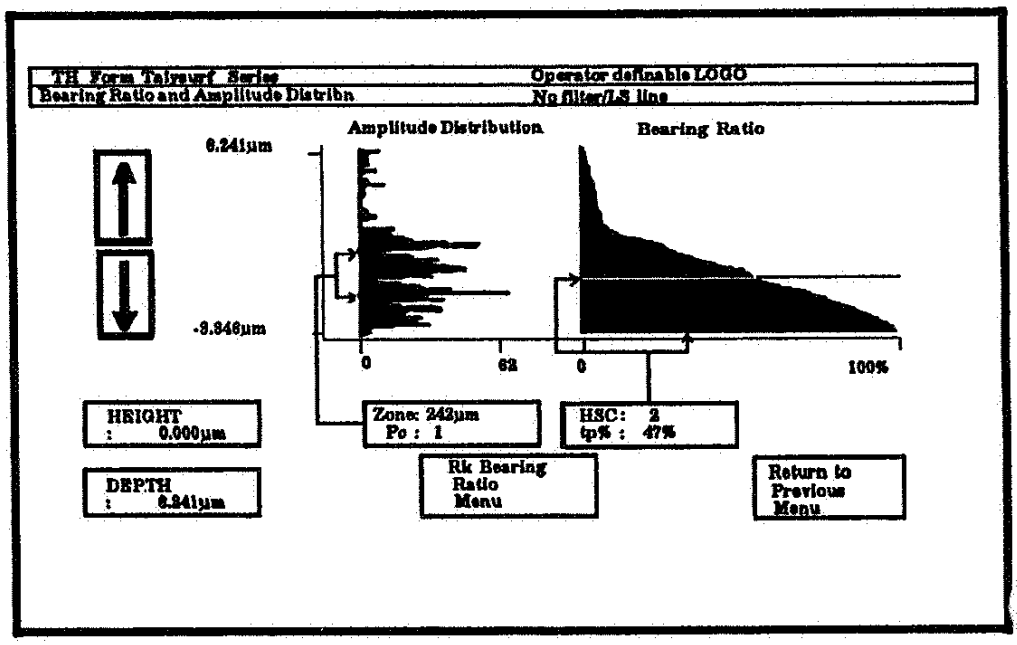


To clear the error message, it must be acknowledged by selection of the error message window, before any further action can be taken.

See section on **Warning and Error Messages.**

BEARING RATIO & AMPLITUDE DISTRIBUTION MENU

BEARING RATIO AND AMPLITUDE DISTRIBUTION MENU



DESCRIPTION Providing one, or both of the Bearing ratio/Amplitude distribution parameters has been selected in the Parameter Selection Menu, then this menu is accessed by selecting the Bearing ratio/Amplitude distribution box on the RESULTS PAGE.

Interactive analysis of either the Bearing ratio (Abbot-Firestone Curve) and/or the Amplitude distribution curve is provided.

Note If Rk is selected and there is no Bearing ratio or Amplitude distribution, then direct access is possible from the results page to the Rk menu.

If the Rk parameters have been selected (when in Roughness mode only) then the Bearing Ratio & Amplitude Distribution Menu allows access to the Rk Bearing Ratio menu. See the Rk Bearing Ratio Menu for further details.

The display consists of two arrows which when selected will interactively move the cursor lines up or down (or in the case of Peak Count the Bandwidth up or down), and the appropriate parameters will be displayed for the new cursor location.

If required, one of the other selection boxes can be selected to enter a direct value from the keyboard.

HEIGHT When selected the operator will be prompted to enter a *HEIGHT* from the keyboard. After entry of the value, in microns or microinches (µm or µin), then the cursor position will move directly to the entered value and the appropriate results will be displayed.

DEPTH When selected, the operator will be prompted to enter a *DEPTH* from the keyboard. After entry of the value, in microns or microinches (µm or µin), then the cursor position will move directly to the entered value and the appropriate results will be displayed.

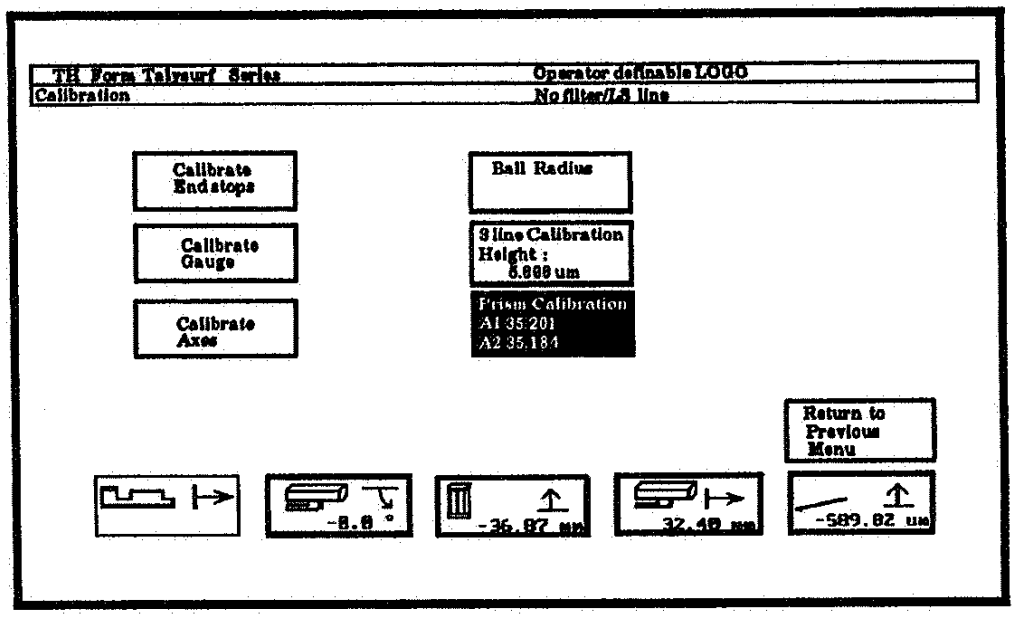
HSC Tp% Not operator selectable - Displays the High Spot Count (HSC) and Bearing Area (Tp%) for the current cursor position.

ZONE Pc Not operator selectable - Displays the current Zone (Bandwidth) about the height 0.0 and the associated value for Peak Count. If the modified profile does not cross the height = 0.0 line, then the Zone and Peak count are undefined and will be displayed as asterisks (****).

RETURN TO PREVIOUS MENU Returns operation to the menu from which the BEARING RATIO & AMPLITUDE DISTRIBUTION MENU was accessed.

CALIBRATION MENU

CALIBRATION MENU



DESCRIPTION Allows Axes, End Stops and Gauge to be calibrated via a series of menus.

CALIBRATE END STOPS This option allows software end stops for the column, traverse unit and traversing table to be set anywhere within the actual traverse lengths of each unit.

See **CALIBRATE END STOPS MENU** for further details.

CALIBRATE GAUGE Allows the gauge to be calibrated relative to either a STEP HEIGHT or BALL RADIUS reference specimen.

See **GAUGE SET UP MENU** for further details

CALIBRATE AXES This option allows the current position of the Column, Traverse Unit or Traverse Table to be entered. This is usually done after switching on the system.

See **CALIBRATE AXES MENU** for further details.

BALL RADIUS This option is only available with systems equipped with Form or Extended Form software.

The current calibration ball radius is displayed. On selection, the operator is prompted to enter a new value. The value indicated should match that marked on the standard used during calibration.

This method of calibration applies an arcuate correction to the gauge information, resulting in linearised data through the full dynamic range of the gauge.

3 LINE CALIBRATION HEIGHT The current 3 line calibration height is displayed. On selection, the operator is prompted to enter a new value. The value indicated should match that marked on the standard used during calibration.

This method of calibration is valid for surface texture measurement only.

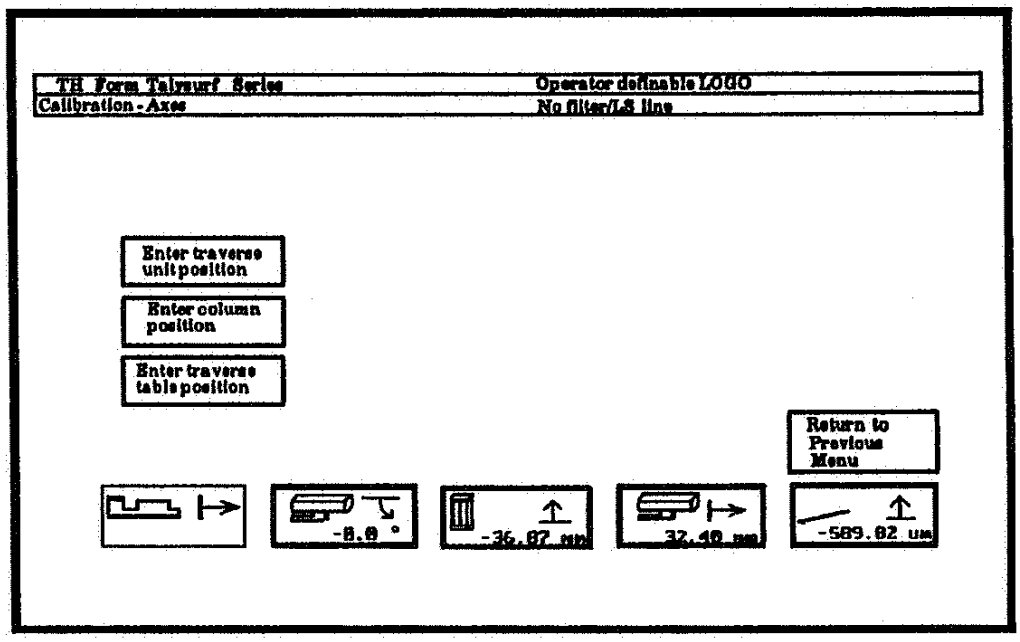
PRISM CALIBRATION This option is only available with systems equipped with Form or Extended Form software and is an additional calibration routine that provides a refinement to the ball or radius calibration. This routine modifies the correction constants achieved from the ball calibration, providing the appropriate corrections for the measurement of angular features.

For further details.see **PRISM CALIBRATION in section 5.**

RETURN TO PREVIOUS MENU **Returns operation to the Menu from which the CALIBRATE MENU was accessed.**

CALIBRATE AXES MENU

CALIBRATE AXES MENU



DESCRIPTION Allows the operator to reference the Column, Traverse Unit or Traverse Table for its current position either relative to part geometry or to an absolute position on the scales of each of the modules.

ENTER TRAVERSE UNIT POSITION When selected the operator will be prompted to enter the current Traverse unit position from the keyboard. When this is complete the value shown in the Traverse Unit Icon will be updated. If the system was correctly 'Terminated' then the position when switched off will be displayed.

ENTER COLUMN POSITION When selected the operator will be prompted to enter the current Column position from the keyboard. When this is complete the value shown in the Column Icon will be updated. If the system was correctly 'Terminated' then the position when switched off will be displayed.

ENTER TRAVERSE TABLE POSITION When selected, the operator is prompted to enter the current Traverse Table position from the keyboard. When this is complete the value shown in the Traverse Table Icon will be updated. If the system was correctly 'Terminated' then the position when switched off will be displayed.

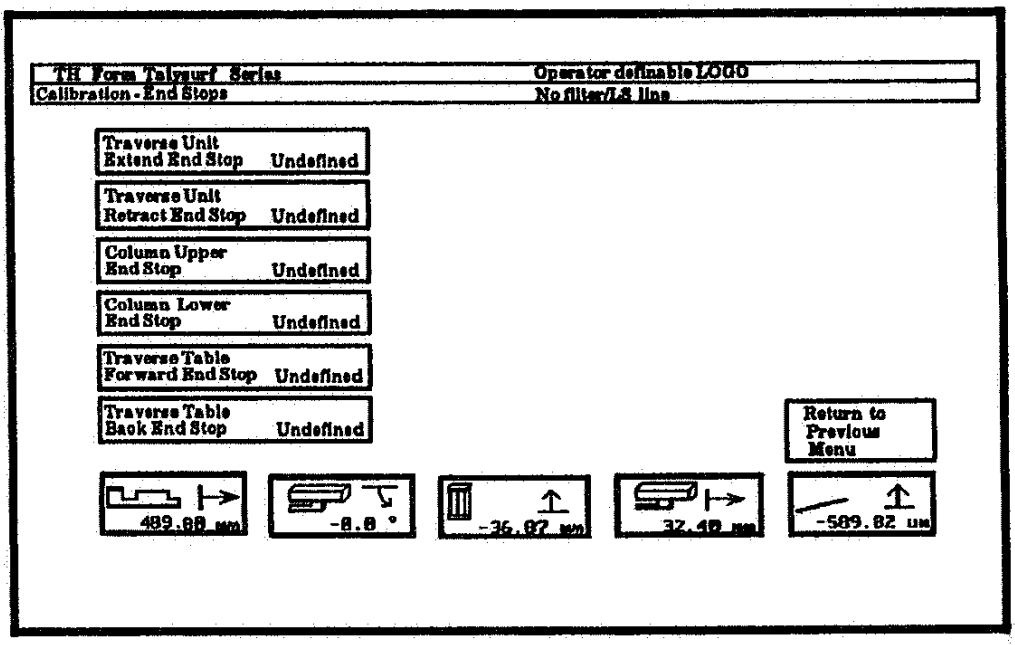
Note Calibration of the Tilt axis is **NOT** required.

Note When any axis is recalibrated, software endstops for all the axes are reset to their default values.

RETURN TO PREVIOUS MENU Returns operation to the Menu from which the CALIBRATE AXES MENU was accessed.

CALIBRATE END STOPS MENU

CALIBRATE END STOPS MENU



DESCRIPTION This menu allows software end stops to be set for each traversing axis. When a column is not included in the system, the selection box for calibrating the column end stops are displayed with a thin line and are not selectable. When a traverse table is not included in the system, no selection boxes for calibrating the table end stops are displayed.

TRAVERSE UNIT EXTEND END STOP On selection the operator will be prompted to enter a value from the keyboard. This will then be set as the left-hand (Extended) end stop.

TRAVERSE UNIT RETRACT END STOP On selection the operator will be prompted to enter a value from the keyboard. This will then be set as the right-hand (Retracted) end stop.

COLUMN UPPER ENDSTOP On selection the operator will be prompted to enter a value from the keyboard. This will then be set as the top (Upper) end stop.

COLUMN LOWER END STOP On selection the operator will be prompted to enter a value from the keyboard. This will then be set as the bottom (Lower) end stop.

TRAVERSE TABLE FORWARD END STOP This option is only displayed when a traverse table is connected to the system. On selection the operator will be prompted to enter a value from the keyboard. This will then be set as the appropriate end stop.

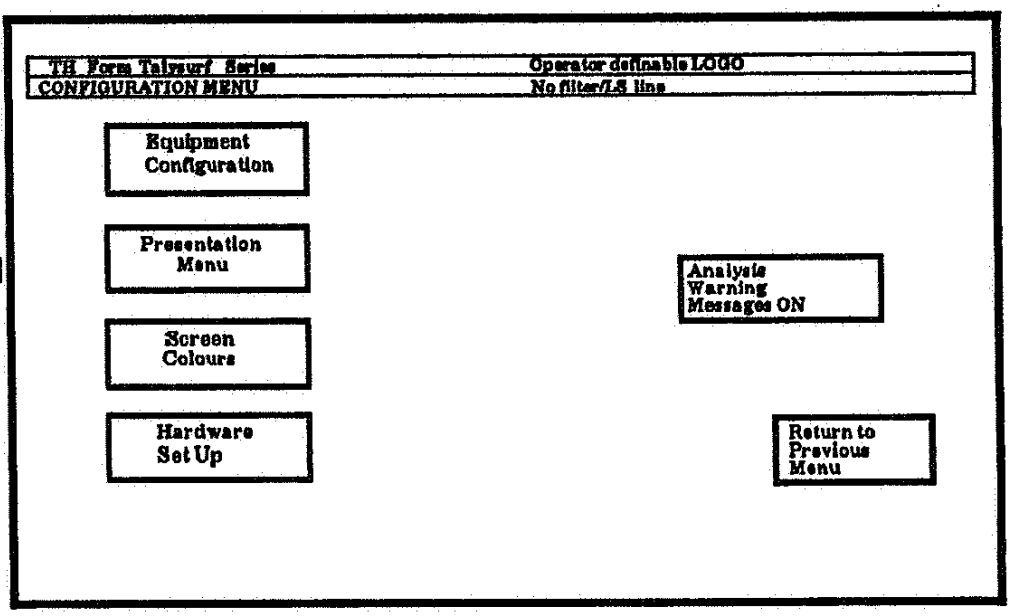
TRAVERSE TABLE BACK END STOP This option is only displayed when a traverse table is connected to the system. On selection the operator will be prompted to enter a value from the keyboard. This will then be set as the appropriate end stop.

Note Entries which conflict with the current axis position are detected and not allowed.

RETURN TO PREVIOUS MENU Returns operation to the Menu from which the CALIBRATE END STOPS MENU was accessed.

CONFIGURATION MENU

CONFIGURATION MENU



DESCRIPTION This option enables the operator to define the system configuration to the computer.

EQUIPMENT CONFIGURATION Selecting this option causes the CONFIGURATION - EQUIPMENT MENU to be displayed.

PRESENTATION MENU Selecting this option causes the PRESENTATION MENU to be displayed.

SCREEN COLOURS Selecting this option causes the SET SCREEN COLOURS MENU to be displayed.

HARDWARE SETUP Selecting this option causes the HARDWARE CONFIGURATION MENU to be displayed.

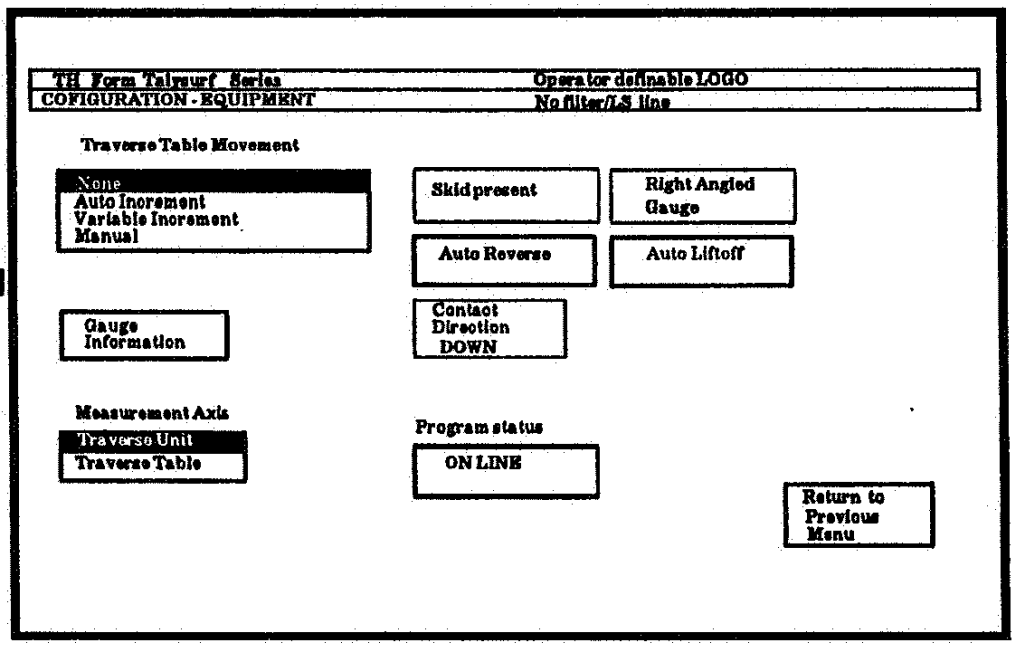
ANALYSIS WARNING MESSAGES This option enables the analysis warning messages to be turned OFF or ON, as required.

These messages can be displayed on the results page after an analysis is complete and provide a warning about the current state of the results.

RETURN TO PREVIOUS MENU Returns operation to the Main Menu.

CONFIGURATION EQUIPMENT MENU

EQUIPMENT CONFIGURATION MENU



DESCRIPTION This option enables the operator to inform the computer of the various parts of the system and their required mode of operation.

TRAVERSE TABLE MOVEMENT: NONE This option is used when either no traverse table is connected or if all measurements are to be made with the Traverse unit, with the Traverse table remaining stationary.

TRAVERSE TABLE MOVEMENT: AUTO INCREMENT This option is used when the traversing table is to make successive indexing traverses, automatically spaced apart at equal preselected intervals after completion of the measurement traverse.

TRAVERSE TABLE MOVEMENT: VARIABLE INCREMENT This option is used when the traversing table is to make successive measurement traverses, spaced apart at unequal intervals.

TRAVERSE TABLE MOVEMENT:MANUAL This option should be selected when the traversing table is to make measurement traverses under manual control.

GAUGE INFORMATION This option displays the GAUGE INFORMATION MENU, and is used to select or modify specific gauge details. See **GAUGE INFORMATION MENU** for further details.

MEASUREMENT AXIS This option enables either the traverse unit or a traversing table to be selected to make the measurement traverse. Selection of the Traverse Unit as the measurement axis will cause all measurements to be performed by the Traverse Unit and all spacing motions by the Traversing Table.

Selection of the Traverse Table as the measurement axis will cause all measurements to be performed by the Traverse Table and all spacing motions by the Traverse Unit.

SKID PRESENT The Skid Present option must be selected, as appropriate, to inform the computer of the presence of a skid nosepiece on the pick-up. This option serves to set the gain of the automatic stopping circuit used on the column and for satisfactory operation it must be set appropriately for the mode of pick-up operation. Incorrect setting will not result in damage but could lead to system oscillation on surface contact and failure to achieve a stable condition.

AUTO REVERSE When the Auto Reverse option is selected, the traverse unit (or the traversing table) is automatically returned to its start position on completion of a measurement. The stylus remains in contact with the component during the return traverse, unless the AUTO LIFT OFF option is also selected.

RIGHT ANGLED GAUGE In order to provide the appropriate corrections for the stylus geometry, this option must be selected when measurements are to be made at right angles to the direction of traverse, either by using a right angled pick-up or by mounting the Contour pick-up at right angles.

AUTO LIFT OFF When the Auto Liftoff option is selected, the stylus is lifted clear of the component on completion of a measurement and the traverse unit (or the traversing table) is automatically returned to its

start position (if Auto Return is also selected, otherwise the stylus will be just lifted off the surface).

If the Contour gauge is being used, then the absolute position for the gauge can be entered. The lift off height entered must be sufficient to cause the stylus to move away from the component.

CONTACT DIRECTION The contact direction of the gauge determines the direction of the column drive and **must** be correctly selected. Damage to the instrument may result if the wrong direction is selected.

This does not apply to the Contour pick-up or the P.G.I. gauge, the contact directions of which are automatically set. However, the P.G.I. gauge can be set in any position between UP and DOWN. In this case, the Contact Direction is shown as OFFSET, no Contact operation is permitted and the column drive can only be operated via the joystick control.

RETURN TO PREVIOUS MENU Returns operation to the Menu from which the CONFIGURATION-EQUIPMENT MENU was accessed.

Program Mode Measurement programs can be produced with the instrument ON LINE and interactively performing each command of the program as it is compiled or, with the instrument OFF LINE, by compiling a series of instructions which can be run only after the instrument has been restored to ON LINE.

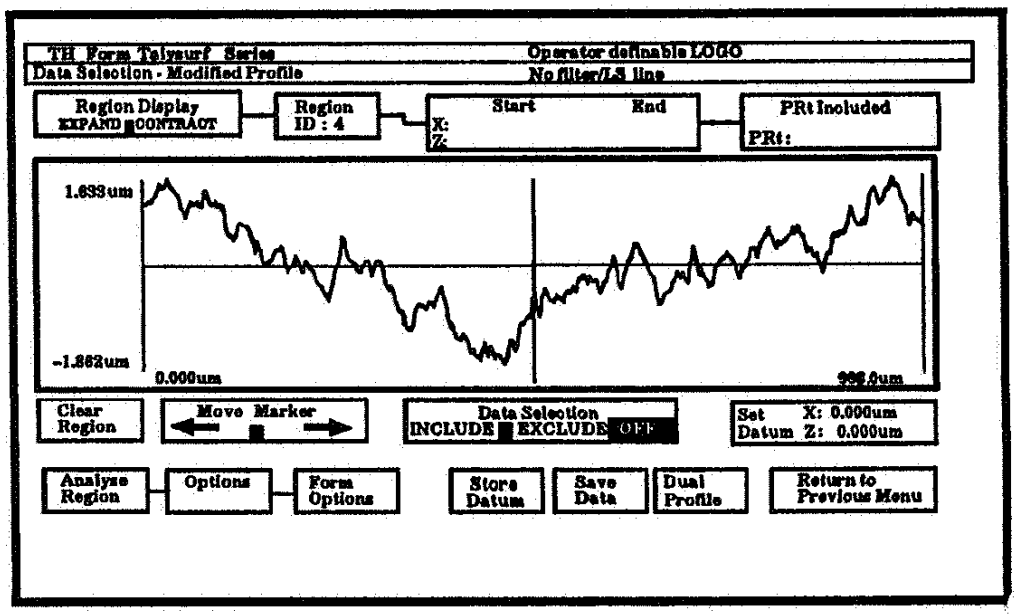
When a Data Collection or Analyse step is learned, the following option identifiers for the options selected are shown at the end of the relevant line in the program table:

L auto **L**ift off
R auto **R**everse
S **S**kid present
A right **A**ngled gauge present.

e.g. /**LRSA**

DATA SELECTION-MODIFIED PROFILE MENU

DATA SELECTION - MODIFIED PROFILE MENU



DESCRIPTION The functions of this menu is similar to the DATA SELECTION-RAW PROFILE menu, however the data has already been processed (modified) by arcuate correction and perhaps filtering.

This menu can only be accessed by selecting the modified profile window from the **Results** page.

The operator can select various areas for further analysis, view specific regions in greater detail, or exclude data from the mathematical fit of the selected reference.

Up to 5 pre-defined regions can be defined (and are programmable) for ease of analysis.

REGION DISPLAY: EXPAND If data has been excluded from the ends of the profile then this option will remove the ends of the current display and increase the horizontal resolution to fill the display with the remaining profile. Data excluded within the profile remains, and is still shown as excluded (shaded).

Note If data is only excluded from within the profile (i.e. the start and end are still included) then the EXPAND option will have no effect.

REGION DISPLAY: CONTRACT If the data has been expanded within the current region then the CONTRACT option will return the display to it's previous state, with the complete profile re-displayed.

REGION ID: On selection the operator will be prompted to enter a region number, valid entries being in the range of 0 to 4. These 5 regions can be used to pre-define Included and Excluded data, and are programmable. This can be of value when measuring repeated components of the same type where various analysis regions are required.

START-END (X,Z) This option will remain blank until either data is included or excluded. When values are displayed they refer to the Start position (in X and Z) of the first valid (Included) data point, and the End position (in X and Z) of the last valid (Included) data point.

CLEAR REGION Clears the currently selected region. All Included/Excluded areas will be removed and the complete profile is re-displayed.

Note If the Data Selection menu is left with a region set which is based on an expanded profile (other than region 0), the complete profile will not be displayed on the next measurement. This usually occurs after a new region has been selected (or re-defined). Therefore to display the complete profile select the CLEAR REGION option.

Only region 0 is cleared with each measurement.

MOVE MARKER: LEFT The marker (vertical cursor line) will move to the left as long as the option is selected or until it reaches the beginning of the profile region.

MOVE MARKER: RIGHT The marker (vertical cursor line) will move to the right as long as the option is selected or until it reaches the end of the profile region.

DATA SELECTION: INCLUDE After positioning the start (or end) point of the data to be analysed with the marker, selection of the INCLUDE option will cause all the remaining data to be excluded. The marker can then be moved Left or Right to select the area of profile to be included in the analysis.

If further regions are to be included then the DATA SELECTION option must be turned OFF and the marker re-positioned to the next area using the Left and/or Right Marker. The next area of included data can then be selected by selecting the INCLUDE option and again positioning the Marker as appropriate.

All Included data is shown outside of the shaded regions. Up to 7 included areas can be defined.

DATA SELECTION: EXCLUDE This option is similar to the Include option but works in reverse (i.e. Excludes data not Includes data). Operation is the same as for the Include option but selecting the Exclude option in it's place.

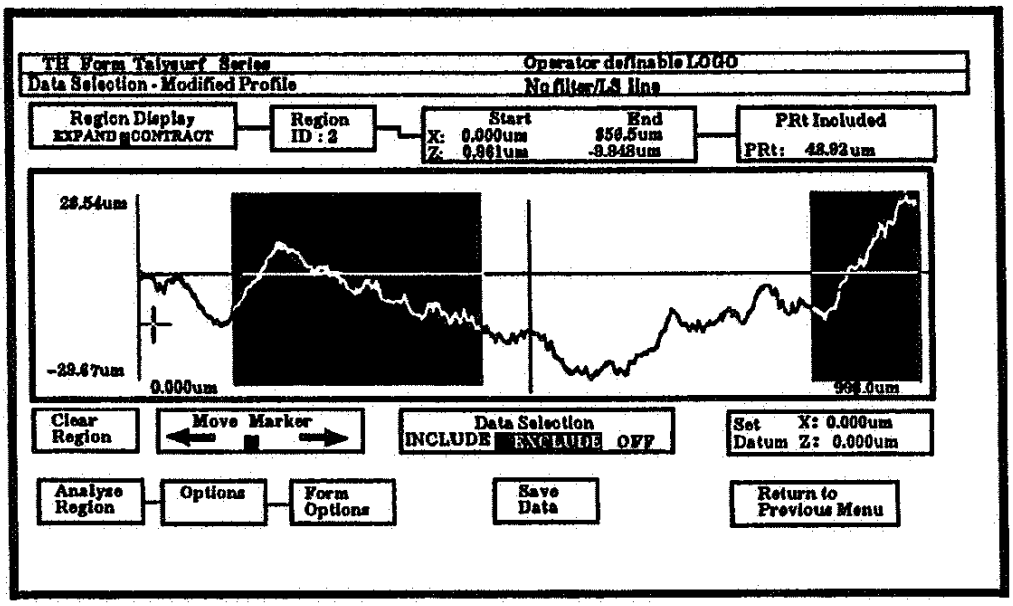
All Excluded data is shown shaded, i.e. Included data is shown outside the shaded areas. Up to 7 excluded areas can be defined.

Note Since the Include and Exclude options are very similar, the choice of which one to use is dependent on the ratio of excluded to included data.

Note The result will always be to exclude the shaded areas from the calculation of the reference line. All data however will be used for parameter calculation.

Note If data is excluded from the ends of the profile (or data is Included within the profile) then unless this region is expanded, all data including the ends will be used in the parameter calculation.

EXCLUDED DATA IS SHOWN SHADED



SET DATUM This allows the current marker position to be used as a Datum. I.E. all values are referenced to zero in both X and Z dimensions to the current intersection point of the profile and Marker. The values displayed will be set to ZERO at the time of selection. The markers new position will be displayed after movement is completed and will be referenced to the new datum position.

ANALYSE REGION Causes the currently Included (i.e. not shaded) data to be analysed to the current reference line, after which, ALL data is analysed to the filter and parameter options selected.

PROFILE DISPLAY AREA The horizontal (x) position of the marker can be set directly or moved to a required location, by selecting the position on the profile where the marker is required. On selection, by clicking a button on the mouse, the marker moves directly to the indicated position. If the mouse button is held down and the mouse is moved to the left or right, then the marker line moves as a cursor and can be placed at the required position.

When directly moving the marker in this manner, the following functions are available:

1. If the marker is moved when the DATA SELECTION is **OFF**, them the marker is moved to the required position, as described above.
2. If the marker is moved when the DATA SELECTION is set to **INCLUDE**, then the the area between the previous and current marker positions is included.
3. If the marker is moved when the DATA SELECTION is set to **EXCLUDE**, then the the area between the previous and current marker positions is excluded.

OPTIONS Displays the Filter & Parameter Selections Menu where either the filters and/or parameters can be changed prior to analysis with the ANALYSE REGION option.

See **FILTER & PARAMETER SELECTIONS MENU** for further details.

FORM OPTIONS Displays the Form Options Menu. From this menu, the selection of the Reference line can be made.

See **FORM OPTIONS MENU** for further details.

STORE DATUM Selecting this option causes the whole modified profile to be stored as a reference against which subsequently obtained modified profiles can be compared.

The **Store Datum** option is only available if **Dual Profile - Continuous** is selected from the PRESENTATION MENU.

SAVE PROFILE Displays the Saving Data Menu to allow the raw profile, modified profile or parameter values to be saved or transmitted. See **SAVING DATA MENU** for further details.

DUAL PROFILE Selecting this option causes the **DUAL PROFILE MENU** to be displayed. This option is only available if either:

Dual Profile - Template is selected from the PRESENTATION MENU.

or

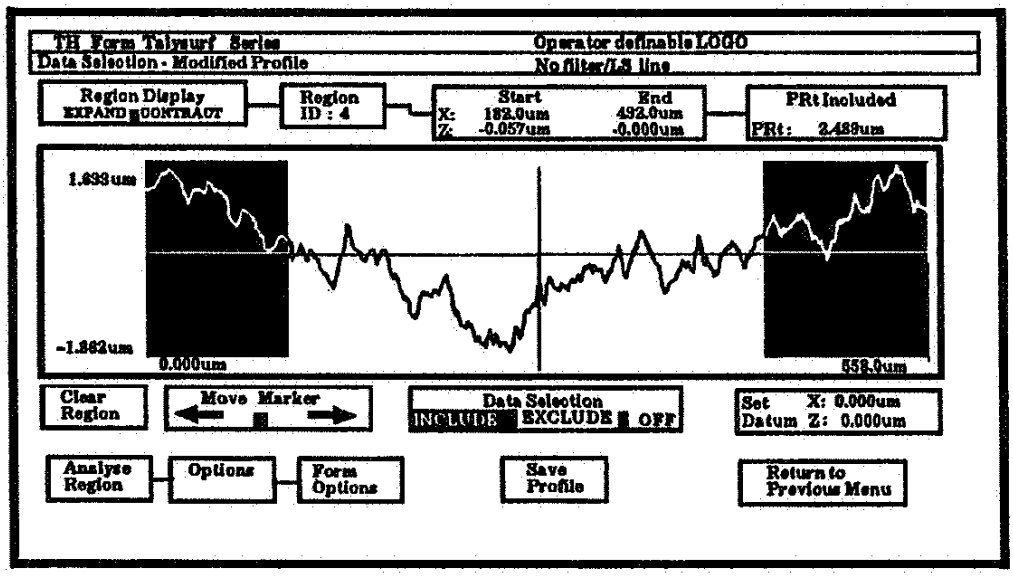
Dual Profile - Continuous is selected from the **PRESENTATION MENU** and a reference profile is stored via the **Store Datum** option of this menu.

See **DUAL PROFILE MENU** for further details.

Rt INCLUDED Gives a value of the Peak to Valley measurement of all the included data in the current display. Movement of the Marker or changing the region will cause the displayed values to be cleared.

Note When first entering the menu a value is displayed (Rt, WRt, PRt depending on which filter mode)

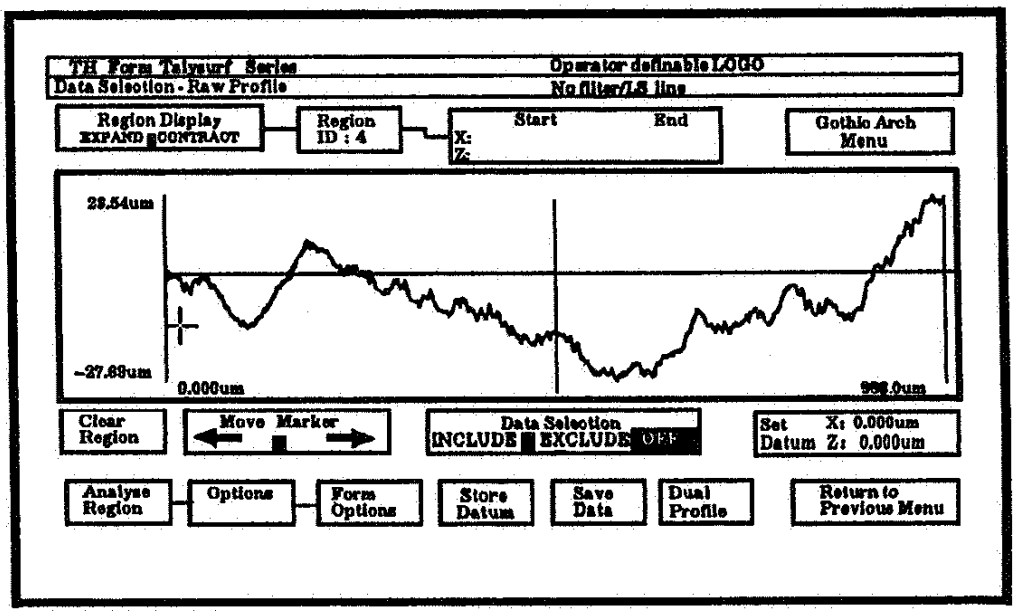
DATA SELECTION - MODIFIED PROFILE MENU (Rt included)



RETURN TO PREVIOUS MENU Returns operation to the Menu from which the DATA SELECTION MODIFIED PROFILE was accessed.

DATA SELECTION-RAW PROFILE MENU

DATA SELECTION - RAW PROFILE MENU



DESCRIPTION The Data Selection-Raw Profile Menu is displayed after a Data Collection, on selection of RAW-DATA SELECTION from the Results page, or when key F5 is pressed.

The operator can select various areas for further analysis, view specific regions in greater detail, or exclude data from the mathematical fit of the selected reference.

Up to 5 pre-defined regions can be defined (and are programmable) for ease of analysis.

If region 0 is used, then after a new data collection is made, this region will always be cleared so that all of the raw data is displayed.

CAUTION The data displayed is RAW data and is subject only to the A calibration constant (linear correction), no arcuate corrections have been applied. Therefore this display should only be used for selection of the data prior to further analysis, and not for direct measurements from the screen or it's nominal

screen dimensions (e.g. Peak to Valley, Traverse Length).

REGION DISPLAY: EXPAND If data has been excluded from the ends of the profile then this option will remove the ends of the current display and increase the horizontal resolution to fill the display with the remaining profile. Data excluded within the profile remains, and is still shown as excluded (shaded).

Note If data is only excluded from within the profile (i.e. the start and end are still included) then the EXPAND option will have no effect.

REGION DISPLAY: CONTRACT If the data has been expanded within the current region then the CONTRACT option will return the display to it's previous state, with the complete profile re-displayed.

REGION ID: On selection the operator will be prompted to enter a region number, valid entries being in the range of 0 to 4. These 5 regions can be used to pre-define Included and Excluded data, and are programmable. This can be of great value when measuring repeated components of the same type where various analysis regions are required.

START-END (X,Z) This option will remain blank until either data is included or excluded. When values are displayed they refer to the Start position (in X and Z) of the first valid (Included) data point, and the End position (in X and Z) of the last valid (Included) data point.

GOTHIC ARCH MENU This option is available only when the appropriate dongle is fitted. Selecting this option causes the Gothic Raw data menu to be displayed. Details of this analysis are given in GOTHIC ARCH ANALYSIS in Section 5

CLEAR REGION Clears the currently selected region. All Included/Excluded areas will be removed and the complete profile is re-displayed.

Note If the Data Selection menu is left with a region set which is based on an expanded profile (other than region 0), the complete profile will not be displayed on the next next measurement This usually occurs after a new region has been selected or (re-defined) as may occur when multiple operators are used. Therefore to display the complete profile select the CLEAR REGION option.

Only region 0 is cleared with each measurement.

MOVE MARKER: LEFT The marker (vertical cursor line) will move to the left as long as the option is selected or until it reaches the beginning of the profile region.

MOVE MARKER: RIGHT The marker (vertical cursor line) will move to the right as long as the option is selected or until it reaches the end of the profile region.

DATA SELECTION: INCLUDE After positioning the start (or end) point of the data to be analysed with the marker, selection of the INCLUDE option will cause all the remaining data to be excluded. The marker can then be moved Left or Right to select the area of profile to be included in the analysis.

If further regions are to be included then the DATA SELECTION option must be turned OFF and the marker re-positioned to the next area using the Left and/or Right Marker. The next area of included data can then be selected by selecting the INCLUDE option and again positioning the Marker as appropriate.

All Included data is shown outside of the shaded regions. Up to 7 included areas can be defined.

DATA SELECTION: EXCLUDE This option is similar to the Include option but works in reverse (i.e. Excludes data not Includes data). Operation is the same as for the Include option but selecting the Exclude option in it's place.

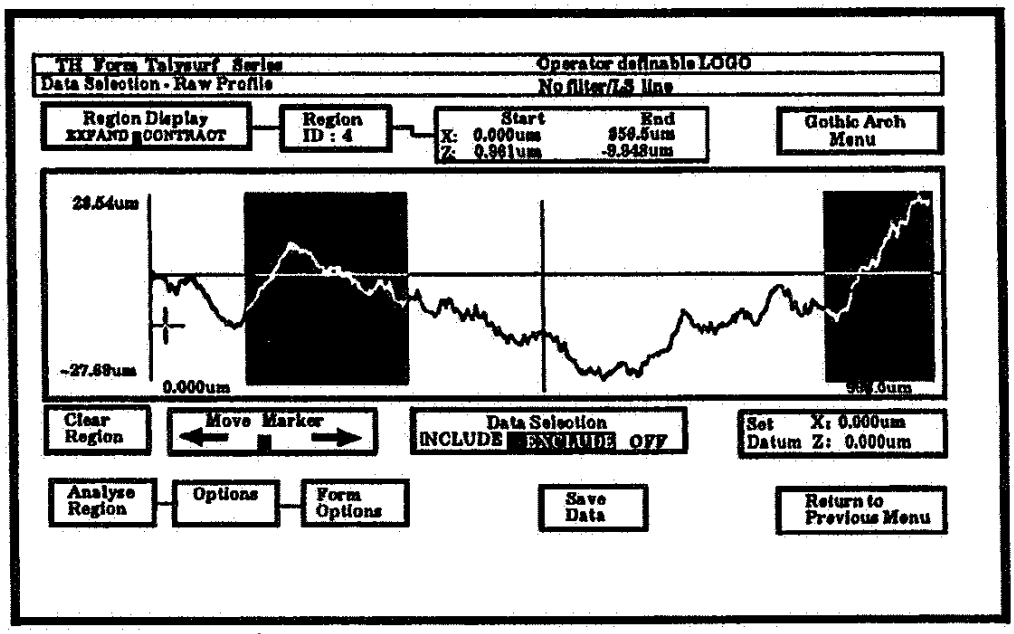
All Excluded data is shown shaded, i.e. Included data is shown outside the shaded areas. Up to 7 excluded areas can be defined.

Note Since the Include and Exclude options are very similar, the choice of which one to use is dependent on the ratio of excluded to included data.

Note The result will always be to exclude the shaded areas from the calculation of the reference line. All data however will be used for parameter calculation.

Note If data is excluded from the ends of the profile (or data is Included within the profile) then unless this region is expanded, all data including the ends will be used in the parameter calculation.

EXCLUDED DATA IS SHOWN SHADED



SET DATUM This allows the current marker position to be used as a Datum. I.E. all values are referenced to zero in both X and Z dimensions to the current intersection point of the profile and Marker. The values displayed will be set to ZERO at the time of selection. The markers new position will be displayed after movement is completed and will be referenced to the new datum position.

ANALYSE REGION Causes the currently Included (i.e. not shaded) data to be analysed to the current reference line, after which, ALL data is analysed to the filter and parameter options selected

PROFILE DISPLAY AREA The horizontal (x) position of the marker can be set directly or moved to a required location, by selecting the position on the profile where the marker is required. On selection, by clicking a button on the mouse, the marker moves directly to the indicated position. If the mouse button is held down and the mouse is moved to the left or right, then the marker line moves as a cursor and can be placed at the required position.

When directly moving the marker in this manner, the following functions are available:

1. If the marker is moved when the DATA SELECTION is **OFF**, them the marker is moved to the required position, as described above.
2. If the marker is moved when the DATA SELECTION is set to **INCLUDE**, then the the area between the previous and current marker positions is included.
3. If the marker is moved when the DATA SELECTION is set to **EXCLUDE**, then the the area between the previous and current marker positions is excluded.

OPTIONS Displays the Filter & Parameter Selections Menu where either the filters and/or parameters can be changed prior to analysis with the ANALYSE REGION option. See **FILTER & PARAMETER SELECTIONS MENU** for further details.

FORM OPTIONS Displays the Form Options Menu, where the selection of Reference line can be made.

See **FORM OPTIONS MENU** for further details.

STORE DATUM Selecting this option will cause the whole raw profile to be stored as a datum against which subsequently obtained modified profiles can be compared.

The **Store Datum** option is only available if **Dual Profile - Continuous** is selected from the PRESENTATION MENU.

SAVE DATA Displays the Saving Data Menu to allow the RAW PROFILE to be saved or transmitted.

See **SAVING DATA MENU** for further details.

DUAL PROFILE Selecting this option causes the **DUAL PROFILE MENU** to be displayed.

This option is only available if either:

Dual Profile - Template is selected from the PRESENTATION MENU.

or

Dual Profile - Continuous is selected from the **PRESENTATION MENU** and a reference profile is stored via the **Store Datum** option of this menu.

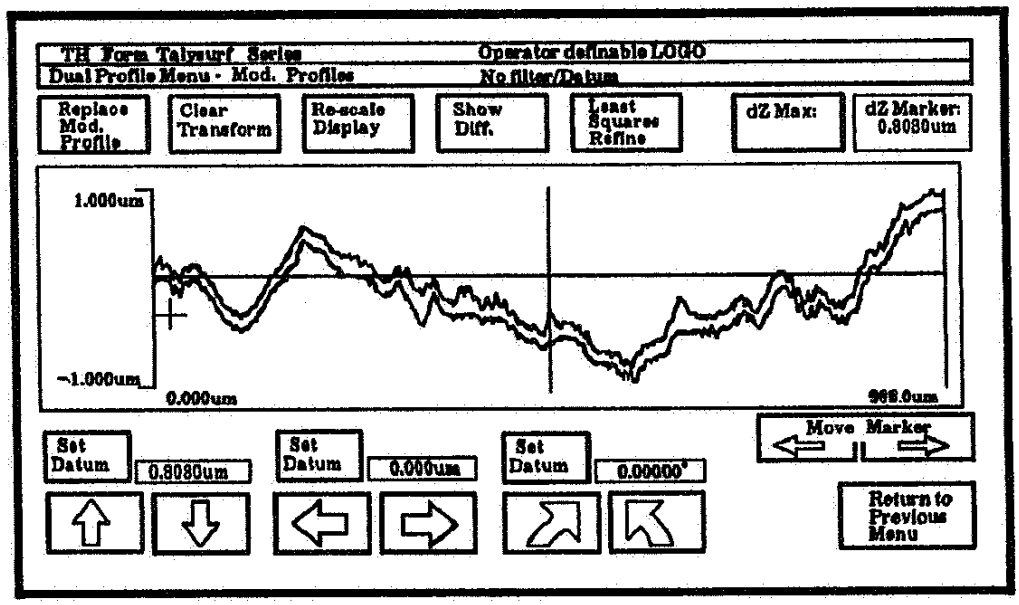
See **DUAL PROFILE MENUS** for further details.

PITCH AND SLOPE Pitch or Slope parameters are automatically calculated when subsequent analyses are made from this menu (see PITCH and SLOPE in section 6 - PARAMETERS, DEFINITIONS AND THEORY).

RETURN TO PREVIOUS MENU Returns operation to the Menu from which the **DATA SELECTION-RAW PROFILE** was accessed.

DUAL PROFILE MENU

DUAL PROFILE MENU



DESCRIPTION This menu is displayed when the **Dual Profile option is selected from a Data Selection** menu.

The menu carries the stored datum profile and the profile under test. These profiles are presented at the same scale and are sized to fit the display. The menu provides three sets of arrows which enable the test profile to be moved (transformed) vertically, horizontally or rotated about the point at which the marker intersects the profile. Each set of arrows has an associated box in which the displacement of the test profile in the direction of the arrows is displayed.

A print of dual profile will be automatically scaled in the vertical axis and the horizontal scale will be that set in the SCALING MENU.

NOTE Profile rotation is limited to approximately 6[illegible] degrees.

When Dual Profile assessment is included in a program, the program pauses at the Dual Profile

menu to allow test profile manipulation. All the facilities available from the top row of option boxes on this menu, can be learned and executed in a program. In program EDIT mode, only one step at a time can be learned.

To allow the residual display (see the SHOW DIFF. paragraph on the next page) to be reached and the step to be learned, a pop-up window is displayed when the SHOW DIFF. option is selected. Show difference may not be required, as a separate step, if a residual print/display/replacement is required as the step.

The Dual Profile step in the program table has the format: **Dual Profile (C)** or **Dual Profile (T). Where C** denotes Continuous mode and **T** denotes Template mode.

SET DATUM Each pair of test profile movement arrows has a SET DATUM option. Selecting this option, cancels any movement of the profile which has been generated by the associated pair of arrows. The displacement counter for the arrows is set to zero and the displayed test profile is accordingly repositioned.

Movement of the profile made by the other sets of arrows is not affected.

MOVE MARKER The marker line (which provides the rotation pivot point for the test profile) will move, in the direction of the selected arrow.

REPLACE MOD. PROFILE This facility is only available for use with MODIFIED PROFILE data.

Selecting this option causes the transformed test profile data to replace the current modified profile data. This allows the operator to return to the Results Page and perform a re-analysis which will recalculate the parameter values based on the transformed modified profile.

Selecting this option when the residual profile is displayed (see SHOW DIFF. option below), causes the residual data to replace the modified profile data. Parameter calculations can then be made on the residual data. This process can require extended computation time, in which case a message is displayed indicating that the computer is busy.

NOTE If the INVERT DISPLAY option is on (see FORM OPTIONS MENU), then, when displayed as a test profile in the dual display, the replaced modified profile will also be inverted.

CLEAR TRANSFORM Resets the test profile to its position prior to any transformations being made.

RE-SCALE DISPLAY When a large transformation displaces the full test profile from the display, selecting this option automatically rescales the display to show both full profiles.

SHOW DIFF. Selecting this option causes a display to be given of the differences between the datum profile and the test profile as displayed on the screen.

The profile displayed is derived from the residual vertical differences between the datum profile and the test profile at all points of coincidence along their lengths. As the calculation of the difference values is based on the test profile data, the number of points in the residual profile is equal to,or less than, the number of points in the test profile.

When the residual profile is displayed, the SHOW DIFFERENCE option is replaced by the option RETURN TO DUAL. This enables a return to be made to the dual profile display. All other options are locked and inoperative except the RETURN TO PREVIOUS MENU option.

Printing the residual profile will result in a low resolution printout, which corresponds to the screen display. If a high resolution printout is

required, then the REPLACE MODIFIED PROFILE facility can be used with a subsequent printout of the modified profile. The vertical and horizontal scale of the print will be that which is set in the SCALING MENU.

The Difference profile, as shown, is not affected by the INVERT DISPLAY and FORM options (see FORM OPTIONS menu).

LEAST SQUARES REFINE This facility is only available for use with MODIFIED PROFILE data.

A refinement of the test profile, after completing transformations, using a least squares algorithm for data overlapping in the X axis, can be applied by selecting this option.

The boxes which indicate the displacement of the test profile are updated accordingly. The starting X value of the profile is not altered by the refinement process.

dZ MAX: The maximum vertical distance separating the profiles is displayed. If the test profile is subsequently transformed, this value will disappear and the **dZ MAX** box must then be selected to obtain an up-to-date value.

dZ MARKER: The vertical distance separating the profiles, at the marker position, is displayed.

RETURN TO PREVIOUS MENU Returns operation to the **DATA SELECTION MENU.**

LEARN MENU If, when a program is being edited, the DUAL PROFILE MENU is selected, then the option LEARN MENU replaces the option to RETURN TO PREVIOUS MENU. LEARN MENU must be selected to include the DUAL PROFILE MENU in the program.

Notes a) For accurate Dual Profile measurement it is recommended that the Modified Profile is used (assessed with a DATUM reference). Care

should be taken when using a RAW Profile since the data is not corrected for arcuate stylus motion.

b) When Modified Profile data is used for Dual Profile analysis, the Raw Data for the test profile is discarded and cannot be restored from the computer memory.

c) Only profiles of the same type can be compared (i.e.Raw Profile with Raw Profile or Modified Profile with Modified Profile).

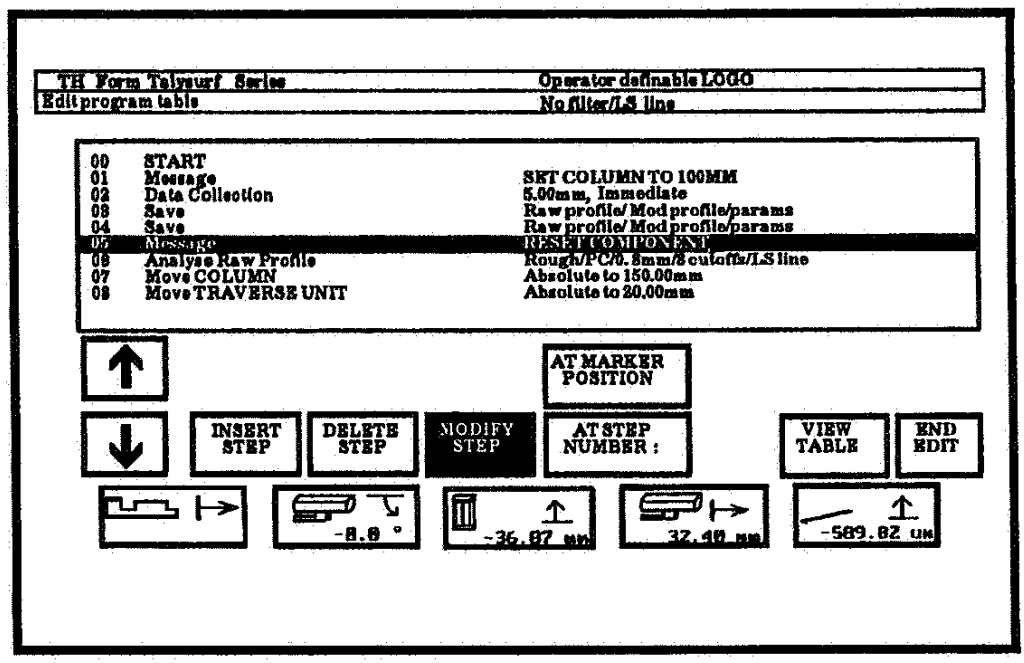
d) In program EDIT mode, selecting any of the movement or SET DATUM windows will store the step so that when the program is run, it will pause, to allow profile manipulation. Selecting any of the other windows will store the step associated with that Dual Profile feature.

e) There is a limit to the rotation of the profile to ensure that the X start of the profile is always less than the X end of the profile.

NOTE For explanations of the Continuous and Template modes and general details for using the dual profile facility see MAKING A DUAL PROFILE MEASUREMENT in Section 5.

EDIT PROGRAM TABLE MENU

EDIT PROGRAM TABLE MENU



Note This menu is **not** available with Form Talysurf Series E software

DESCRIPTION A tabular form is used to display the Program steps, the step number, step description and relevant parameters. Scrolling up and down the table is performed by moving the highlight bar up and down the table using the arrow boxes. A program can comprise up to 200 steps. Single program steps can be modified or deleted, and new steps inserted.

When this menu is displayed, a print of the program listing can be obtained by pressing function key F7.

INSERT STEP This option will allow a new program step to be inserted either before the current marker position or before a specific step number. After selecting the insertion location of a new program step the operator is returned to the MAIN MENU where

the required menu command can be performed to enter the new program step

BEFORE CURRENT MARKER If **INSERT STEP** was selected this option will allow a new program step to be entered immediately before the current marker (highlight) position.

AT MARKER POSITION If **MODIFY STEP** was selected then the current program step (highlighted) will be modified.

If **DELETE STEP** was selected then the program step highlighted at the current marker position will be deleted.

BEFORE STEP NUMBER If **INSERT STEP** was selected this option will allow a new program step to be entered immediately before a specific step number. The operator is prompted to enter the required step number.

AT STEP NUMBER If **MODIFY STEP** was selected, then the specified step number will be modified. The operator is prompted to enter the required step number.

If **DELETE STEP** was selected this option will delete a step at a specific step number. The operator is prompted to enter the required step number.

MODIFY STEP Will return the operator to the MAIN MENU where the selected step can be modified as per the new programmed command.

VIEW TABLE This option will allow a larger display of the program table to be shown.

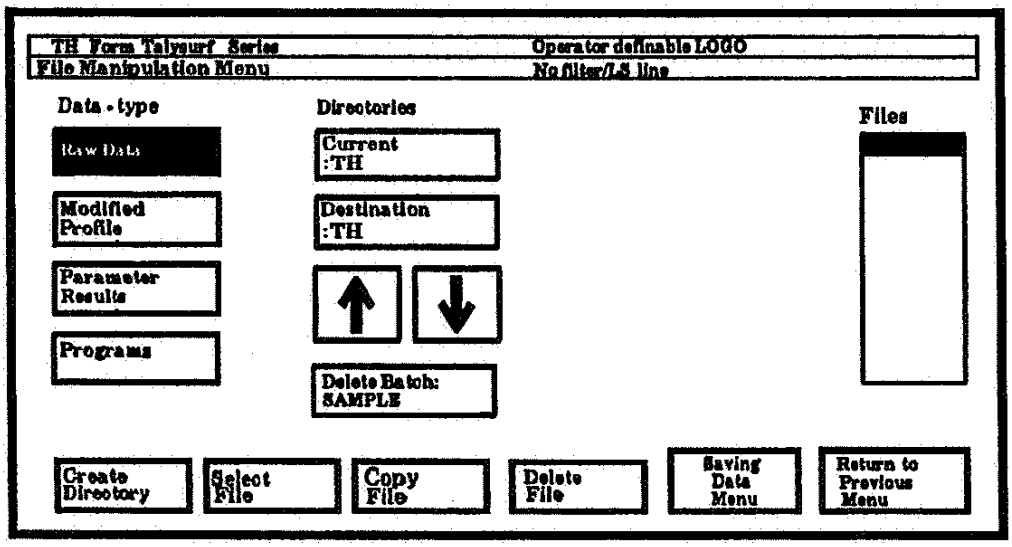
See **VIEW TABLE MENU** for further details.

END EDIT This completes program editing and returns the operator to the PROGRAM MENU, where the modified program should now be saved o abandoned.

RETURN TO PREVIOUS MENU Returns operation to the Menu from which the EDIT PROGRAM TABLE MENU was accessed.

FILE MANIPULATION MENU

FILE MANIPULATION MENU



DESCRIPTION The File Manipulation Menu allows the operator to view, select, copy & delete files as well as creating sub directories in an MS-DOS format without any requirement of programming knowledge. The file types that can be saved are:

Raw Data
Modified Profile
Parameter Results
Programs

The current directory to which the analysis details are saved can be a floppy disk. If this is the case, then a floppy disk must be present in the drive.

RAW DATA When highlighted, the file listing box displays all available stored Raw Data files.

If a large number of Raw Data profiles have been saved, they may not all fit into the display window. To scroll the list, select the UP/DOWN arrows and move the highlight marker to the bottom of the list. When the highlight has reached the last entry, continued selection causes the list to scroll upwards until the last file on the list is visible. This procedure can also be used from the top of the list, to scroll back.

MODIFIED DATA When highlighted, the file listing box displays all available stored modified data files.

If a large number of Modified profiles have been saved, they may not all fit into the display window. To scroll the list, select the UP/DOWN arrows and move the highlight marker to the bottom of the list. When the highlight has reached the last entry, continued selection causes the list to scroll upwards until the last file on the list is visible. This procedure can also be used from the top of the list, to scroll back.

PARAMETER RESULTS When highlighted, the file listing box displays all available stored Parameter Result files.

If a large number of Parameter results have been saved, they may not all fit into the display window. To scroll the list, select the UP/DOWN arrows and move the highlight marker to the bottom of the list. When the highlight has reached the last entry, continued selection causes the list to scroll upwards until the last file on the list is visible. This procedure can also be used from the top of the list, to scroll back.

PROGRAMS When highlighted, the file listing box displays all available stored measurement Program files.

If a large number of measurement Programs have been saved, they may not all fit into the display window. To scroll the list, select the UP/DOWN arrows and move the highlight marker to the bottom of the list. When the highlight has reached the last entry, continued selection causes the list to scroll upwards until the last file on the list is visible. This procedure can also be used from the top of the list, to scroll back.

CURRENT (directory) To change the **CURRENT** directory, select the CURRENT box. The list of existing directories is then displayed. Use the UP/DOWN arrows to highlight the directory required in the Directory listing box, and then select the SELECT File box.

If a large number of directories have been created, they may not all fit into the display window. To scroll the list, select the up / down arrows and move the highlight marker to the bottom of the list. When the highlight has reached the last entry, continued selection causes the list to scroll upwards until the last directory on the list is visible. This procedure can also be used from the top of the list, to scroll back.

Each directory retains the analysis details selected when it was last in use as the current directory. When a directory is restored as the current directory, the retained analysis details are automatically loaded. This makes it possible to have a number of analysis set-ups which can be rapidly recalled by simply changing directories.

DESTINATION (directory) To change the **DESTINATION** directory, select the DESTINATION box. The list of existing directories is then displayed.

Use the UP/DOWN arrows to highlight the directory required in the Directory listing box, and then select the SELECT File box. If a large number of directories have been created, they may not all fit into the display window. To scroll the list, select the UP/DOWN arrows and move the highlight marker to the bottom of the list. When the highlight has reached the last entry, continued selection causes the list to scroll upwards until the last directory on the list is visible. This procedure can also be used from the top of the list, to scroll back.

Among the directories available are DISK A (and DISK B etc. and the RS232 port. Files can, therefore, be copied to these destinations.

DELETE BATCH This option is used to delete all of the directories (and their contents) which are saved under the entered batch name. On selection, of this option,

the current batch name is highlighted. Confirm that this is the required batch, by pressing the enter key, or enter the name of the batch to be deleted and press the enter key. The option to confirm or abandon the operation is then displayed. Select the option required to continue.

For details of batch mode operation, see SAVING DATA in section 5 and also the BATCH MODE option of the SAVING DATA MENU in section 4.

CREATE DIRECTORY Allows the creation of a new directory which can be used for subsequent storage of data and programs.

On selecting the **CREATE DIRECTORY** box, the operator is prompted to 'Enter Directory Name'.

Enter a suitable name followed by the **ENTER** key, the appropriate directory is now created.

Note Directories can only be created at the same level as the RTH directory.

SELECT FILE When the Select File box is selected, then the current file (Raw Data, Modified Data, Programs or Parameter results) which is highlighted in the file listing box is selected. This file can then be copied, deleted or transferred via the RS232 port.

When files are being selected, this option is available for **Raw Data** and **Program** files only. If, when the box is selected, the current filename is a Raw Data file, then the filename is entered as the **Data Source** in the MAIN MENU ready for reanalysis of the data. If the current filename is a program, then this file is loaded as the **Input program** in the PROGRAM MENU.

When selecting a directory, this option becomes **Select Directory,** and is used to select the directory required.

Note This method of file selection can also be used in place of entering the Program or Filename via the

keyboard as requested from the MAIN or PROGRAM menus.

COPY FILE Allows the selected file to be copied to the destination directory.

To copy a file, first select the required destination directory (this can be the current directory, if the file is to be copied and given a new name). Select the Copy File box. A prompt to Enter Destination Name is given (this is the name the file to be copied will have in the destination directory), enter the required filename. The highlighted file is copied into a new file in the destination directory.

NOTE When the COPY FILE operation is learned as a program step, the program table displays the Source Directory and file name and the Destination Directory and file name.

DELETE FILE Deletes the current highlighted file.

DELETE DIRECTORY When changing either the CURRENT or DESTINATION directory, this option replaces the DELETE FILE option. When selected, an option to confirm or abandon the operation is displayed. Select the option required to continue.

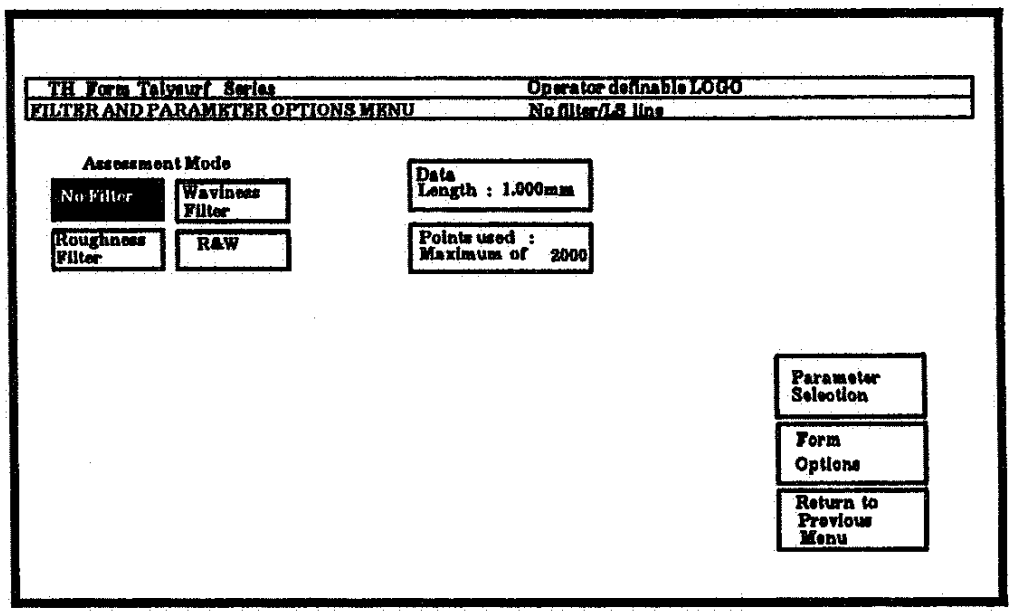
NOTE Confirming the delete operation, will cause all of the files in the directory and the directory itself to be deleted. The RTH directory is used as the default directory and cannot be deleted.

SAVING DATA MENU When selected, this option causes the **SAVING DATA MENU** to be displayed.

RETURN TO PREVIOUS MENU Returns the operator to the menu from which the operator entered the **FILE MANIPULATION MENU**.

FILTER & PARAMETER OPTIONS MENU

FILTER OPTIONS MENU (Unfiltered mode)



DESCRIPTION This menu allows the operator to select the appropriate Filter and associated Cut-off values required. It also provides access to the Parameter Selection Menu.

The filter options available depend on the filter mode selected. The filter type and cutoff length can then be selected in roughness or waviness mode. In unfiltered mode only the assessment length can be specified. Surface finish parameter selection is made in a separate menu, which is obtained by selecting the Parameter Selection box.

The Number of Cutoffs selection (available in roughness filter or waviness filter modes) is used to determine the assessment length in terms of the number of cutoffs and the cutoff length specified in the Filter Cutoff length selection. In No Filter and R&W modes, the option to select the maximum number of points to be used in the evaluation is given. This can be used to minimise results computation time.

ASSESSMENT MODE The choices for filter mode are: No Filter
Roughness Filter
Waviness Filter
R&W Mode.

CUTOFF LENGTH In roughness filter mode, the cutoff length is used to specify the high pass wavelength: lengths of 0.08, 0.25, 0.8, 2.5, 8.0 and 25.0 mm are available from the displayed options. In waviness filter mode, the cutoff length is used to specify the low pass wavelength: all of the displayed cutoff length options are available (from 0.0025 to 25.0 mm).

The availability of the extreme cutoff lengths depends on the data spacing used. An example of an invalid combination is the 25mm cutoff length with a data spacing of 0.25µm. In this case, the maximum traverse length (30mm) provides only 1 cutoff; which is insufficient for evaluation.

DATA LENGTH The **Data Length** (up to the full traverse length) can be entered. This determines the length of traverse for measurements initiated from **Data Source: Component** and **Immediate**.

NUMBER OF CUTOFFS / POINTS USED The number of cutoffs required for a roughness or waviness assessment are entered at this option. In the No Filter mode, the maximum number of data points to be used in the calculations can be entered.

In the Filtered mode, the Data Length can also be entered, subject to it being compatible with the selected cutoff length limitations, e.g. the Data Length selected must be a multiple of the selected cutoff and not exceed the length determined from the maximum **number of cutoffs** permitted.

Note If the entered value is a multiple then it will be rounded up, if it is too long it will be shortened.

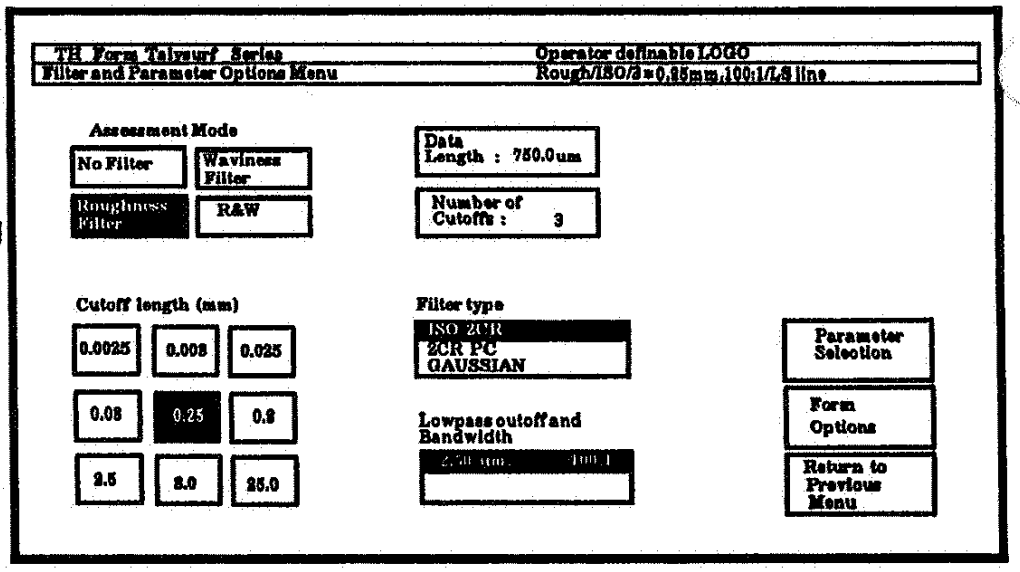
Up to 150 cutoffs, for roughness or waviness can be entered, except for the 2.5mm (0.1in), cutoff, which has a maximum of 48, the 8.0mm (0.3in) cutoff, which has a maximum of 15 and the 25.0mm (1.0in) cutoff, which has a maximum of 4.

In the NO Filter and R&W modes, selecting the Points Used option gives the operator the option to use all available data points (up to 120000) or to enter a reduced set of points. The maximum selectable reduced set is 8000 points. If all data points are used, then the computation times can be quite long. A typical value of 2000-4000 data points is more than adequate for most surfaces.

The maximum number of data points for the system is 120000. The system will datalog at 0.25µm intervals for traverses up to 30mm and for traverses in excess of 30mm data logging is at 1µm intervals.

FILTER TYPE The type of filter can be selected, when either the roughness or waviness filter modes are selected. The choices are:- ISO 2CR
2CR PC (phase corrected)
GAUSSIAN

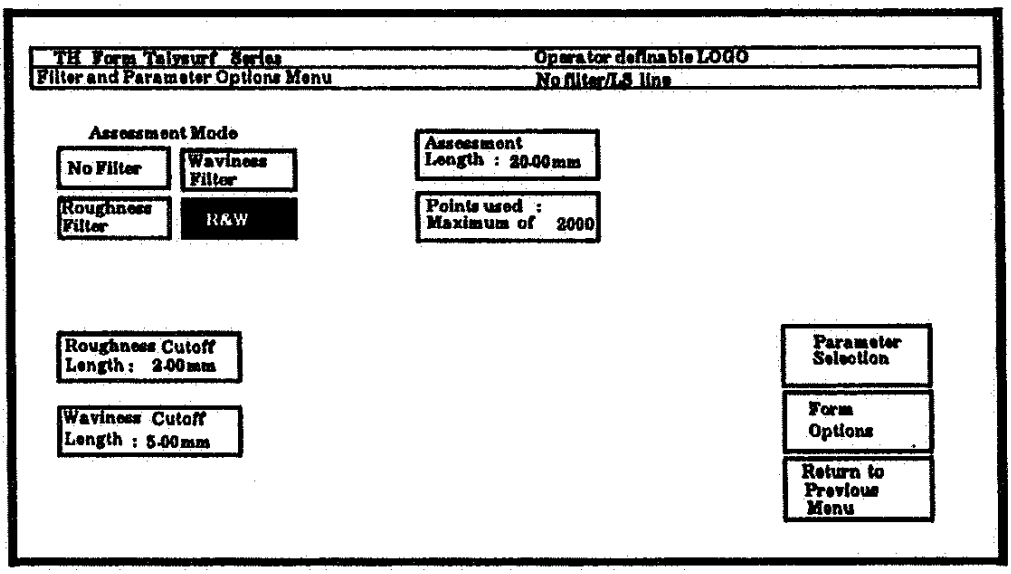
FILTER OPTIONS MENU (Roughness mode)



LOW PASS CUTOFF AND BANDWIDTH In roughness mode the low pass cutoff length and associated bandwidth needs to be specified. Bandwidths of 100:1, 320:1 (approximately) and 1000:1 are available and the associated low pass cutoff length is dependent upon the high pass cutoff length selected.

R &W When the R&W Assessment Mode is selected, the menu is revised to display only the relevant selections.

R&W ASSESSMENT MODE OPTIONS



ROUGHNESS CUT-OFF LENGTH A roughness cut-off length, between 0.05mm and 25.00mm (1.97min and 984.25min) can be entered.

WAVINESS CUT-OFF LENGTH A waviness cut-off length, between 0.05mm and 25.00mm (1.97min and 984.25min) can be entered.

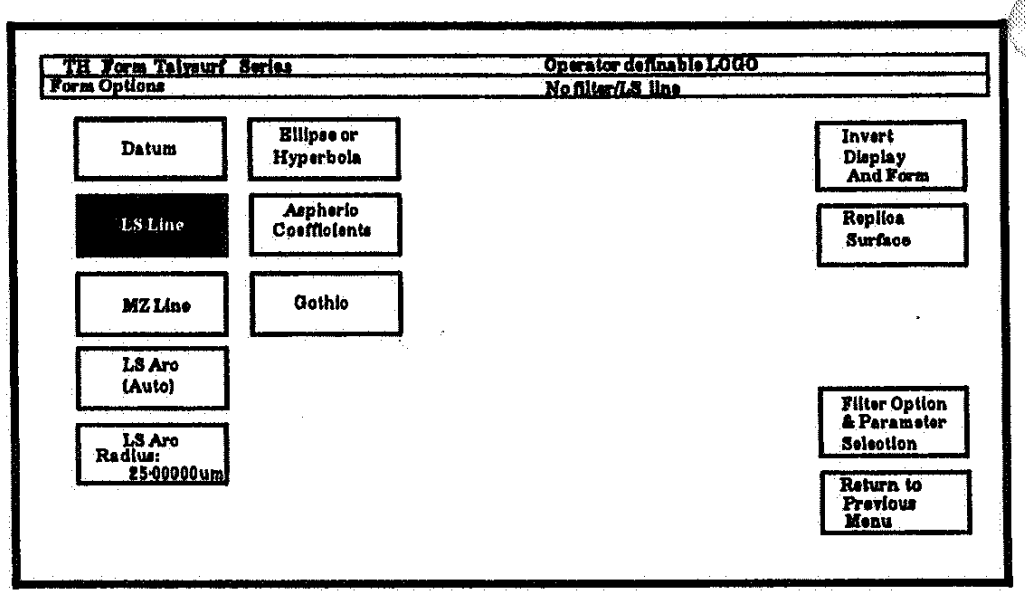
This value must equal to or less than the Data Length selected and must be greater than the value for the roughness cut-off length.

FORM OPTIONS Displays the **FORM OPTIONS MENU.**

RETURN TO PREVIOUS MENU Displays the menu from which the Filter and Parameter menu was originally selected.

FORM OPTIONS MENU

FORM OPTIONS MENU



DESCRIPTION This menu is a sub menu from the Main Menu but it can also be accessed from the Results Summary page or Data Selection pages. It allows the selection of the type of reference line to be calculated.

INVERT DISPLAY AND FORM This option is **not** available with Form Talysurf Series E software. When selected, all Raw and Modified Data displays and printouts are inverted. Also the slope of any line form fit is inverted for display and printout purposes. On Dual Profiles, the test profile is inverted but the datum profile remains unchanged.

When this option is selected, the letter I is added to the current filter and cut-off summary on the menu heading.

REPLICA SURFACE This option is **not** available with Form Talysurf Series E software. Selection of this option causes the gauge signal to be inverted, so that all analysis calculations and screen displays are based on inverted raw data. For Dual Profiles both the datum and the test raw profile are inverted. This option is for use when measuring a replica surface (in which the peaks of the original surface have

become valleys, the valleys have become peaks and its amplitude/distribution is inverted). When this option is selected, the letter R is added to the current filter and cut-off summary on the menu heading.

DATUM The **DATUM** reference causes the displayed data to be shown relative to the traverse datum. It is not modified (other than for arcuate correction) and will show any slope or other form in the measurement. This option is **not** available with Form Talysurf Series E software.

LS LINE This option is included in the **FORM SOFTWARE ONLY.**

The **LS LINE** reference is probably the most commonly used. A least squares best fit line is fitted to the data and the data is displayed relative to this line. Any slope therefore will be removed. This option should normally be selected for all surface finish measurements.

Note On systems not equipped with either of the Form option software packages, the LS reference is shown with slope removed.

MZ LINE This option is included in the **FORM SOFTWARE ONLY** and is **not** available with Form Talysurf Series E software.

This option fits 2 lines (not shown) to the measured data which are parallel, enclose all the data and have a minimum separation. The bisector of these 2 lines is shown as the Reference Line. A typical use, is for the assessment of straightness.

LS Arc (Auto) This option is included in the **FORM SOFTWARE ONLY** and is **not** available with Form Talysurf Series E software.

This option should be selected when measuring the Radius of curvature. A least squares best fit radius is fitted to the measured data, the CONVEX or CONCAVE shape being automatically determined

when an analysis is made. The analysis is indicated in results by "LS Rad".

LS Arc Radius: This option is included in the **FORM SOFTWARE ONLY** and is **not** available with Form Talysurf Series E software.

When this option is selected, the input of a radius value is requested. This radius provides a datum from which results obtained from measurements of concave or convex components are then calculated. The CONVEX or CONCAVE shape is automatically determined when an analysis is made. A least squares best fit radius is fitted to the measurement data, and the results are given as deviations of the measured data from the datum radius. This analysis is indicated in results by "AB Rad".

ELLIPSE OR HYPERBOLA This option is included only in the **EXTENDED FORM** software and the **CONIC FORM** software and is **not** available with Form Talysurf Series E software.

When this option is selected, a least squares best fit Ellipse or hyperbola (conic section) is fitted to the data. This option can be used when determining the radius of the Major and Minor axis curves of components having a conic form.

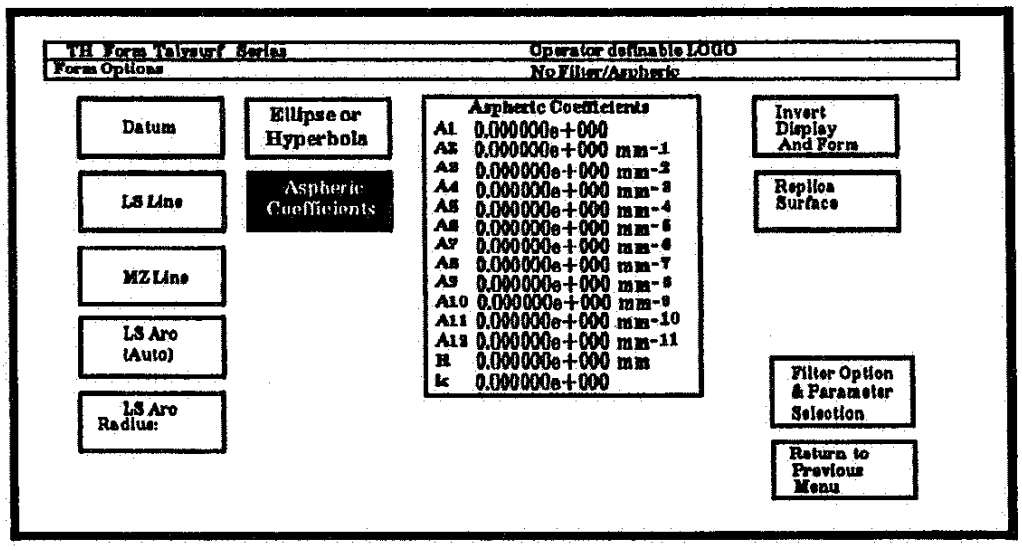
ASPHERIC COEFFICIENTS This option is included in the **EXTENDED FORM SOFTWARE ONLY** and is **not** available with Form Talysurf Series E software.

The analysis performed, when this option is selected, compares the results from measuring a surface with that of a theoretical surface which is defined by the equation:

$$Z = \left[\frac{X^2}{R + \sqrt{R^2 - (K+1)X^2}} \right] + A_1|X| + A_2X^2 + \ldots A_{20}X^{20}$$

When the ASPHERIC COEFFICIENT option is selected, a table of coefficients is displayed. The design details of the surface to be compared with the measured surface must be entered into this table. The values of the coefficients entered are

applied to the above formula. The general form is input as R, where a positive value denotes a convex form and a negative value denotes a concave form.



To enter the design data, select in the table box; the first coefficient is then highlighted. Enter the required value and press the Enter key. Each time the Enter key is pressed, the current value is entered and the highlight moves to the next coefficient. All entries must be completed, as exit from the list is only permitted when the highlight is on the **top** value.

The UP/DOWN arrows (↑ and ↓) on the keyboard can be used to move the highlight, if desired.

To enter exponent values , the data should be entered in the format: **1.23456E10**

The position of the decimal point is not restricted and the value will be normalised when entering e.g. **123.456E-10 = 1.23456E-8**

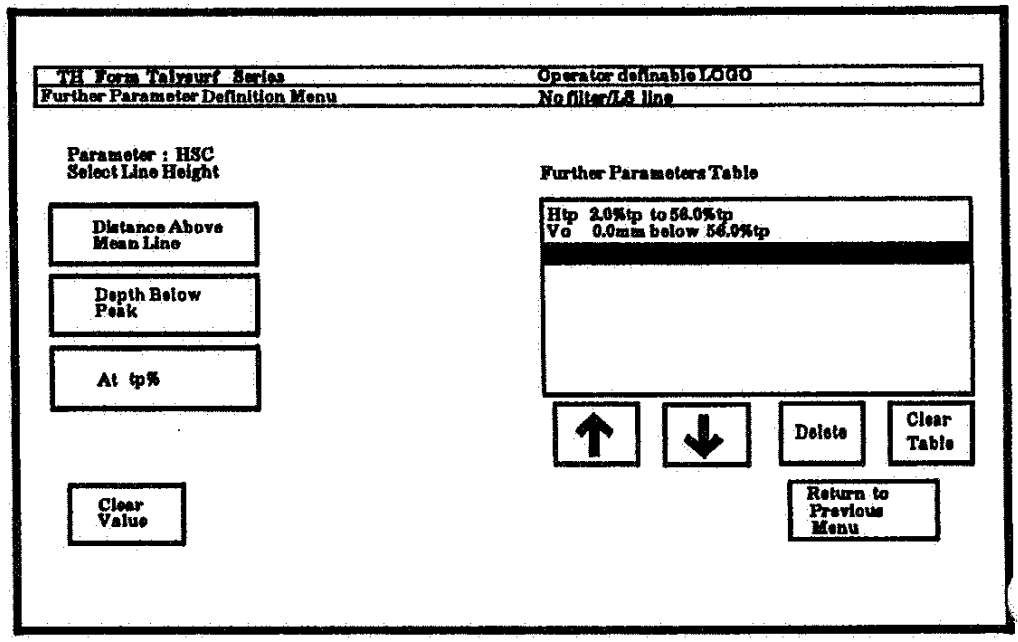
Note Concave base forms should be entered with a negative (-ve) radius value. Convex base forms have a positive (+ve) radius.

FILTER OPTIONS & PARAMETER SELECTION Displays the FILTER & PARAMETER OPTIONS menu.

RETURN TO PREVIOUS MENU Displays the menu from which the Form Options Menu was originally selected.

FURTHER PARAMETER DEFINITION MENU

FURTHER PARAMETER SELECTIONS MENU



DESCRIPTION This menu is accessed on selection of any of the further parameter selections (HSC, Pc, tp%, Htp and Vo) on the Parameter Selection menu. The menu comprises a table of all currently selected Further Parameters and their associated values, together with the facility for entering new values of the selected further parameter.

The actual options offered on this menu, are dependent on which parameter was selected from the Parameter Selection menu

The display also provides 2 arrows for movement of the cursor highlight up and down the further parameter table.

DELETE Deletes the currently Highlighted parameter from the table.

CLEAR TABLE On selection the operator is prompted to confirm the request to delete all entries in the table.

DISTANCE ABOVE MEAN LINE Available for HSC, Pc & tp% parameter selections.

This option sets the reference line for calculation of the appropriate parameter, negative (-ve) values will set this level BELOW the mean line.

When selected, the operator is requested to enter a value from the keyboard. When entered, an additional box is displayed requesting confirmation of the parameter selection. When confirmed the parameter is entered into the table.

DEPTH BELOW PEAK Available for HSC and Pc parameter selections. All values must be positive (+ve).

When selected the operator is requested to enter a value from the keyboard. When entered, an additional box is displayed requesting confirmation of the parameter selection. When confirmed the parameter is entered into the table.

AT Tp% Available for HSC and Pc parameter selections.

When selected the operator is requested to enter a value from the keyboard. The value must be in the range 0 to 100.

When entered an additional box is displayed requesting confirmation of the parameter selection. When confirmed the parameter is entered into the table.

BANDWIDTH Available for Pc parameter selection only.

When selected the operator is requested to enter a value from the keyboard.

When entered an additional box is displayed requesting confirmation of the parameter selection. When confirmed the parameter is entered into the table.

Note Conventionally the Pc parameter is evaluated over a Bandwidth which is spaced equally about the mean line, however by using the other reference methods the Bandwidth can be centred about any user definable position.

Note Either a **DISTANCE ABOVE MEAN LINE, DEPTH BELOW PEAK**, or **At tp%** must also be set before the parameter value can be entered into the table.

HEIGHT ABOVE VALLEY Available for tp% parameter selection only.

When selected the operator is requested to enter a value from the keyboard.

When entered an additional box is displayed requesting confirmation of the parameter selection. When confirmed the parameter is entered into the table.

FROM Available for Htp parameter selection only

When selected, the operator is requested to enter a value from the keyboard.

Note A corresponding TO value must also be set.

When entered, an additional box is displayed requesting confirmation of the parameter selection. When confirmed the parameter is entered into the table.

TO Available for Htp parameter selection only.

When selected, the operator is requested to enter a value from the keyboard.

Note A corresponding **FROM** value must also be set.

When entered, an additional box is displayed requesting confirmation of the parameter selection. When confirmed the parameter is entered into the table.

tp% Available for Vo parameter selection only.

When selected the operator is requested to enter a value from the keyboard.

When the value has been entered, an additional box is displayed requesting confirmation of the parameter selection. When confirmed the parameter is entered into the table.

tp% REFERENCE LEVEL

Available for tp% and Vo parameter selection.

When selected, the operator is requested to enter a value from the keyboard. This value must be entered with respect to the value of a second parameter, as follows:

tp% The tp% parameter requires that a corresponding **DEPTH BELOW REFERENCE LEVEL** must also be set before the parameter can be confirmed.

Vo The Vo parameter requires that a corresponding **BEARING AREA DEPTH must also be set before the parameter can be confirmed.**

When values for both the tp% REFERENCE LEVEL and its appropriate associated parameter have been entered, an additional box is displayed. This requests confirmation of the parameter selection. When confirmed, the parameter is entered into the table..

DEPTH BELOW REFERENCE LEVEL

Available for tp% parameter selection only and must be used in conjunction with the tp% REFERENCE LEVEL.

When selected, the operator is requested to enter a value from the keyboard. When values for both this parameter and the tp% REFERENCE LEVEL have been entered, an additional box is displayed. This requests confirmation of the parameter selection. When confirmed, the parameter is entered into the table.

BEARING AREA DEPTH

Available for Vo parameter selection only.

When selected the operator is requested to enter a value from the keyboard. This value must be entered with respect to the value entered at the tp% REFERENCE LEVEL

CONFIRM PARAMETER SETTING When any of the parameter selections have been made the operator must first confirm the selection before it can be entered into the table.

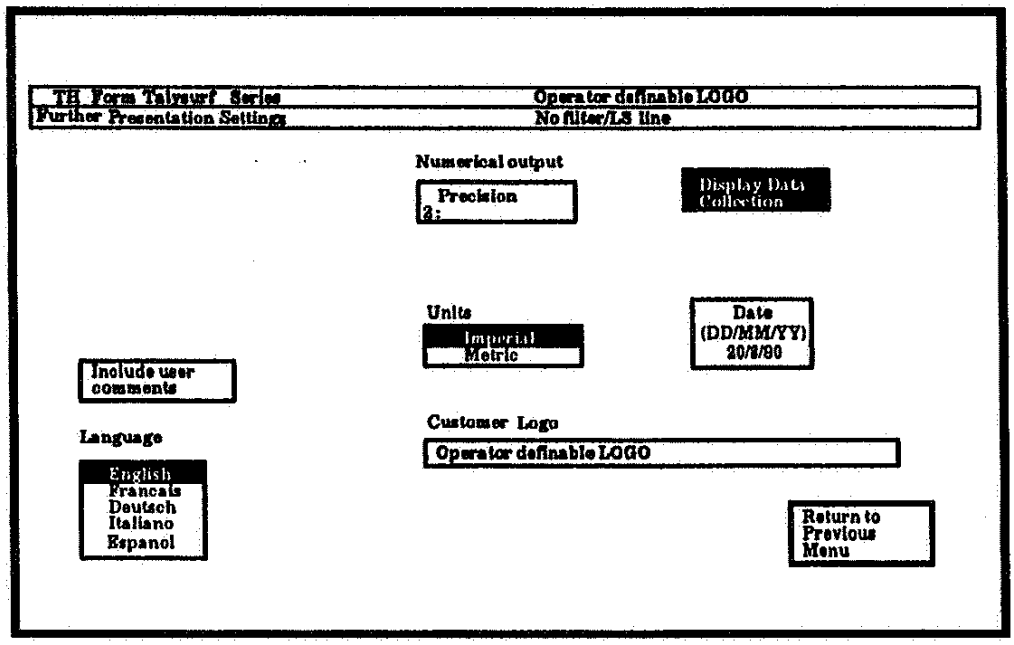
CLEAR VALUE If the values entered are not correct then selecting **CLEAR VALUE** will delete the values entered and new values can be re-selected.

Note This functions only when the **CONFIRM PARAMETER SELECTION** box is displayed.

RETURN TO PREVIOUS MENU Returns the display to the menu from which the **FURTHER PARAMETER SELECTION MENU** was accessed.

FURTHER PRESENTATION SETTINGS

FURTHER PRESENTATION SETTINGS MENU



DESCRIPTION This menu provides further presentation options, and controls the selection of print-out format, selection of imperial or metric units for results presentation and input for the customer logo. .

INCLUDE USER COMMENTS When selected, this option causes any USER COMMENTS (key F11), to be included in print-outs.

LANGUAGE Select the Language required, from the displayed list, for displays and print-outs.

NUMERICAL OUTPUT Select the precision of numerical results, by entering the number of digits after the decimal place to appear in displays and print-outs.

UNITS Select, as required, Imperial or Metric units for results output.

CUSTOMER LOGO The customer's logo can be entered. The logo's length is restricted to the size of the box provided.

DISPLAY DATA COLLECTION Select this option to give a display of the data collected after each measurement.

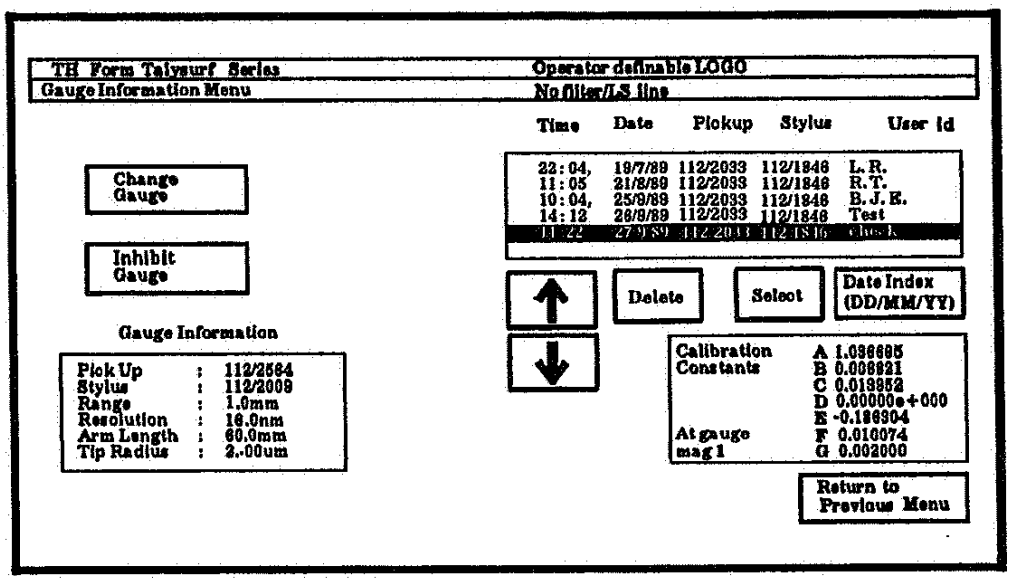
Note When this option is deselected (not highlighted) the Data Selection Menu - Raw Data will not be displayed after a Data Collection has been made. It should therefore normally only be deselected when making automatic measurements when a display of the Raw Data is not required.

DATE The date can be entered/corrected for inclusion in all results print-outs. The current date should be maintained (and displayed) by the computer, however it can be modified if required.

RETURN TO PREVIOUS MENU Returns operation to the **PRESENTATION MENU**.

GAUGE INFORMATION MENU

GAUGE INFORMATION MENU



DESCRIPTION This menu is accessed from the CONFIGURATION EQUIPMENT MENU, the GAUGE SETUP MENU, the RESULTS PAGE after a gauge calibration has been made, or by pressing key F12. The menu allows the current gauge information to be viewed or changed.

The gauge information and calibration constants information is that which will be used by the system.

A calibration history file is maintained and the calibrations made with the selected gauge type are displayed in tabular form. The table can be scrolled up and down, by selecting the up/down arrows, with the current record being highlighted. When the option SELECT is chosen the calibration constants for this record will be displayed. The information is presented in chronological order and an index by date into the table is provided.

The maximum number of calibration records which can be stored is 100. The box indicating stylus data reflects the range available at the currently selected gauging magnification.

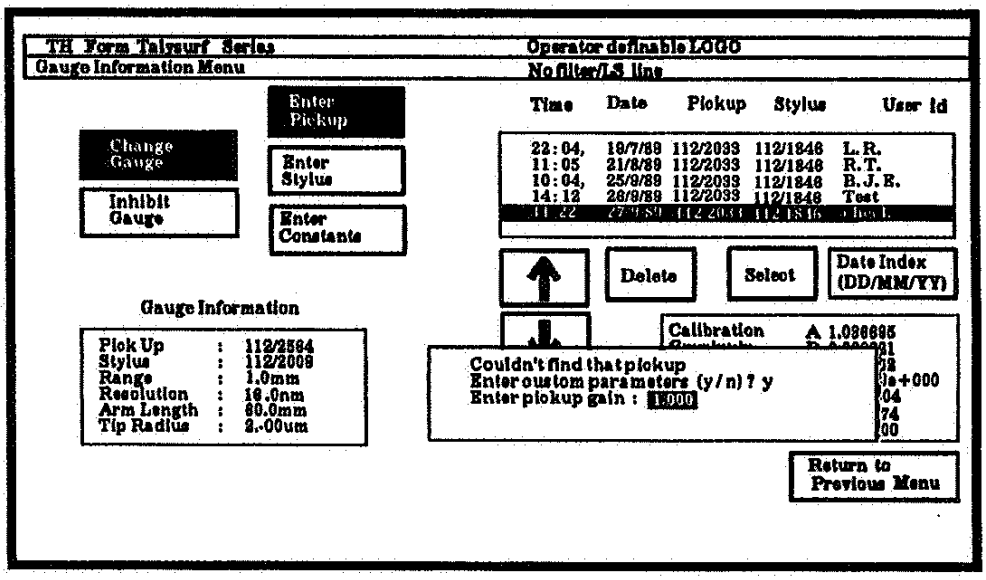
CHANGE GAUGE If the option **CHANGE GAUGE** is selected then a different gauge can be specified in terms of part codes for pick-up and stylus. If a different gauge is

specified, then the displayed gauge information is updated and the displayed calibration history is changed. When this option is selected, the following further options are given:

ENTER PICK-UP
ENTER STYLUS
ENTER CONSTANTS

ENTER PICK-UP Allows the operator to enter a code number (e.g. 112/2564) for a particular pick-up (gauge cartridge). If the code number entered is not recognised (i.e. Not a standard Taylor Hobson pick-up) then the operator will be requested to enter the specific gauge details. This function is useful should any user specific gauges be designed or modified.

ENTERING SPECIAL GAUGE DETAILS



Note If the pick-up is a standard Taylor Hobson part and is found not to match the current system, then a warning message is displayed.

ENTER STYLUS Allows the operator to enter a code number (e.g. 112/2009) for a particular stylus. If the code number entered is not recognised (i.e. Not a standard Taylor Hobson Stylus) then the operator will be requested to enter the specific stylus details.

This function is useful should any user specific gauges be designed or modified.

If a contour pick-up was selected then a prompt will also be given for the stylus tip code.

Note If the stylus is a standard Taylor Hobson part and is found not to match the current system, then a warning message is displayed.

ENTER CONSTANTS Allows the operator to modify the calibration constants used for calculation.

The calibration constants displayed are either those obtained from the current gauge calibration or those currently selected from the table and will be used in any future data analysis. They can be changed by selecting a past calibration from the table or by typing in new values.

Note The use of the **ENTER CONSTANTS** option should be used with EXTREME CARE. It is intended primarily for research applications.

INHIBIT GAUGE The option **INHIBIT GAUGE** is only available for use with the inductive Contour gauge. When selected then the gauge signal is disregarded and the stylus can be changed without producing out of range error messages. When this option is selected, the joystick control is also inhibited. Normal conditions are restored by reselecting the **INHIBIT GAUGE** box or by making any axis movement (except via the joystick).

DATE INDEX On selection, the operator can input a reference date following which the highlight in the selection box will move directly to the last entry for that date. This can therefore be used to quickly move to a particular calibration file.

SELECT When selected, the calibration record currently highlighted will be loaded, the new values being used for subsequent data analysis. This will be prefixed with an 'S' and it's calibration constants displayed in the constants window.

DELETE When selected the calibration record currently highlighted will be deleted.

SAVE THE NEW GAUGE INFORMATION When the gauge information has been changed the option **SAVE NEW GAUGE INFORMATION** is displayed. Only when this option is selected will the new information be saved into the calibration history. When selected a User id code should be entered.

NOTE If an incorrect gauge/stylus combination is selected, then an error message is displayed on starting the software.

RETURN TO PREVIOUS MENU Returns operation to the Menu from which the **GAUGE INFORMATION MENU** was accessed.

PICK-UP AND STYLUS DETAILS Details of the various pick-ups and stylus arms are listed below. Normally only the items in **bold** require entering, all other relevant details being already stored in the computer program.

Standard inductive pick-up: **112/2564**

Stylus	Tip Radius(µm)	Arm Length(mm)	Shank Length(mm)	Tip type
112/2009	2.0	60	11.05	Conical
112/2010	500	120	18.14	Ball
112/2011	2.0	60	16.00	Conical
112/2012	2.0	60	5.43	Conical
112/2013	2.5	60	11.05	Chisel

Laser pick-up: **112/2033**

Stylus	Tip Radius(µm)	Arm Length(mm)	Shank Length(mm)	Tip type
112/1834	2.0	60	1.86	Conical
112/1836	2.0	60	12.37	Conical
112/2041	500	150	18.04	Ball
112/2042	500	120	18.04	Ball
112/1846	2.0	60	15.71	Conical
112/1848	2.0	60	26.2	Conical
112/1959	2.0	60	15.71	Conical
112/2061	2.0	60	1.44	Conical

Contour pick-up **112/2613**

Stylus Arm	Length (mm)	Stylus Tip	Radius (µm)	Shank Length	Tip type
112/2046	250	**12/2024**	20	4.0	Conical
112/2047	187.5	**112/2025**	20	4.0	Chisel edge
		112/2026	500	4.0	Ball

Wide Range pick-up **112/2628**

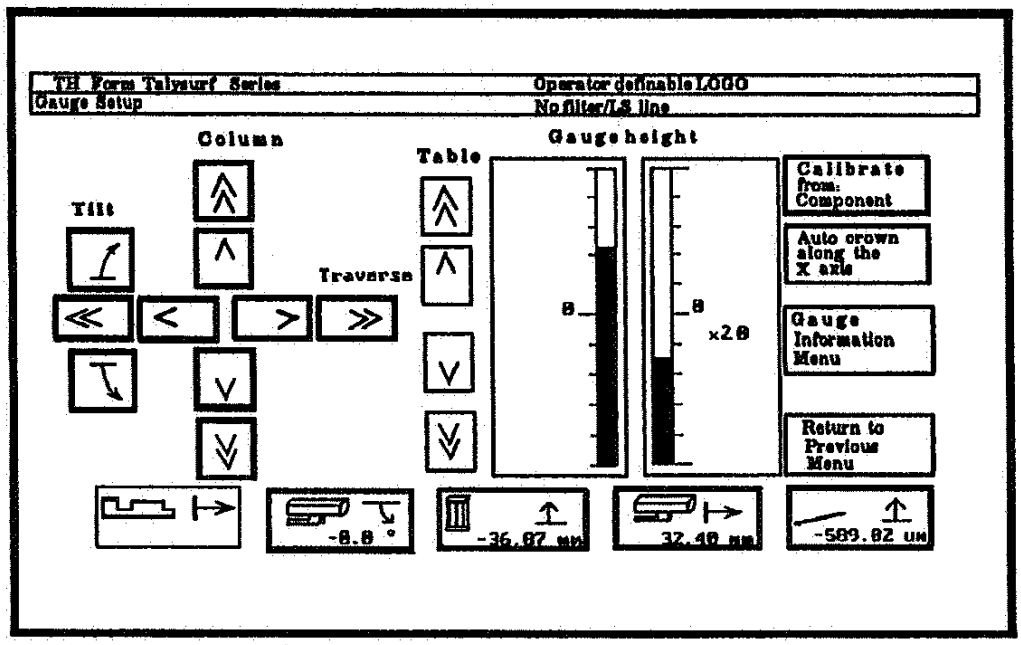
Stylus	Tip Radius(µm)	Arm Length(mm)	Shank Length(mm)	Tip type
501/1684	20	160	2.98	Chisel edge
501/1685	20	160	2.98	Conical
501/1686	500	160	2.98	Ball

P.G.I. gauge **510/9491**

Stylus	Tip Radius(µm)	Arm Length(mm)	Shank Length(mm)	Tip type
112/2619	2.0	60	12.37	Conical
112/2620	500	120	18.04	Ball
112/2621	500	150	18.04	Ball
112/2622	2.0	60	1.86	Conical
112/2623	2.0	60	1.44	Conical
112/2624	2.0	60	26.2	Conical
112/2625	2.0	60	15.71	Conical
112/2626	2.0	60	15.71	Conical
112/2689	2.0	60	12.37	Conical

GAUGE SET UP MENU

GAUGE SET UP MENU



DESCRIPTION This menu is accessed either from the function key F4 or from the **CALIBRATION-CALIBRATE GAUGE** menu.

This display can be used for either setting up the gauge position from the GAUGE HEIGHT display or for calibrating the Gauge relative to either a Ball or Step Height standard (depending on the calibration selected in the **CALIBRATE MENU**).

The display contains facilities for moving the traverse unit up and down the column, for driving the pick-up to the left or to the right, for tilting the traverse unit and for driving a traverse table (when included). These are in the form of Arrow heads which indicate the hardware and direction of traverse. Selecting an arrow head causes the movement to commence. A vernier style graphic indicates the stylus position within the gauge range. If the stylus is not in contact with the component, then the vernier graphic will be blank.

Arrow boxes depict all available traverse options (note non-valid options are shown in thin edged boxes), the double arrows indicating the fast accelerating traverse speeds.

CALIBRATE FROM On selection, this option will cause the system to obtain a set of known data and compute the calibration values. If either **COMPONENT** or **IMMEDIATE** are selected on the **DATA SOURCE** option of the **MAIN MENU**, the calibration data is obtained by making a measurement of the calibration standard: if **MEMORY** is selected, then the data currently in the computer memory is used as the calibration data: similarly data loaded from the **FILE** option can be used as the calibration data.

The type of measurement and computation will depend on which calibration method is defined in the **CALIBRATE** menu (either **BALL RADIUS** or **3 LINE CALIBRATION**).

If the calibration is relative to a **BALL RADIUS** then the measurement is assumed to commence at the Crown of the ball, and the system will reverse the traverse unit a fixed amount dependent on the actual ball radius and adjust the height of the column to perform the measurement in the central range of the gauge.

If the measurement is relative to the **STEP HEIGHT** then it is assumed to commence at the left hand edge of the box in which the 3 lines are etched.

AUTO CROWN ALONG X AXIS This feature is particularly useful for both calibration and for measurements on convex and concave curved surfaces.

When selected the system will make a short measurement, and calculate the theoretical position of the centre of the radius. The system will then drive the column to a suitable clearance height and position the stylus at the theoretical centre of radius.

Further measurements will then be taken to refine the positioning. On completion the stylus will be at the crown of either the Convex or Concave surface.

Important The Auto Crown feature assumes that the centre lies within the bounds of the traverse length of the system.

GAUGE INFORMATION MENU This will display the **GAUGE INFORMATION MENU**.

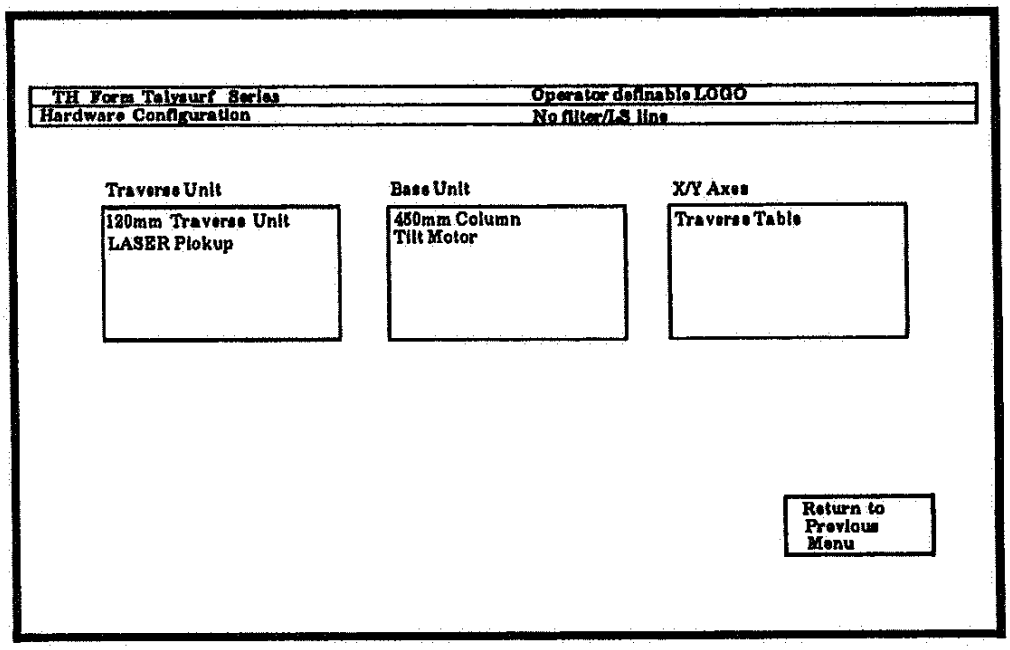
See **GAUGE INFORMATION MENU** for further details.

LEARN MENU If, when a program is being edited, the GAUGE SETUP MENU is selected and displayed, then the option LEARN MENU replaces the RETURN TO PREVIOUS MENU option. LEARN MENU must be selected to include the GAUGE SETUP MENU in the program.

RETURN TO PREVIOUS MENU Returns operation to the Menu from which the **GAUGE SET UP** Menu was accessed.

HARDWARE CONFIGURATION MENU

HARDWARE CONFIGURATION MENU

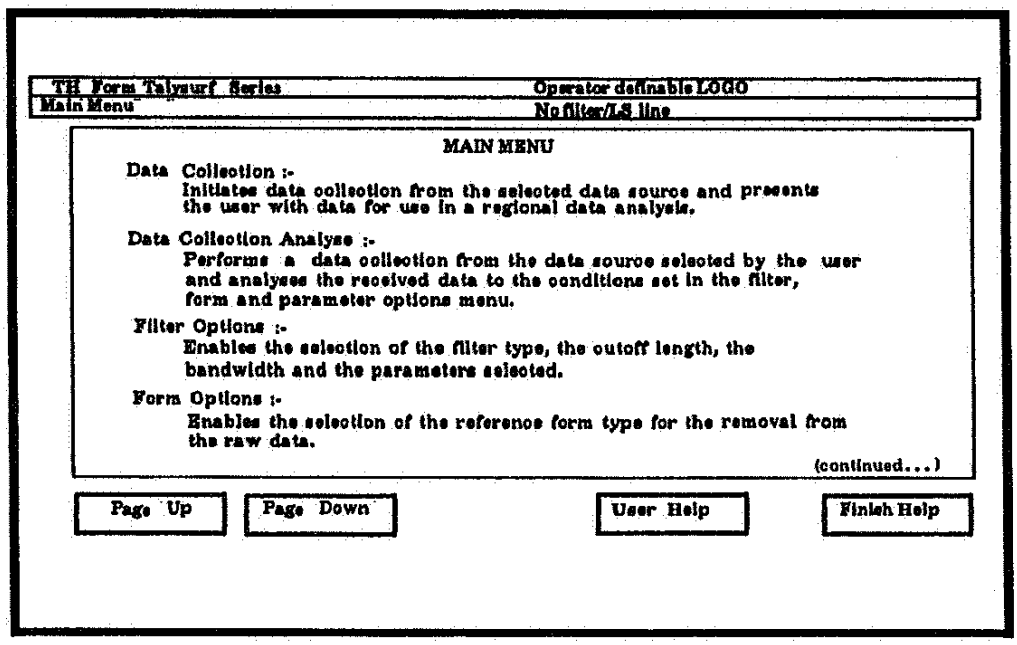


DESCRIPTION This option will display a list of the hardware that is connected to the system, this list is determined automatically by the system and cannot be amended by the operator.

RETURN TO PREVIOUS MENU Returns the operator to the **MAIN MENU**.

HELP MENU

HELP MENU (for Main Menu)



DESCRIPTION The **HELP MENU** is accessed by selection of the function key F2 and will provide a synopsis of each menu function appropriate to the menu currently selected. Further help can be defined by the operator and stored for future benefit of other user's. This help can be defined in the operator's own words and thus overcome any interpretation problems. In some cases more than 1 page of help may be provided in which case the help screen can be paged up and down to reveal all topics of help.

PAGE UP Pages the help screen one page up

PAGE DOWN Pages the help screen one page down.

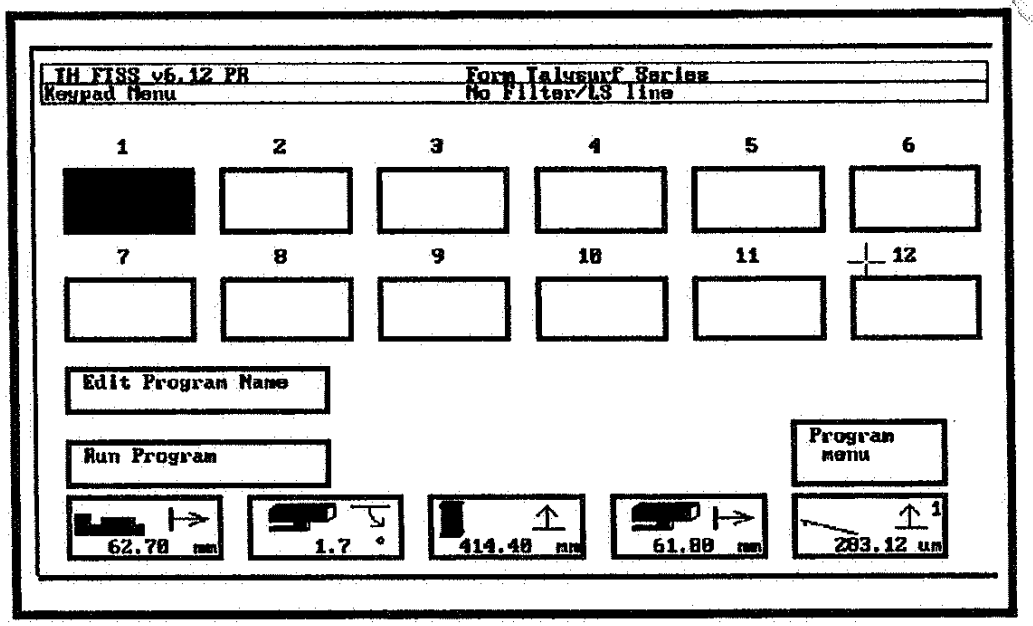
USER HELP Takes the user to the **USER HELP MENU**. See **USER HELP MENU** for further details.

FINISH HELP Returns the operation to the previously selected menu. (key F2 performs the same function)..

NOTE This facility is not available for the **KEYPAD MENU**, details of which are given on the following page.

KEYPAD MENU

MAIN MENU (Manual Mode)



DESCRIPTION When the Form Talysurf Series E software is installed, this menu is the first to appear after the program has been started. This menu allows measurement programs to be allocated to the numbered boxes that are displayed. These can then be selected and run as required.

The Main Menu can be accessed by pressing key F1.

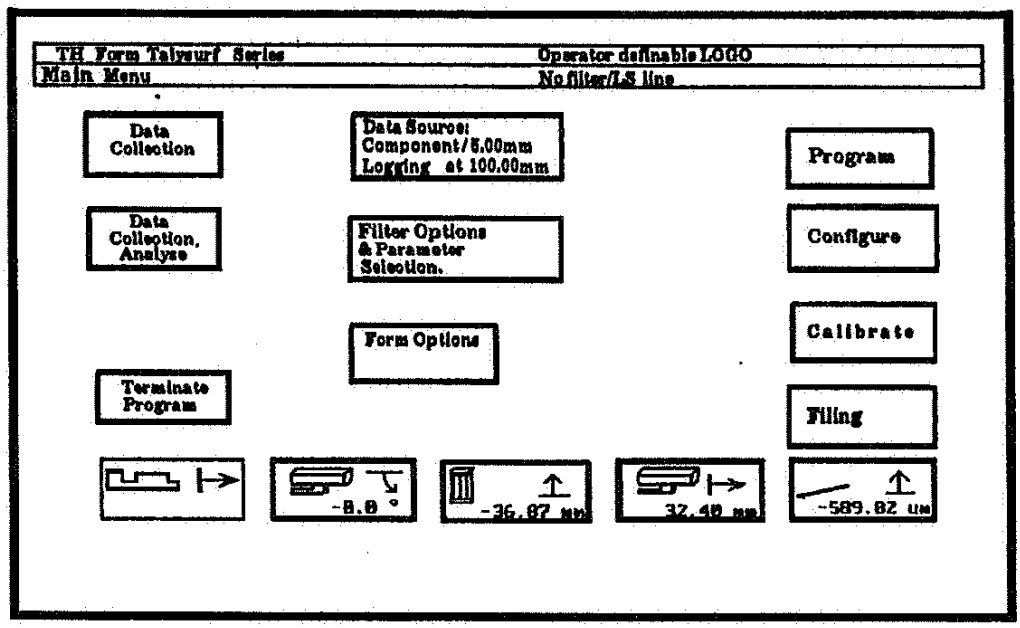
Note This menu is **not** included with the standard software.

EDIT PROGRAM NAME After selecting one of the numbered boxes, the operator is prompted to enter the name of the program to be allocated to this box. This can be any program stored in the current directory.

RUN PROGRAM Selecting this option causes the current program to be run.

MAIN MENU

MAIN MENU (Manual Mode)



DESCRIPTION When standard software is installed, this menu is the first to appear after the program has been started. If the Form Talysurf Series E software is installed, then the Keypad Menu is initially displayed and the Main Menu can be accessed by pressing key F1.(see **KEYPAD MENU** for more details).

Displayed in the menu are selections which control the acquisition of data and its analysis, system configuration, calibration, file handling and program options. The equipment status icons are also displayed to show the equipment positions and enabling direct control of hardware movements.

CALIBRATE Displays the calibration menu from which the options to calibrate end stops, gauge and instrument axes are given. It is necessary to calibrate the instrument axes before an absolute move can be performed.

See **CALIBRATION MENU** for more details.

CONFIGURE Selecting this option enables the operator to define the system configuration to the computer.

The configuration menu can only be accessed from the main menu when in manual mode. When this menu is selected, a number of options are displayed. These allow the equipment, results presentation, screen colours and hardware configuration to be selected as required by the operator. See **CONFIGURATION MENU** for more details.

DATA COLLECTION Data Collection will initiate a measurement from the source indicated and will then display the Raw Profile in the Data Selection - Raw Profile menu.

DATA COLLECTION, ANALYSE Data Collection, Analyse will initiate a measurement from the source indicated and will then immediately analyse the data according to the form, filters and parameters selected (and as shown in the summary information), and display the results in the results page.

DATA SOURCE This option determines the source from which data is used for data collection. This can be a new measurement, using the **IMMEDIATE** or **COMPONENT** options, from data currently residing in the **MEMORY** of the **E.I.M** (i.e the last measurement made) or from a stored **FILE**.

When **DATA SOURCE** is selected, the four options are displayed, the current selection being highlighted. If a new measurement is to be made, select the **COMPONENT** option. The message *Enter traverse length* is displayed. Enter the length of traverse required and press the ENTER key. The message *Enter data log position* is then displayed. Enter the traverse unit scale position at which the measurement is to begin and press the ENTER key. If a new traverse length or start position are not required, just press the Enter key to accept the current entry.

If the measurement is to be commenced having previously positioned the traverse unit at the start position, then select the **IMMEDIATE** option.

The assessment length for measurements from this option is set from the **FILTER AND PARAMETER OPTIONS MENU**

Note In order that operational speed and stability are achieved before starting the collection of measurement data, a traverse run-up distance of 0.3mm is made before the data is collected. Measurements initiated from the **IMMEDIATE** option, start to run up from the current position. The actual measurement, therefore, starts at a position 0.3mm after the initial start position. At the commencement of each **COMPONENT measurement, the traverse unit moves to a position 0.3mm in front of the specified start position, data collection is then commenced from the start position specified.**

If an analysis of previously stored data is to be made, select the **File** option. The message *Enter filename* is displayed. Enter the filename of the previously stored data and press the ENTER key. The data will then be loaded into the computer memory for analysis after selecting either the **Data Collection** or **Data Collection, Analyse** option.

Selecting the **Memory** option, retrieves the data (after selecting either the **Data Collection** or **Data Collection, Analyse** option) from the last measurement or analysis (and is already in the memory of the E.I.M undisturbed. This can then be analysed as required.

FILING Selecting the Filing option from the **MAIN MENU**, causes the File Manipulation menu to be displayed.

This option should be used to view and select files for use either as a program or for data retrieval. It can also be used to copy, or delete files for file maintenance. See **FILE MANIPULATION MENU** for further details.

FILTER OPTIONS AND PARAMETER SELECTION Selecting this option will display the **FILTER AND PARAMETER OPTIONS MENU** which subsequently allows the selection of the filter options and the surface finish parameters. See **FILTER and PARAMETER OPTIONS MENU** for further details.

FORM OPTIONS This option enables the operator to select the specific type of form required for the analysis of the measurement data. See **FORM OPTIONS MENU.**

PROGRAM Displays the **PROGRAM MENU.** This will allow the selection of the program to be used for the purposes of Automatic instrument operation, Editing of programs, or the creation of new programs. See **PROGRAM CONTROL** for further details.

Note With the Form Talysurf Series E software, the **Program** option is replaced by the **Keypad** option.

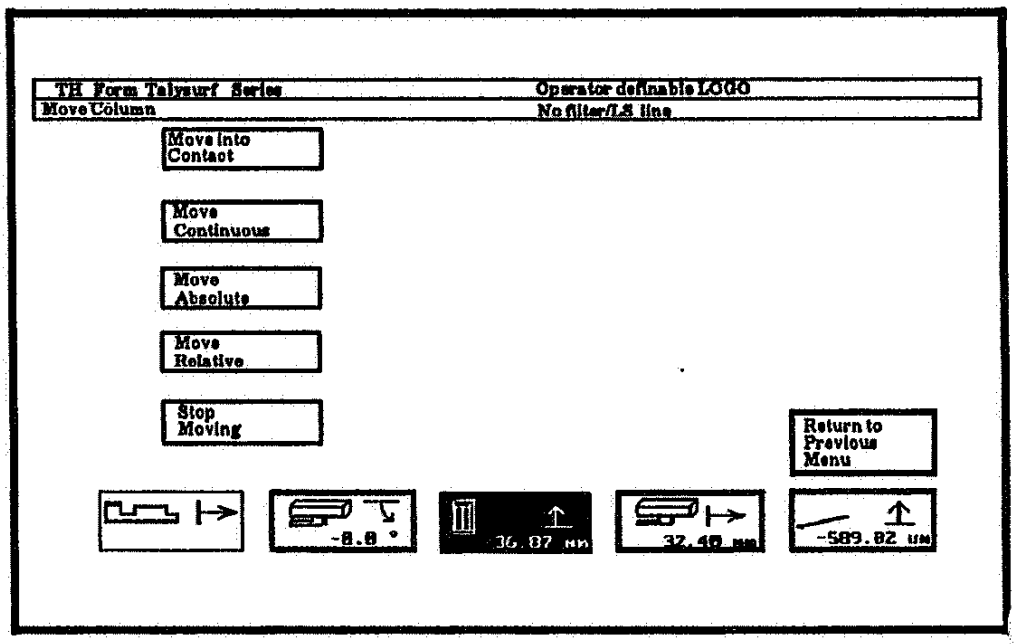
TERMINATE PROGRAM Selection of this option causes the current settings to be stored and the operator is given the option to switch off or continue with the program. Confirmation of termination, returns the operator to the operating system of the computer (MS-DOS). This option should be used prior to switching off the system.

PROGRAM MESSAGE When the system is in Program creation or Edit mode, then the option to Terminate the program is replaced by an option to include a program message. This can be used to instruct the operator to perform certain key tasks which must be acknowledged prior to continuation of the program (e.g. Insert the correct stylus or position the workpiece etc.).

When this option is selected a box (window) is displayed, into which the message is typed. The message is restricted to one line of up to 76 characters. During program execution, the message appears at the top of the screen and the program pauses until it is acknowledged and cleared by selecting in the message box or pressing the ENTER key.

MOVE COLUMN MENU

MOVE COLUMN MENU



DESCRIPTION **ONLY AVAILABLE WHEN A MOTORISED COLUMN MODULE IS CONNECTED TO THE SYSTEM.**

This menu is displayed on selection of the Column Icon It allows control of the positioning of the column carriage.

Various options are available to which additional options are given dependent of the function required.

MOVE INTO CONTACT On selection this will cause the column carriage to move DOWN or UP (dependent on the contact direction set in the **CONFIGURATION-EQUIPMENT MENU**) at a computer selected speed, until the stylus contacts the workpiece in the centre of it's range.

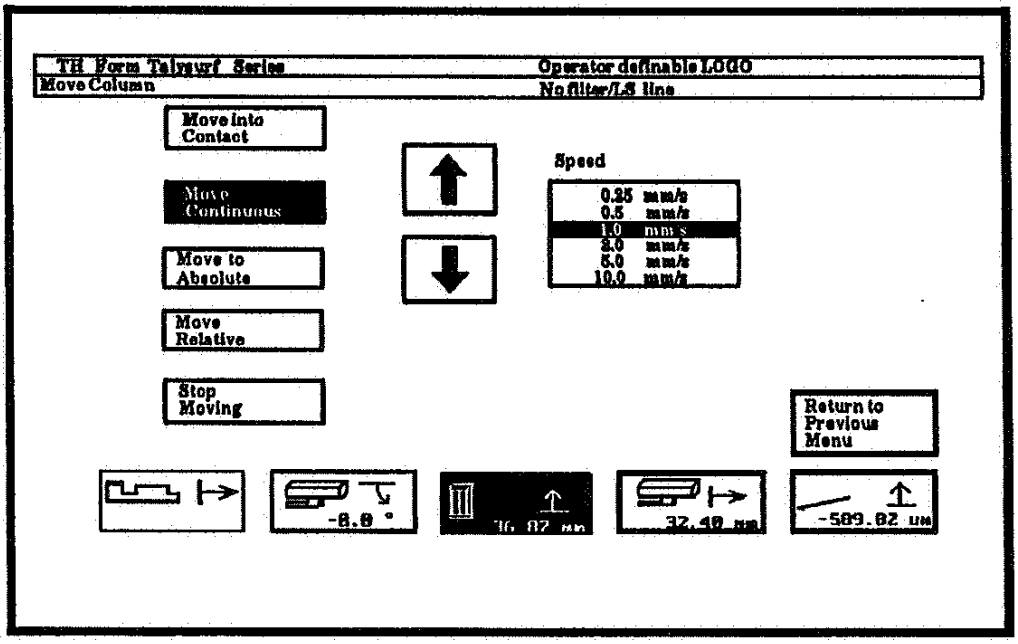
CAUTION **If the stylus is left in contact with a surface and the system is switched off then, after switching on again, the stylus must be raised clear of the surface before the MOVE INTO CONTACT facility is used. Failure to do this may result in damage to the instrument.**

MOVE CONTINUOUS This option allows the Column carriage to be moved continuously (or until an End Stop is detected).

When selected, additional options are presented These enable the direction and speed of the carriage traverse to be chosen.

Selecting either the Up or Down arrow causes carriage movement to commence. As soon as selection is released, the movement will stop.

MOVE COLUMN MENU (continuous selected)



The operator is given a choice of 6 traverse speeds:-

0.25mm/sec
0.50mm/sec
1.0mm/sec
2.0mm/sec
5.0mm/sec
10.0mm/sec

NOTE When using Terminal Module 2, some individual finger actions can be misread by the computer and occasionally, during a *Move Continuous* operation, the computer may not recognise when a finger has been lifted from the screen. If this occurs, then the icon is not cleared and the move continues. Immediately re-touching the screen will correct this action.

MOVE ABSOLUTE When selected, the operator is prompted to enter a position. The column scale position, to which the carriage is to be moved, is entered from the keyboard and the ENTER key then pressed.

The column carriage then moves, at a computer controlled speed to the position indicated.

Note The system axes should be calibrated before any Absolute moves are carried out.

MOVE RELATIVE This option will allow the column carriage position to be moved relative to it's current position. On selection the operator is requested to enter a traverse direction of either move **UPWARDS** or **DOWNWARDS**, followed by the **DISTANCE** required. The distance is entered from the keyboard and the ENTER key then pressed.

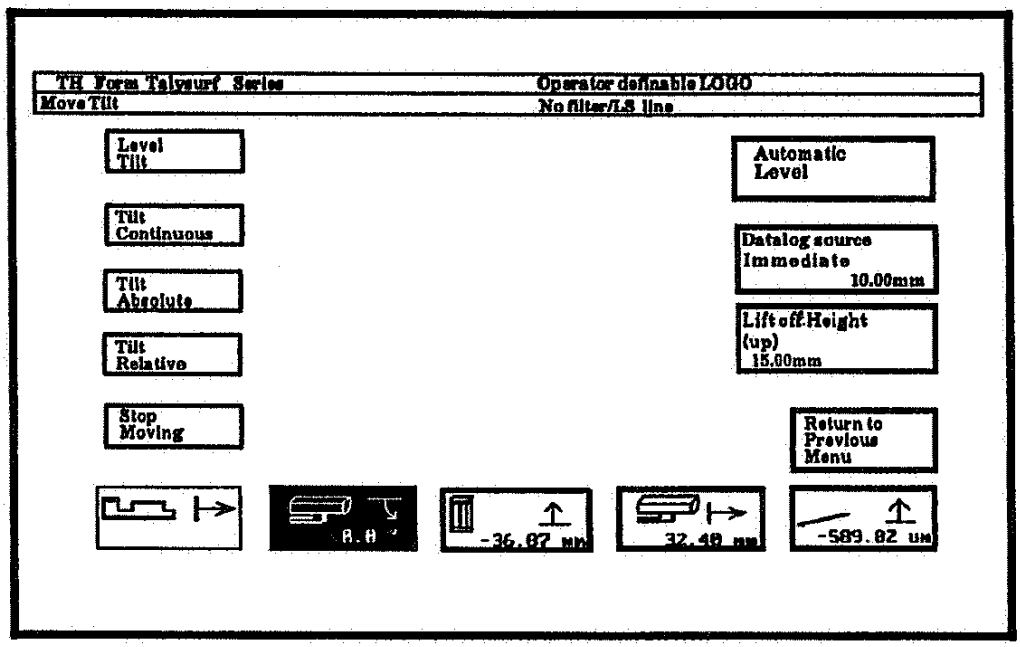
The column carriage then moves at a computer controlled speed to the position indicated.

STOP MOVING Stops any of the above operations.

RETURN TO PREVIOUS MENU Returns operation to the Menu from which the **MOVE COLUMN MENU** was accessed.

MOVE TILT MENU

MOVE TILT MENU



DESCRIPTION **ONLY AVAILABLE WITH THE MOTORISED COLUMN MODULE.**

This menu is displayed on selection of the Traverse Tilt Icon, and allows control of the positioning of traverse unit tilt movement.

Various options are available to which additional options are given dependent of the function required.

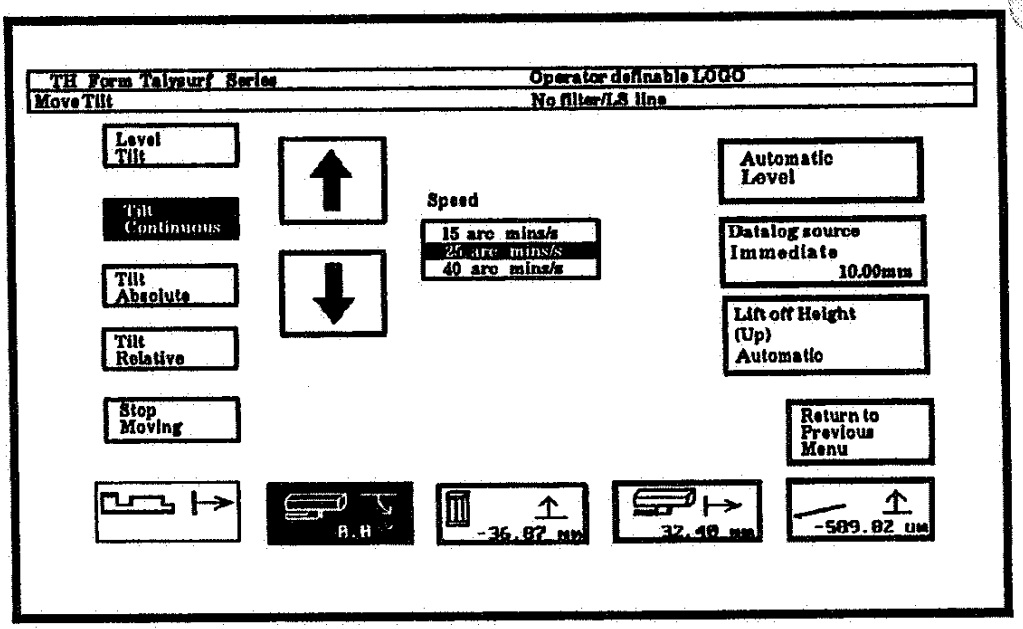
LEVEL TILT When selected the Traverse unit tilt will be moved to zero degrees (nominal).

TILT CONTINUOUS This option will allow the Traverse Tilt to be moved continuously (or until an End Stop is detected). When selected, additional options are presented. These enable the traverse tilt direction and speed to be chosen.

Selecting either the Up or Down arrow causes tilting to commence. As soon as selection is released, the movement will stop.

Note The **UP** arrow will cause the traverse unit to rotate **CLOCKWISE**, and the **DOWN** arrow will cause the traverse unit to rotate **ANTI-CLOCKWISE** (counter clockwise).

MOVE TILT MENU (continuous selected



The operator will be given a choice of 3 traverse speeds:

15 arc mins/sec
25 arc mins/sec
40 arc mins/sec

NOTE When using Terminal Module 2, some individual finger actions can be misread by the computer and occasionally, during a *Move Continuous* operation, the computer may not recognise when a finger has been lifted from the screen. If this occurs, then the icon is not cleared and the move continues. Immediately re-touching the screen will correct this action.

TILT ABSOLUTE When selected the operator will be prompted to enter an 'Angle'. The angle should be entered from the keyboard followed by the ENTER key, as soon as the enter key is pressed then the traverse unit will tilt at a computer controlled speed to the angl indicated.

TILT RELATIVE This option will allow the traverse unit to be tilted 'relative' to it's current angle. On selection the

operator will be requested to enter a tilt direction of either **TILT UP** or **TILT DOWN**, followed by the **ANGLE** required. The angle should be entered from the keyboard followed by the ENTER key, as soon as the enter key is pressed then the traverse unit will tilt at a computer controlled speed to the position indicated

STOP MOVING Stops any of the above tilt operations.

AUTOMATIC LEVEL On selection a Data Collection, Analyse measurement will commence as defined in the Datalog Source box. After analysis the Column will automatically adjust it's height position or lift off the specified distance in the Lift Off Height box and then correct the traverse unit 'tilt'.

DATALOG SOURCE When selected, the operator is requested to enter a 'TRAVERSE LENGTH'. The value entered is coupled with the IMMEDIATE measurement mode to define the measurement conditions for assessing the 'tilt' between the traverse unit datum and the component surface. See AUTOMATIC LEVEL.

LIFT OFF HEIGHT The distance the traverse unit moves away from the component following an automatic level operation can be set via this option. On selection, the choice of either entering a distance or selecting AUTOMATIC is given. Selecting AUTOMATIC will set a lift off distance of nominally 30mm (1.2in).

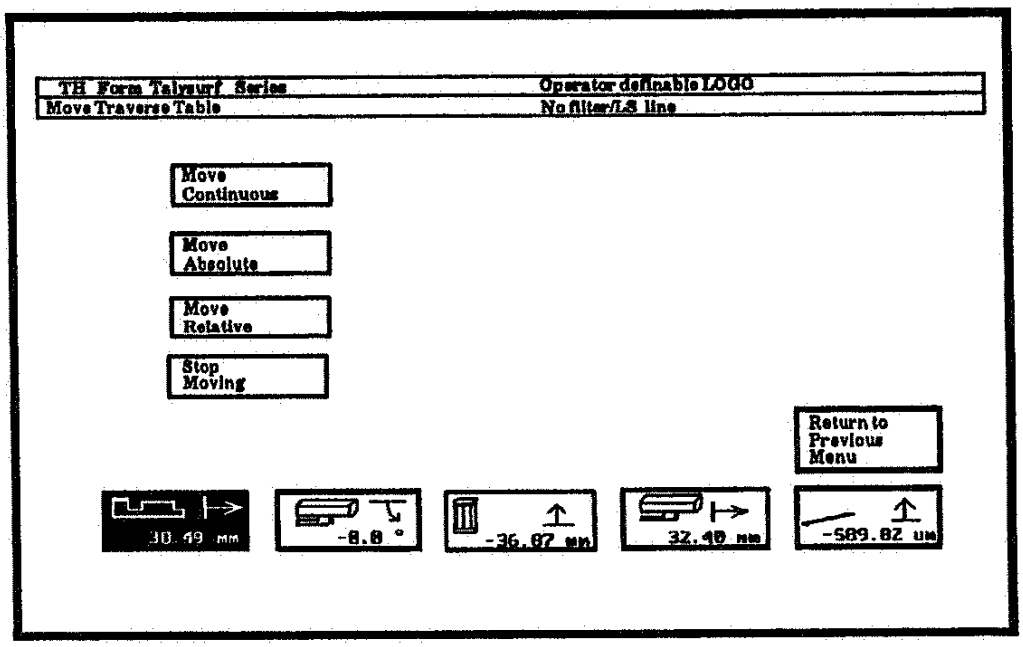
Note If the contact direction is set to UP (e.g. gauge inverted) then the lift off direction will be DOWN.

CAUTION **Care should be taken when using the Automatic Level function when operating in restricted spaces or in bores.**

RETURN TO PREVIOUS MENU Returns operation to the Menu from which the **MOVE TILT MENU** was accessed.

MOVE TRAVERSE TABLE MENU

MOVE TRAVERSE TABLE MENU



NOTE **THIS FACILITY IS ONLY AVAILABLE WHEN A CORRECTLY INTERFACED TRAVERSE TABLE MODULE (Y AXIS STAGE) IS CONNECTED TO THE SYSTEM.**

DESCRIPTION This menu is displayed on selection of the Traverse Table Icon, and allows control of the positioning of the traverse table.

Three movement options are available, with additional options being displayed after selection of the function required.

MOVE CONTINUOUS This option will allow the Traverse Table to be moved continuously (or until an End Stop is detected). The movement is carried out in discrete steps of selected distance.

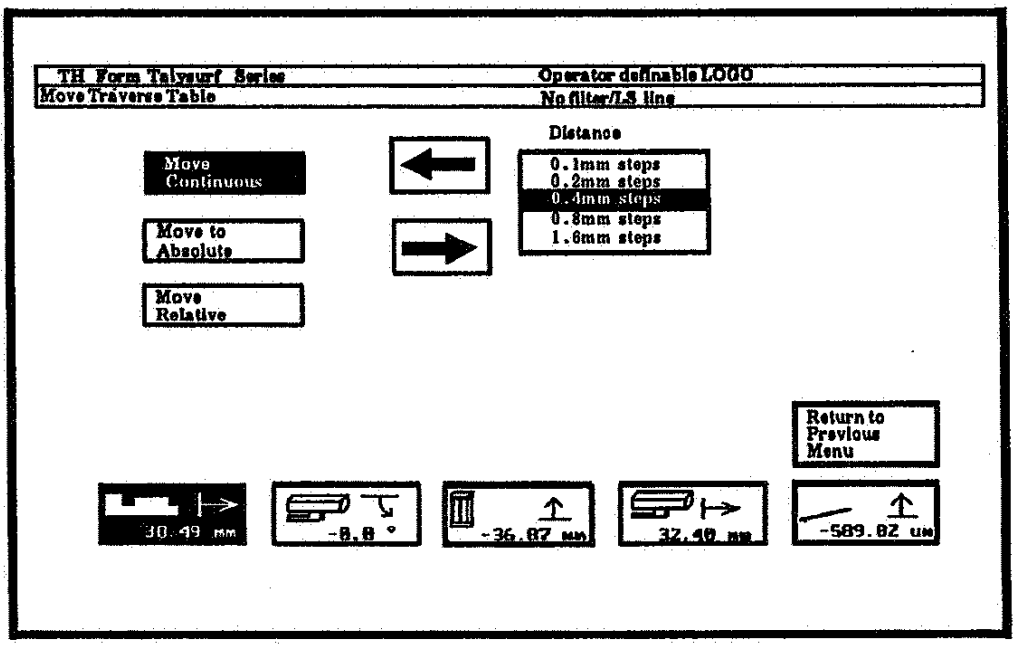
When this option is selected, additional options are presented. These enable the direction of traverse and the step distance to be chosen.

The step distance, for continuous movement, is selected from the list displayed on the menu.

Selecting either the Left or Right arrow causes the traverse table to move at the selected step size.

As soon as the selection is released, the traverse motion will stop.

MOVE TRAVERSE TABLE MENU (continuous selected)



NOTE When using Terminal Module 2, some individual finger actions can be misread by the computer and occasionally, during a *Move Continuous* operation, the computer may not recognise when a finger has been lifted from the screen. If this occurs, then the icon is not cleared and the move continues. Immediately re-touching the screen will correct this action.

MOVE ABSOLUTE When this option is selected, the operator is prompted to enter a 'position'. The position to which the table is required to move should be entered from the keyboard and the ENTER key then pressed. As soon as the enter key is pressed, then the traverse table will move at a computer controlled speed to the position indicated.

MOVE RELATIVE This option enables the traverse unit position to be moved 'relative' to it's current position. On

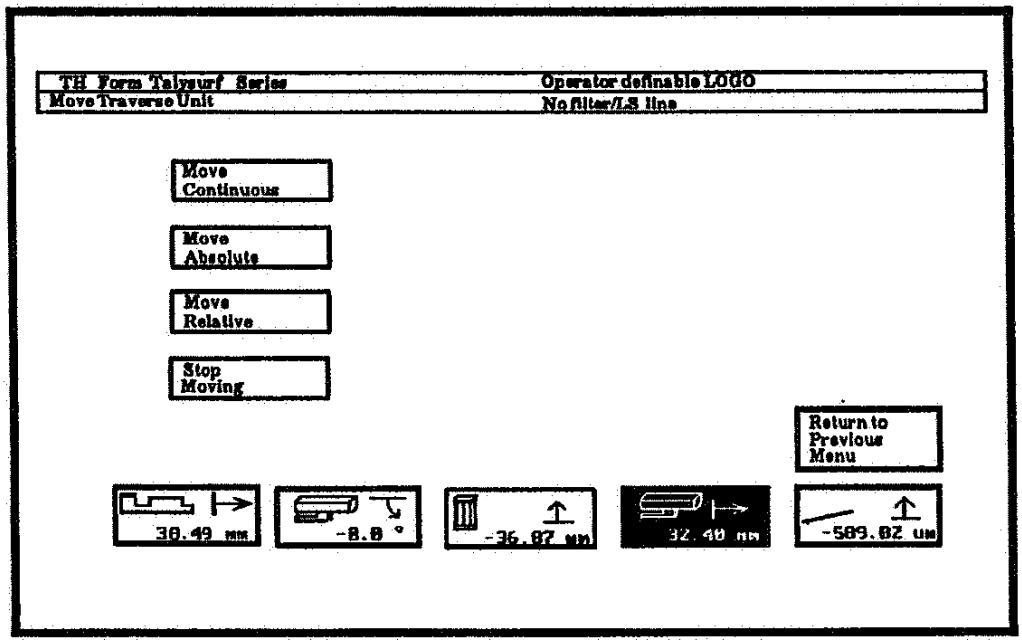
selection, the operator is requested to enter a traverse direction: to either **MOVE TABLE INWARDS** or **MOVE TABLE OUTWARD.** When the direction has been selected, a request is displayed to enter the **DISTANCE** required. The distance required for the table to move is entered from the keyboard and the ENTER key then pressed. The traverse table then moves the distance required, at a computer controlled speed.

STOP MOVING Stops any of the above operations.

RETURN TO PREVIOUS MENU Returns operation to the Menu from which the **MOVE TRAVERSE TABLE MENU** was accessed.

MOVE TRAVERSE UNIT MENU

MOVE TRAVERSE UNIT MENU



DESCRIPTION This menu is displayed on selection of the Traverse Unit Icon, and allows control of the positioning of the traverse unit.

Various options are available, with additional options being displayed after the selection of the function required.

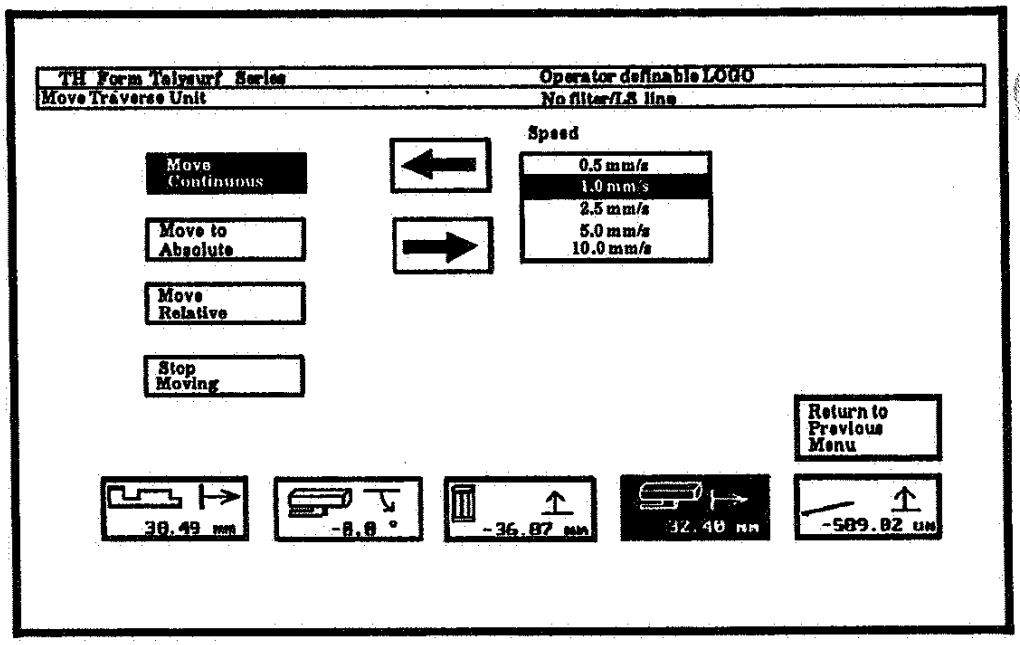
MOVE CONTINUOUS This option will allow the Traverse Unit to be moved continuously (or until an End Stop is detected).

When this option is selected, additional options are presented. These enable the direction and speed of traverse to be chosen.

Selecting either the Left or Right arrow causes the Traverse Unit to move at the selected speed. As soon as selection is released, the traverse motion will stop.

Note The left arrow extends the gauge and the right arrow retracts the gauge.

MOVE TRAVERSE UNIT MENU (continuous selected)



The operator is given the choice of 5 traverse speeds:
0.5mm/sec
1.0mm/sec
2.5mm/sec
5.0mm/sec
10.0mm/sec

NOTE When using Terminal Module 2, some individual finger actions can be misread by the computer and occasionally, during a *Move Continuous* operation, the computer may not recognise when a finger has been lifted from the screen. If this occurs, then the icon is not cleared and the move continues. Immediately re-touching the screen will correct this action.

MOVE ABSOLUTE When this option is selected, the operator is prompted to enter a 'position'. The position to which the traverse unit is required to move should be entered from the keyboard and the ENTER key then pressed. As soon as the ENTER key is pressed, then the Traverse Unit will move at a computer controlled speed to the position indicated.

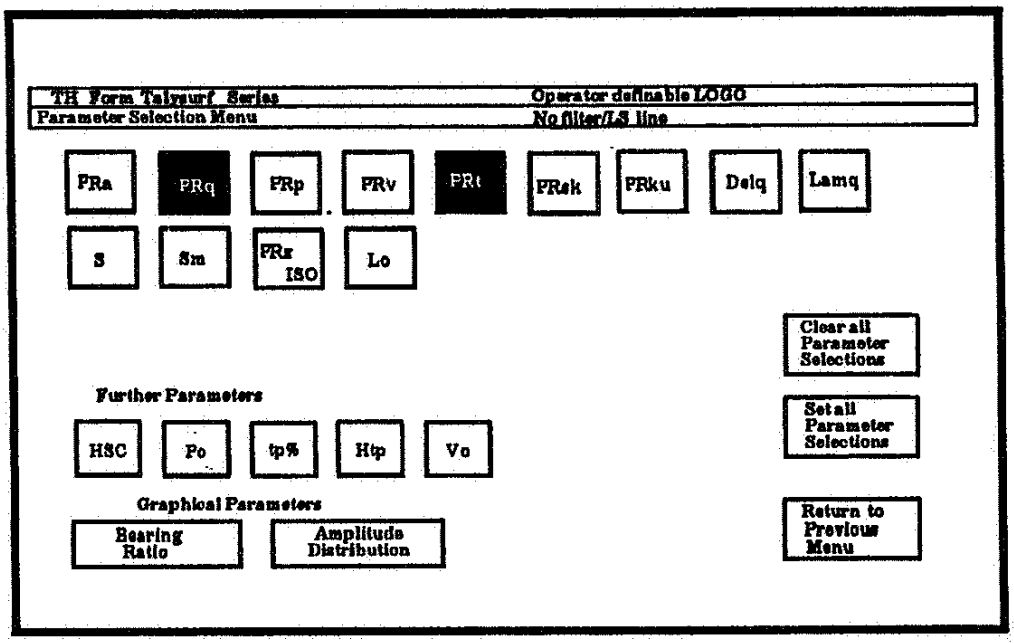
MOVE RELATIVE This option enables the traverse unit position to be moved 'relative' to it's current position. On selection, the operator is requested to enter a traverse direction: of either **EXTEND TRAVERSE UNIT** or **RETRACT TRAVERSE UNIT.** When the direction has been selected, a request is displayed to enter the **DISTANCE required for the traverse unit to move.**

The distance is entered from the keyboard and the ENTER key then pressed. The Traverse Unit then moves, at a computer controlled speed, the distance required in the selected direction,

RETURN TO PREVIOUS MENU Returns operation to the Menu from which the **MOVE Traverse Unit MENU** was accessed.

PARAMETER SELECTION MENU

PARAMETER SELECTIONS MENU (Roughness Mode)



DESCRIPTION This menu displays all of the parameters which can be selected for calculation and display in the current filter mode (e.g. roughness). The current selection is shown, each selected parameter being highlighted. Parameters can be selected or de-selected from the relevant box. The values of the selected parameters can be saved in a file from the results page.

Note A maximum of 20 Rti values will be displayed on the results page, printed out and saved in D.E.P.

In R&W mode, the selection of any of the four roughness parameters (Pt, R, Ar, Rx) causes two extra standard deviation parameters SR and SAr to be selected for output on the Results menu or to the printer. Similarly, the selection of any of the four Waviness parameters (Wt, W, Aw, Wx) causes two extra standard deviation parameters SW and SAw to be selected for output. These extra parameters cannot be selected in any other way.

FURTHER PARAMETERS Some parameters such as HSC and Pc require additional information. When one of these is selected the FURTHER PARAMETER DEFINITIONS MENU is displayed.

See FURTHER PARAMETER DEFINITION MENU for details.

GRAPHICAL PARAMETERS The graphs of bearing ratio and amplitude distribution will only be calculated and displayed on the results page if they are selected from this men

CLEAR ALL PARAMETER SELECTIONS Selection of this option will cause all of the currently selected parameters to be de-selected.

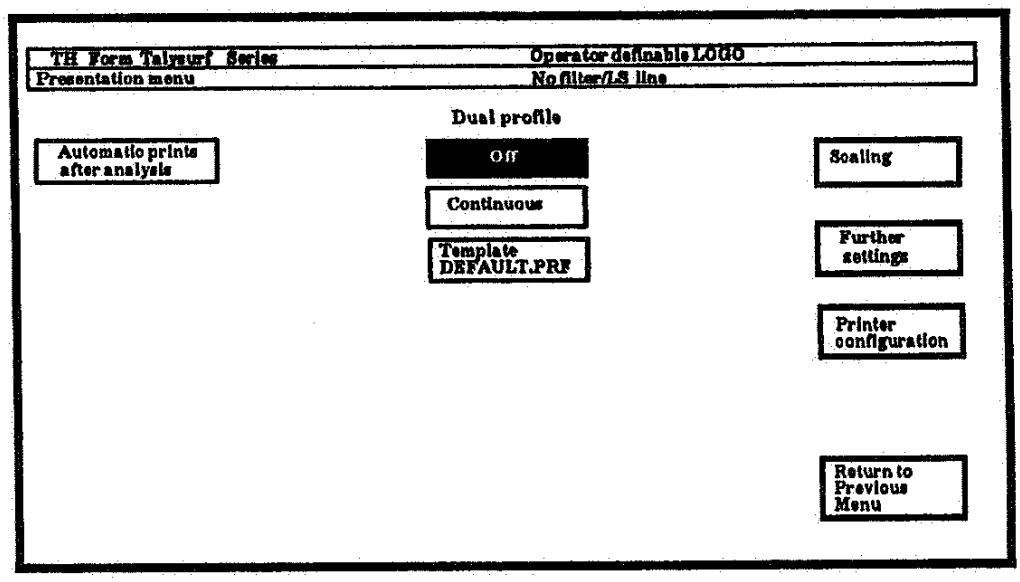
SET ALL PARAMETER SELECTIONS Selection of this option will cause all of the parameters (including any specified further parameters) to be selected.

CAUTION Unless all parameters are necessary it is advised that only the required parameters be selected to avoid long computation times. Parameters such as Rk require various levels of filtering and greatly increase the calculation time required.

RETURN TO PREVIOUS MENU Displays the menu which the Parameter Selection Menu was originally selected.

PRESENTATION MENU

PRESENTATION MENU



DESCRIPTION From this menu the general screen and print-out presentation is configured. A number of the options are presented as a list with the current selections being highlighted.

AUTOMATIC PRINTS AFTER ANALYSIS Selection of this option will cause the result types highlighted in the Printout Content boxes to be printed automatically after a results analysis is performed.

NOTE When learning a program, results printing is added as a separate step in the program after any analysis step. When editing a program, results printing after an analysis must be added as a separate program step.

DUAL PROFILE Select either the **Continuous** or the **Template** option to include the Dual Profile facility in the Data Selection menus.

When **Continuous** is selected, the **Store Datum option is included in the Data Selection menus.**

This enables the profile displayed in the Data Selection menu to be stored for comparison with subsequently obtained profile data.

When Template is selected, a filename is requested. When this has been entered, the data stored in this file is used in the Dual Profile facility of the appropriate Data Selection menu for comparison with subsequently obtained profile data. The filename **must** include all of its components. These are: **Feature name, Underline, Measurement number** and file type Extension. The extension for a raw profile is **.prf** (e.g. TEST_01.prf) and the extension for a modified profile is **.mod** (e.g. TEST_01.mod). Spaces must not be included in the filename.

OFF Selecting **OFF** removes the Dual Profile options from the **DATA SELECTION** menus.

Note: The Dual Profile facility will only compare data of the same type, i.e. Raw Profile with Raw Profile and Modified Profile with Modified Profile.

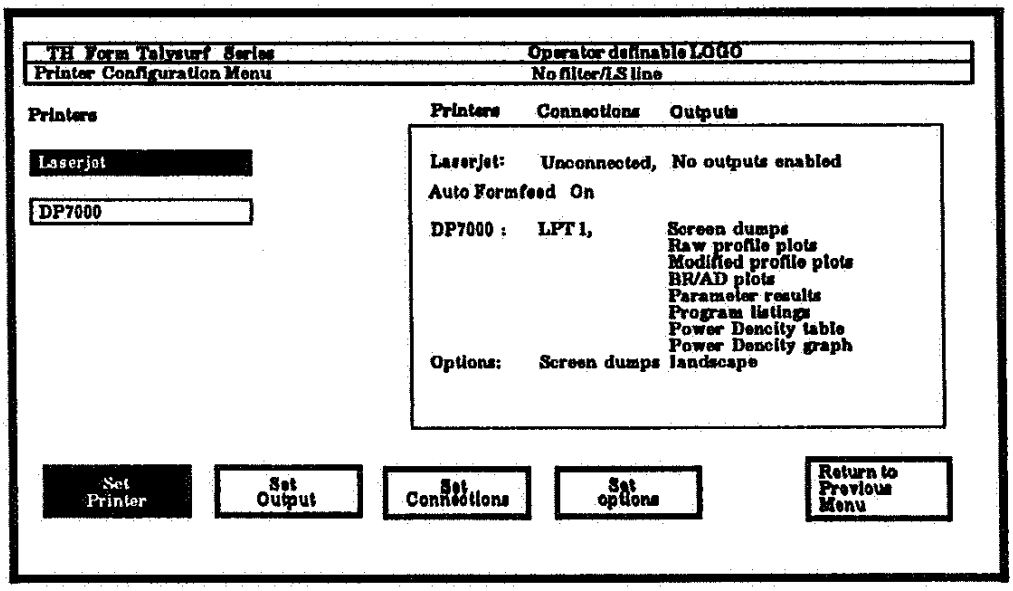
SCALING This option causes the Scaling menu to be displayed. From this menu, the scaling of print-outs and screen displays are set. See **SCALING MENU.**

FURTHER SETTINGS This option causes the **FURTHER PRESENTATION SETTINGS MENU** to be displayed. This menu provides for the selection of printer format, selection of imperial or metric units for results presentation and input for the customer logo. See **FURTHER PRESENTATION SETTINGS MENU.**

PRINTER CONFIGURATION Selecting this option causes the **PRINTER CONFIGURATION MENU** to be displayed. The selection of internal or external printer and the output to the printer are made from this menu

RETURN TO PREVIOUS MENU Returns operation to the Menu from which the **PRESENTATION MENU** was accessed.

PRINTER CONFIGURATION MENU



PRINTER CONFIGURATION MENU (SET PRINTER MODE)

DESCRIPTION From this menu, the choice of printer (either the DP7000 or an optional Laserjet printer) and the print output are selected. The left-hand side of the menu carries the selectable options; the right-hand side of the menu carries an account of the current settings

When entering the menu, the highlighted printer is that for which the options: SET OUTPUT, SET CONNECTIONS and SET OPTIONS apply.

SET PRINTER From this option, select the printer for which the printout setup selections are to be made.

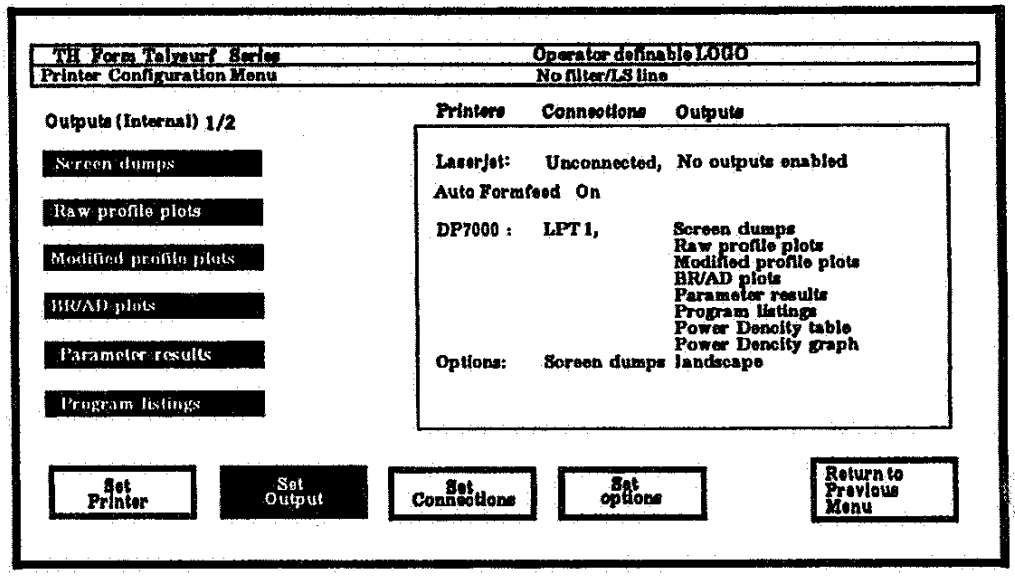
SET OUTPUT Selecting this option causes a menu to be displayed which lists the printout options. Select and highlight the boxes containing the required print output.

Dependent on the content of the system software, this menu may have more than one page of options.

Reselect the SET OUTPUT box to access any other pages: continued selection of the box will *toggle through the pages and return to the first page.*

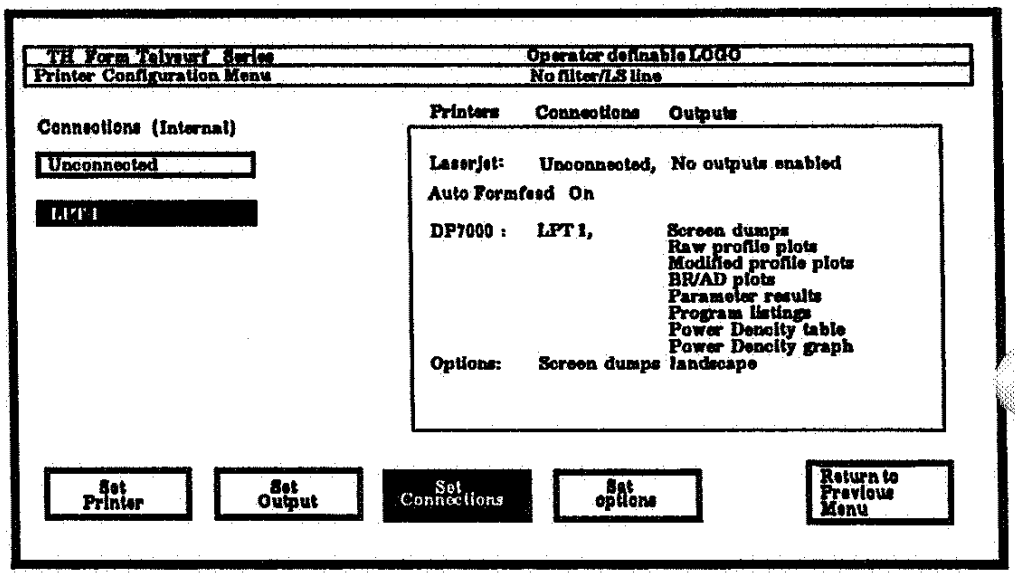
If more than one page is present, then the number of the page displayed and the total number of pages is indicated alongside the heading for the selectable options on the left-hand side of the menu: e.g 1/2 indicates page 1 is displayed and there is a total of 2 pages.

SET OUTPUT MENU (first page)



SET CONNECTION This menu enables the data output signals, from the computer to the printer currently selected in the SET PRINTER option, to be connected or disconnected. The printer selected for use must be connected.

SET CONNECTIONS MENU

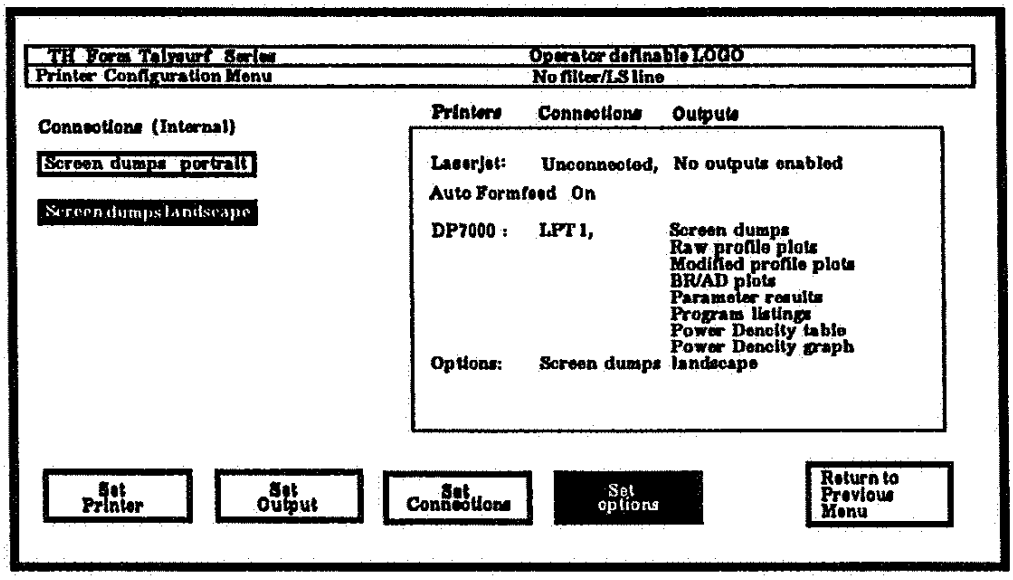


SET OPTIONS When the DP7000 printer is the set printer, this option enables the printer to provide either portrait or landscape presentation of screen dumps.

When **Laserjet** is the set printer, the option to select **Auto Formfeed On** or **Off** is included. When **On** is selected, each set of results is output, from the printer,on a separate sheet of paper. When **Off** is selected, results are not directly output, but are stored until there is enough data to fill a sheet of paper. The combined results are arranged to fit the paper and are then output from the printer.

If the program is exited in the normal manner, then any data stored for printing is output to the printer. If the program is not exited correctly or if power to the system is interrupted, then all stored print data is lost.

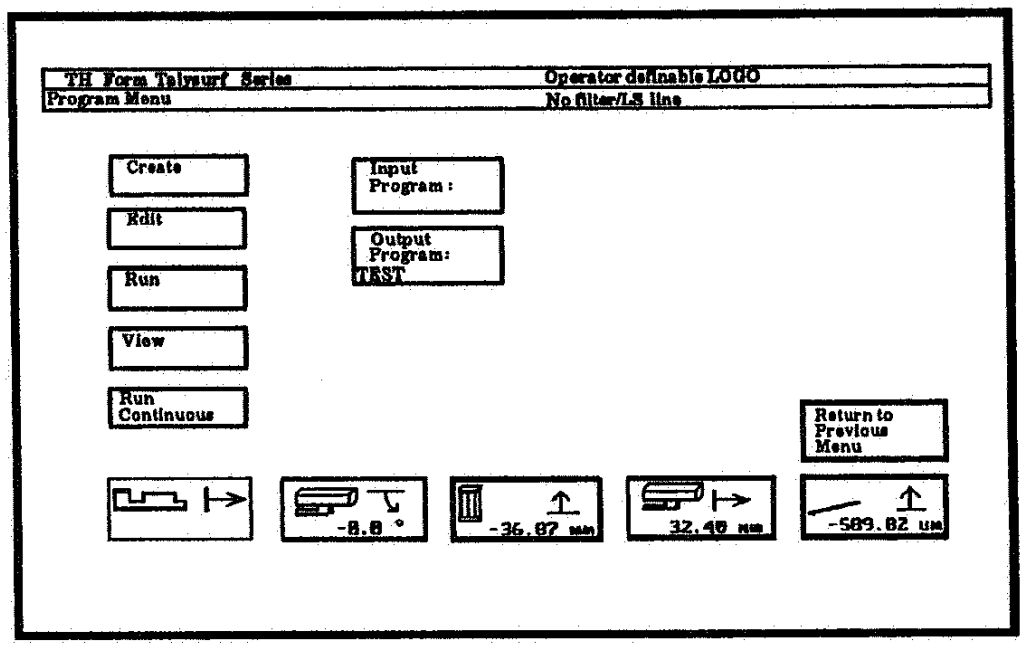
SET OPTIONS MENU



RETURN TO PREVIOUS MENU Returns operation to the Menu from which the PRINTER CONFIGURATION MENU was accessed.

PROGRAM MENU

PROGRAM MENU



DESCRIPTION The program menu controls the operation of programmed measurements and enables the operator to program and execute measurements and analyses either under full computer control or single step operation.

If, when running a program, an error occurs (e.g. gauge out of range during measurement) then, when the error message has been cleared, control is returned to the program.

Programs can be created, edited, run and viewed from this menu by selecting the relevant option (the **Create** and **Edit** functions are **not** available with Form Talysurf Series E software)..

The current program file name is shown in the Input Program name field. If a program is to be created or edited then an output file name must be specified (which can be the same as the input file name).

When a program is being viewed or edited then it can be printed out if key F7 is selected.

CREATE On selection the operator is prompted to *Enter a Program Name in the* **OUTPUT PROGRAM** box. The **MAIN MENU** is then re-displayed.

Most of the normal menus are available and these are used as in manual mode. The procedure to input a program is to perform the measurement sequence in the manner in which it is to be run. The computer learns each stage (step) as it is performed. A return back to the program menu via the MAIN MENU must be made in order to save the created program.

Additional options enabling the program to be saved or abandoned are included on the **PROGRAM MENU** after program creation.

EDIT This option is used to modify an existing program by altering steps, adding new steps, or deleting steps. The Edit facility is only valid for an existing program, and an error message is given if the specified *Input Program* does not exist.

See **EDIT PROGRAM TABLE MENU** for further details.

RUN The program specified in the Input Program name field will be run. The program is stepped through, pausing after data collections and analyses.

VIEW This option displays the VIEW PROGRAM MENU where the program steps can be viewed or printed.

See **VIEW PROGRAM MENU** for further details.

RUN CONTINUOUS This option will cause the currently selected program shown in the INPUT PROGRAM box to be executed continuously, only pausing for Dual Profile analysis and when a programmed message or the Setup menu is displayed.

A prompt for entry of a program will be displayed if there is no program name in the INPUT PROGRAM BOX.

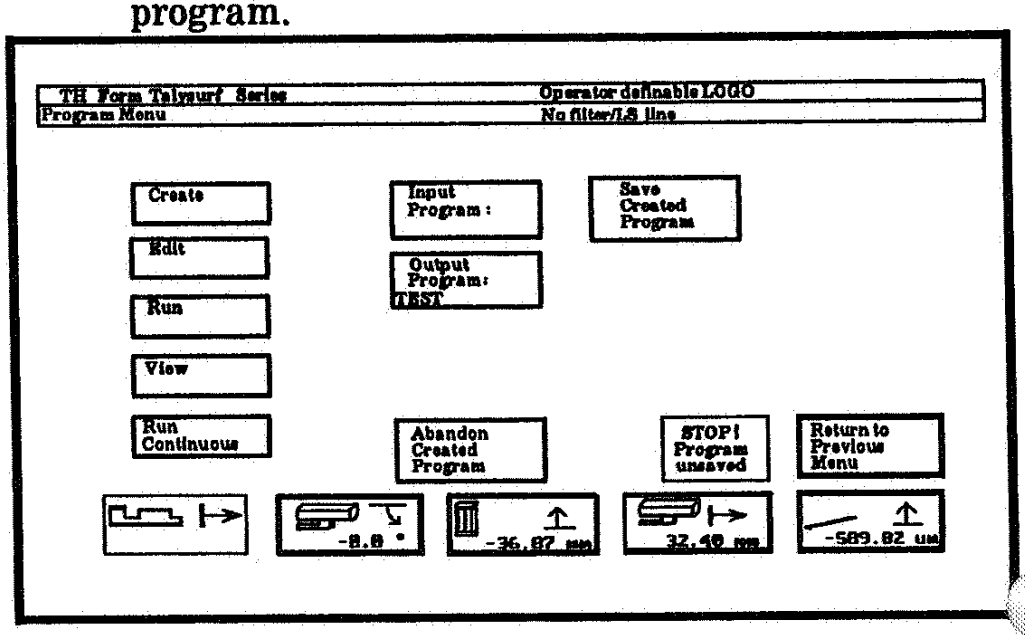
INPUT PROGRAM If any of the Edit, Run, View, or Run Continuous options are selected then the operator is prompted to enter a program name. This program will then act as the reference program for execution, viewing, or modification.

OUTPUT PROGRAM If either the **CREATE** or **EDIT** options are selected then the operator will be requested to enter an Output filename, if one is not already shown. This will be the name under which the program will be stored. In the case of an Edited program then the name can either be the same as the Input Program name or a different name. It is suggested that a new name be given so that the original can always be returned to if editing is not correctly performed by the operator.

ABANDON CREATED PROGRAM This option is only displayed during a program creation or modification. This option should be selected if the program is no longer required to be saved (e.g.If the programming is not considered acceptable).

SAVE CREATED PROGRAM This option is only displayed during a program creation or modification. This option should be used to save a successfully created or Edited program.

PROGRAM MENU (during Creating or Editing a program)



FILENAME EXISTS OVERWRITE? If **SAVE CREATED PROGRAM** is selected, and the **OUTPUT PROGRAM** name is the same as an existing filename then the operator is prompted as to whether the new file should overwrite the existing file.

YES This option is only displayed if while saving a program the filename already exists. Selection of this option will overwrite the old program with the new program.

NO This option is only displayed if while saving a program the filename already exists. Selection of this option will return the operator to the normal Program Menu where either **ABANDON CREATED PROGRAM** can be selected or the OUTPUT PROGRAM name can be changed before subsequent saving.

STOP! PROGRAM UNSAVED This option is only displayed if a created or edited program has not been saved, before the operator can return to the previous menu. Either the program must be saved or abandoned.

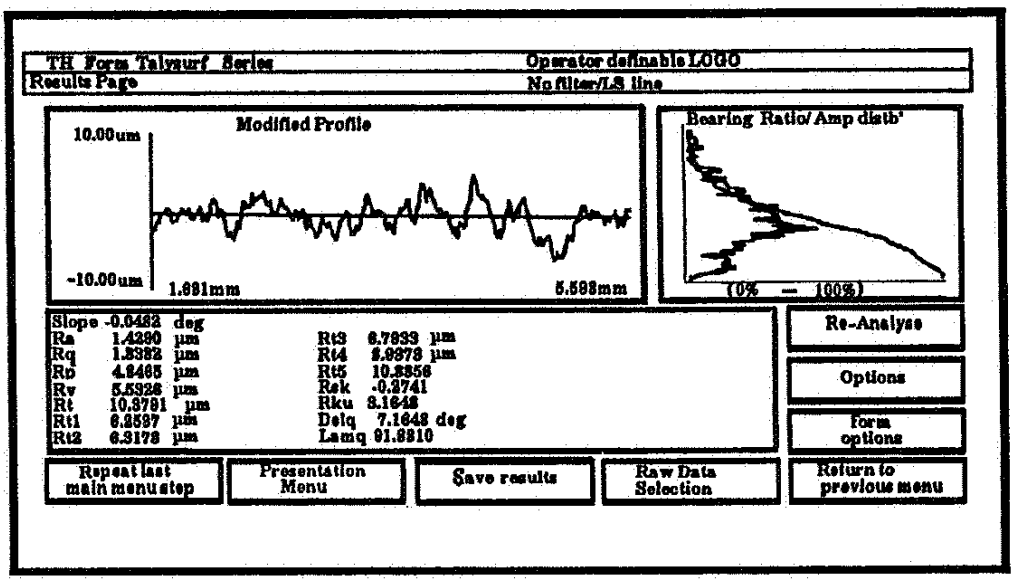
NOTE Programs are stored under MS-DOS with a filename which comprises the program name and the extension .PRG. For example:

A program which has the name TEST would be given the filename TEST.PRG

RETURN TO PREVIOUS MENU Returns operation to the Menu from which the **PROGRAM MENU** was accessed.

RESULTS PAGE

RESULTS SUMMARY PAGE



DESCRIPTION The results page is displayed after a **DATA COLLECTION, ANALYSE** from the main menu, after selecting **ANALYSE REGION** from the data selection menu, after selecting **RE-ANALYSE** from the results page and, when included, after selecting **ANALYSE** from the Gothic menu (for details of Gothic arch, see GOTHIC ARCH in Section 5). The results page can also be accessed by pressing function key F3.

Further detailed study of these results can be achieved by selecting the appropriate results display box.

MODIFIED PROFILE BOX This option will allow the Modified Profile to be further analysed by either selecting different regions, applying different filters or excluding data via the **DATA SELECTION-MODIFIED PROFILE** menu (See **DATA SELECTION-MODIFIED PROFILE** menu for further details).

BEARING RATIO BOX Selecting the bearing ratio box changes the display to the **BEARING RATIO AND AMPLITUDE DISTRIBUTION MENU** (See **BEARING**

RATIO AND AMPLITUDE DISTRIBUTION MENU for further details).

PARAMETER BOX When there are too many parameter results to fit onto the initial summary page **MORE** will be displayed in the bottom right hand corner. By selecting the parameters box the next page of values are displayed. Selecting the box again, restores the first page.

A display of ' ****** ' instead of a parameter's value indicates that a value for this parameter could not be successfully calculated.

When a program is being edited and the **RESULTS PAGE** is active, a page number is displayed in the bottom right-hand corner of the box. This will always be 1 on entry to the page and will go up by 1 every time the parameter box is selected. This number corresponds to the page of parameter results actually displayed (if any). The maximum value that the page number will reach before being set back to 1 is 4. If there are less than 4 pages of actual parameter results, then blank pages of results will be displayed, which show just the page number. This number is only used for screen dump steps so that a required sub page of parameter results can be selected.

SAVE RESULTS Selecting this option displays the Saving data menu to allow subsequent selection of the type of data to be saved and under what filename (See **SAVE DATA MENU** for further details).

REPEAT LAST MAIN MENU STEP This option causes the measurement option that was last selected on the main menu (i.e. **DATA COLLECTION OR DATA COLLECTION/ ANALYSE**) to be repeated.

RAW DATA SELECTION This option causes the raw data profile (as produced from a measurement initiated from the Data Collection option) to be displayed in the Data Selection-Raw Profile Menu (See **DATA SELECTION -RAW PROFILE** for further details).

PRESENTATION MENU This option causes the Presentation Menu to be displayed (See **PRESENTATION MENU** for further details).

RE-ANALYSE This will perform an analysis to the current filter and parameter selections and is typically used after changing a filter option or parameter selection.

Note If a new parameter is selected from the **PARAMETER SELECTION MENU** and then RE-ANALYSE, the analysis does not need to re-calculate the modified profile. Hence new parameter values can be quickly calculated.

Note If an **ANALYSE MENU** was made from the data selection menu, then a RE-ANALYSE will be based on the selected region, and not necessarily on the whole of the raw data, as it would have been if a **DATA COLLECTION, ANALYSE** had been performed.

FORM OPTIONS This will display the FORM OPTIONS menu, to allow the operator to select a different Form fit as necessary.

See **FORM OPTIONS MENU** for further details.

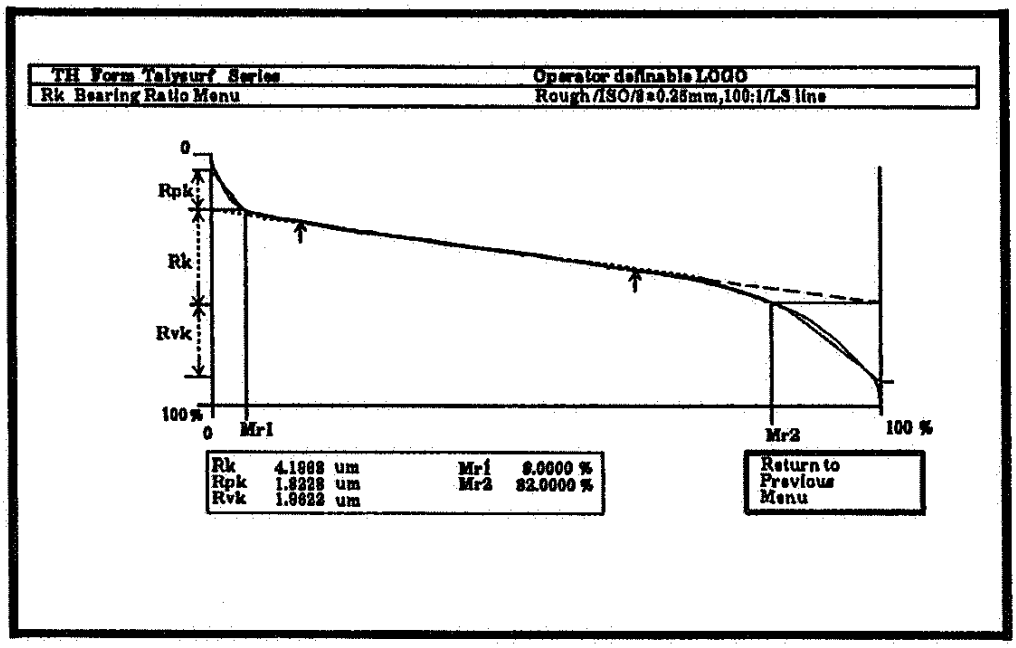
OPTIONS This will display the **FILTER AND PARAMETER OPTIONS MENU** to allow either the assessment length, filters, cut-off, Bandwidth or Number of Data points to be changed. This menu will then also provide access to the Parameter selection menu if required.

See **FILTER AND PARAMETER OPTIONS MENU** for further details.

RETURN TO PREVIOUS MENU This option will return the operator to the previously selected menu. In some instances where the previous menu was either the **DATA SELECTION-RAW PROFILE** or **DATA SELECTION-MODIFIED PROFILE** menus then this option will toggle between the two menus. The F1 key should be used to return to the **MAIN MENU.**

Rk MENU

Rk MENU



DESCRIPTION When a Roughness filter and the Bearing Ratio options have been selected, an option to display the Rk Parameters is given in the **BEARING RATIO & AMPLITUDE DISTRIBUTION MENU.**

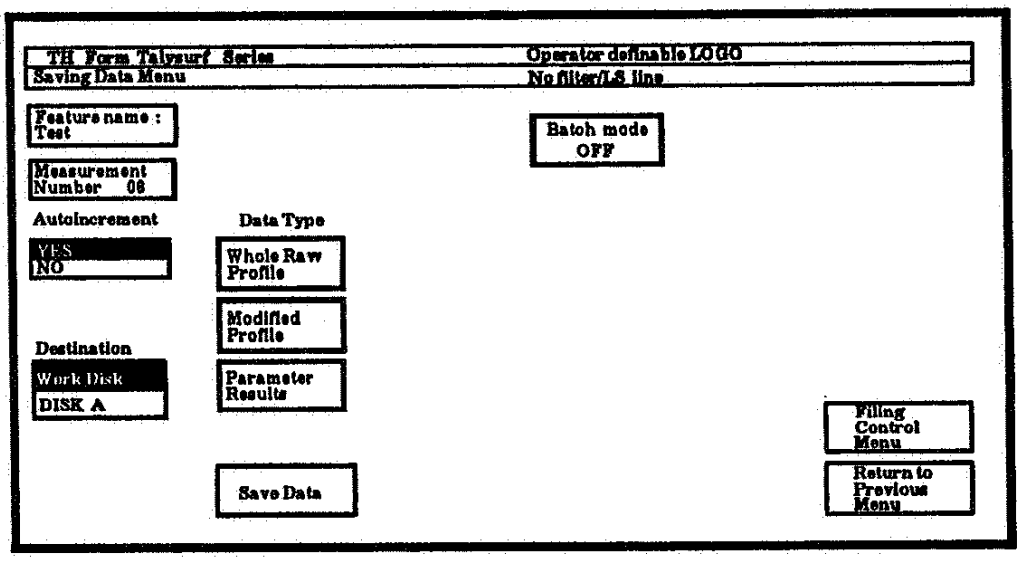
If any of the Rk parameters have been calculated then the Rk parameter results will be displayed in the Rk menu. This menu is accessed by selecting the **Rk Bearing Ratio** menu from the **Results page** or the **Rk BEARING RATIO MENU** option in the **BEARING RATIO AND AMPLITUDE DISTRIBUTION MENU.**

The graphical display shows the appropriate parameters as well as the calculated interception points of the graph.

RETURN TO PREVIOUS MENU Returns operation to the Menu from which the Rk MENU was accessed.

SAVING DATA MENU

SAVING DATA MENU



DESCRIPTION The **SAVING DATA MENU** can be accessed from the Results Page, the Data Selection menus or the File Manipulation menu. When saved, the measurement data is stored by the computer in a directory under a filename which comprises a feature name and number. The names of the directories and the feature names and numbers are specified by the operator. The feature name can be up to 5 characters long and the measurement number can be from 00 to 99. Each directory can contain many feature names and each feature name can have up to 100 sets of data, each stored as a feature number.

Files are stored under MS-DOS with a filename, which is derived from the combined Feature name and measurement number of the data file (see following page) and an extension which identifies the data type. The extensions are:

WHOLE RAW PROFILE .PRF
MODIFIED PROFILE .MOD
PARAMETER RESULTS .PAR

For example:
A raw profile data file which has the feature name TEST and the measurement number 01, would be given the filename TEST_01.PRF.

The limit to the number of directories and feature names is set only by the computer storage capacity and MS-DOS restrictions.

Data can also be copied to floppy discs for further storage or to another computer via the serial port. Data is stored with regard to its data type

Only Raw profile data files can be retrieved for reanalysis. Modified profile Data files are for use with the Dual Profile facility and user applications external to the system.

Note The current directory is set in the **FILE MANIPULATION MENU.**

FEATURE NAME When selected, the operator will be prompted to enter a feature name. This can be up to a maximum of 5 characters (and **must not** contain a full stop character '.'). This is the file name (together with it's associated measurement number) used to store the data on disk.

If a feature name is already entered, then this will be displayed in the Feature name box. If required, the operator can retain this feature name simply by pressing the ENTER key.

MEASUREMENT NUMBER When selected the operator will be prompted to enter a measurement number. This together with its associated FEATURE name is used to store the data on disk. e.g. TEST_01 (Feature name is TEST, Measurement Number is 01). If a Measurement number is already entered then this will be displayed in the Measurement number box. If selected the operator can retain this number simply by pressing the ENTER key.

AUTO INCREMENT-YES When this option is selected then each successive saving of data will be done with the next Measurement number in sequence. Each time the

data is saved the Measurement number can be seen to increment by 1.

When this option is used in program mode, the first name used will be that of the first name used at the time of program creation. It will **NOT** save the data at the next available number.

AUTO INCREMENT-NO When this option is selected then the data will be saved with the current Measurement number.

As this number does not Auto Increment then any existing data with the same Feature Name and Measurement number will be overwritten.

CAUTION Care should be used when the Auto Increment is set to NO, since valuable data can be lost if the measurement number is not incremented.

Note When running a program in **RUN CONTINUOUS mode the measurement numbers are repeated and not auto incremental with each new pass through the program.**

DESTINATION: WORKDISK When selected the data to be stored will be directed to the disk partition which contains the Form Talysurf Series program (normal installation is to disk C:).

DESTINATION: DISK A When selected the data to be stored will be directed to disk A:.

DESTINATION: DISK B When selected the data to be stored will be directed to disk B:.

DATA TYPE: WHOLE RAW PROFILE When selected (Box will be highlighted) the whole Raw Profile, as measured, will be stored.

DATA TYPE: MODIFIED DATA When selected (Box will be highlighted) the Modified Profile, as analysed, will be stored.

DATA TYPE: PARAMETER RESULTS When selected (Box will be highlighted) the parameter results, as calculated, will be stored.

Note Saved Data can consist of 1 or all of the above Data Types.

SAVE DATA When the Feature name and Measurement number have been correctly entered and the Data types chosen, this option must be selected to perform the Save operation.

When this option is selected, the data is saved to the chosen destination and, if the Auto Increment is set to YES, then the Measurement number will be incremented by 1.

BATCH MODE This option is used to turn the Batch mode on or off. When turned on, the options to enter a batch name and number are given.

The Batch Mode facility only comes into operation during the running of a program and enables measured data and results from measurement programs to be saved to either the hard or floppy disk drives of the computer. In this mode, any files which are saved during the running of a program are saved to a batch directory (e.g. BATCH.000). On each subsequent pass through the program, the files are saved to a different batch directory (e.g. BATCH.001, BATCH.002... etc). For details of batch mode operation, see SAVING DATA in section 5, see also the DELETE BATCH option of the **FILE MANIPULATION MENU**.

SPC MENU When included, this additional option selects the **SPC MENU**. See **SPC MENU** for further details.

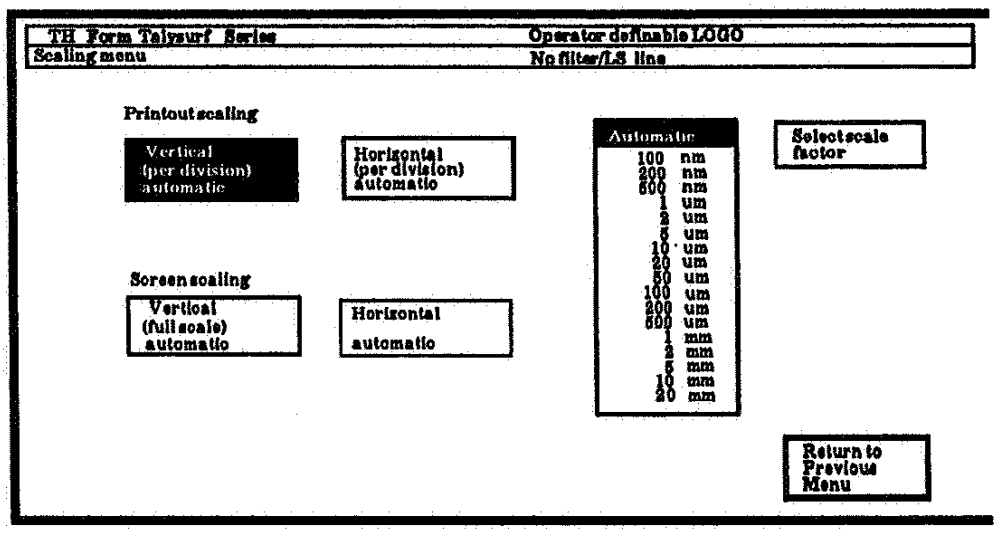
FILING CONTROL MENU This option selects the **FILE MANIPULATION MENU**. This may be chosen to view the current Feature names used to either avoid selecting an already existing Feature name, or to select an existing Feature name on which continued Saving of Data is required.

See **FILE MANIPULATION MENU** for further details.

RETURN TO PREVIOUS MENU Returns operation to the Menu from which the **SAVING DATA MENU** was accessed.

SCALING MENU

SCALING MENU



DESCRIPTION From this menu, the scaling of results displays and print-outs is set.

The horizontal scaling is not selectable for screen displays. The vertical scale is dependent on the resolution of the pick-up in use; minimum values for the nominal gauge range being:

System	Resolution	Screen /Print Scaling
Laser	10nm	2µm
PGI	12.2	2µm
Inductive	16nm	2µm
Contour	305nm	50µm

The scale is determined as follows:
The P to V value of the measured profile is divided by 10 and the result is rounded up to the nearest decade value of 1, 2, 5, 10 ,20, 50, 100... etc. This value then provides the chart scale divisions. If the profile then exceeds the full scale limits, a further rounding to the next value in the decade is made.

The smallest full scale value = 100 x gauge resolution rounded up. If a scale smaller than the gauge range x 100 is selected, then the smallest possible scale is displayed or printed. In this case the profile may be clipped at the top or bottom, as it exceeds the full scale limits.

Note The minimum vertical scaling will be restricted by the resolution of the gauge. The selected scale may therefore automatically be increased when a display or print-out is made.

PRINT-OUT SCALING Graphs printed of RAW PROFILES are automatically vertically scaled. The vertical scaling of graphs to be printed of MODIFIED PROFILES can be selected from the **Vertical (per division)** box. A list of vertical scale options is then displayed. Select in the box until the required scale is highlighted. To confirm the setting, select in the **Select scale factor** box.

Repeat the procedure for the horizontal scale factor, by first selecting in the **Horizontal (per division)** box. The minimum profile length that can be printed is one division.

Note It is possible to select a scale factor which causes the graph to be printed at a magnification higher than that which can be contained within the limits of the paper. In such instances the graph will still be printed with the extremes 'cropped' at the limits of the paper width.

If the scale selected gives a graph magnification which is too high for compatibility with the profile data (which is dependent on the resolution of the pick-up gauge), then the graph is printed with a reduced magnification and the message:
WARNING: VERTICAL SCALE HAS BEEN ADJUSTED.

SCREEN SCALING To set the vertical scaling of displays, select the **Vertical (full scale)** box. A list of vertical scale options is then displayed. Select in the box until the required scale is highlighted.

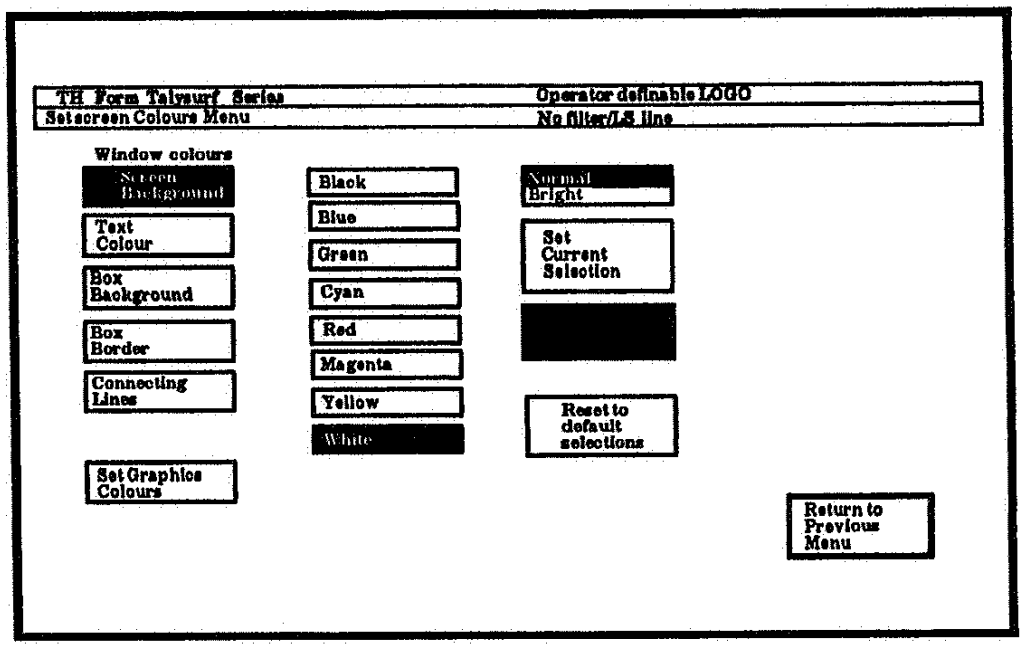
To confirm the setting, select in the **Select scale factor** box.

NOTE The resolution of screen displays is less than that of the printout, therefore, some printouts may show features not visible on the screen.

RETURN TO PREVIOUS MENU Returns operation to the **PRESENTATION MENU**.

SCREEN COLOURS MENU

SET SCREEN COLOURS MENU



DESCRIPTION From this menu, the operator can set up foreground/background screen colours. Having made the required selections, the 'Set Current Selection' option must be selected to confirm the selections. The Reset to default selections option can be selected to restore the Taylor Hobson selections.

NORMAL The selection of **'Normal'** or **'Bright'** colours can be used to enhance the standard colours provided. For example by selection of Bright Black a greyish colour can be obtained.

SET CURRENT SELECTION This option must be selected after choosing the colour, when selected the colour will be shown in the blank colour box.

SET GRAPHICS Allows the colours for the graphical displays and icons to be set.

SET WINDOW COLOURS Allows the colours for the Menu displays to be set.

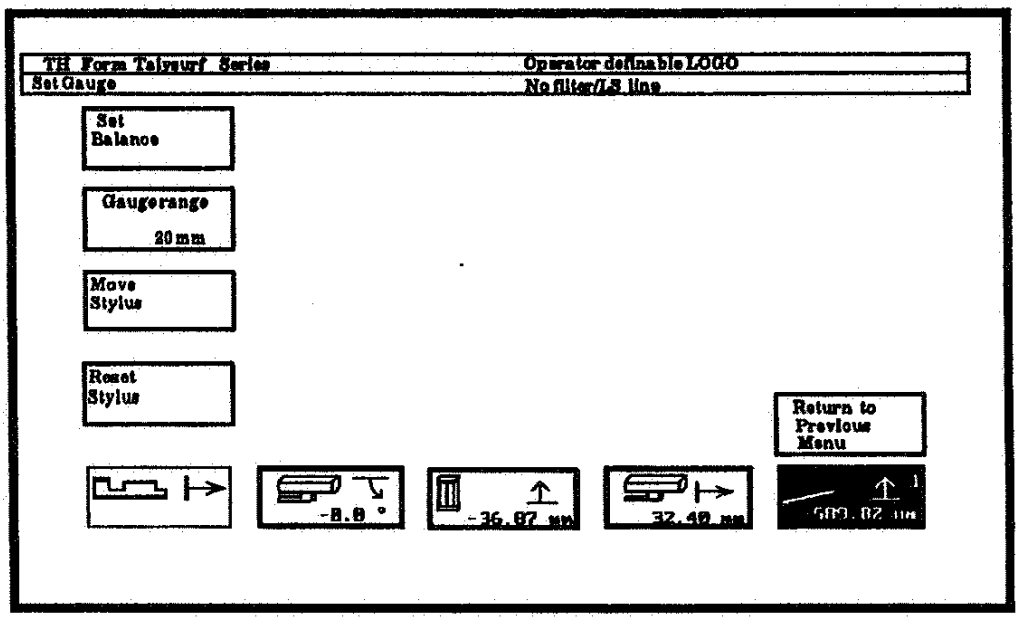
RESET TO DEFAULT SELECTIONS Returns all menu and graph colours to the colours originally set by Rank Taylor Hobson Ltd.

RETURN TO PREVIOUS MENU Returns operation to the menu from which the **SCREEN COLOURS MENU** was accessed.

Note Care should be taken not to select colours which when printed using the F8 screen dump option appear as White on White or Black on Black. e.g. CYAN on WHITE.

SET GAUGE MENU

SET GAUGE MENU



DESCRIPTION This menu is displayed on selection of the Gauge Icon, and is used to set the PHASE and BALANCE of the gauge and the GAUGE RANGE . When a contour pick-up is fitted, options to MOVE STYLUS and RESET STYLUS are also available.

SET BALANCE On selection two options are displayed:

Auto-Balance
Extending
Traverse unit

and

Auto-Balance
Retracting
Traverse unit

See **CHAPTER 5 - SELECTED TOPICS "Matching The Gauge".**

GAUGE RANGE When this option is selected, a list of ranges and associated data resolutions, appropriate to the pick-up and stylus in use, is displayed.

The options given for the standard inductive pick-up are

1mm range stylus arm fitted:

Range #1. This gives a gauge range of 1mm with a resolution of 16nm, care should be used on surface finishes of better than 0.2µm Rq (8µin Rq).

Range #2. This gives a restricted range of 0.2mm, but an increased resolution of 3.2nm,and is more suitable for surface finishes in the order of 0.04µm Rq (1.6µin Rq).

Range #3. Giving a range of 0.04mm, and with a resolution of 0.64nm. This is suitable for all surfaces, including super fine surfaces.

The gauge ranges on systems with a contour pick-up are:

20mm range stylus arm fitted:

Range #1. This gives a gauge range of 20 mm with a resolution of 0.31µm.

Range #2. This gives a range of 4.0mm, with a resolution of 0.06µm.

15mm range stylus arm fitted:

Range #1. This gives a gauge range of 15 mm with a resolution of 0.23µm.

Range #2. This gives a range of 3.0mm, with a resolution of 0.046µm.

The gauge range on systems with a **Laser traverse unit** are not selectable.

Note In program mode, when a measurement is made, the current gauge range is saved with the measurement information. If the measurement is required at a different gauge range, then the program must be edited to select the correct gauge range and then **the actual measurement step must be deleted and then re-entered.**

MOVE STYLUS This option is available for use with the contour pick-up only. When selected, a stylus height position can be entered, to which the stylus arm will move. This position will remain until a reset stylus, contact or measurement operation is carried out.

Any height within the range ±9mm, for the 20mm range stylus, or ±6.5mm for the 15mm range stylus, can be entered, with Range # 1.

RESET STYLUS This option is available for use with the contour pick-up only. When selected, any height value set at the **MOVE STYLUS** option is discarded and the stylus is free to move to its normal rest position.

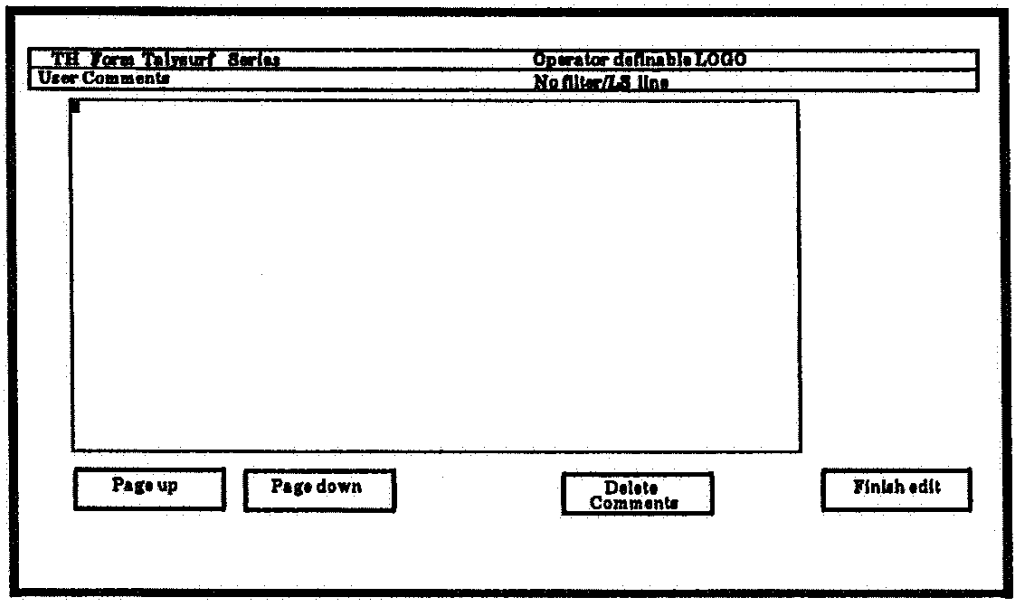
RESET GAUGE This option is available for use with the P.G.I. gauge only. If the stylus, of a P.G.I. gauge is subjected to very rapid movement (e.g. if allowed to fall freely), then the actual position of the stylus arm can be lost to the system. This is apparent when the position of the stylus arm, displayed on the gauge icon, does not agree with actual position of the stylus arm.

In which case, to reset the gauge position, the stylus must be raised clear of contact with any surface and the RESET GAUGE option selected.

RETURN TO PREVIOUS MENU Returns operation to the Menu from which the **SET GAUGE MENU** was accessed.

USER COMMENTS MENU

USER COMMENTS MENU



DESCRIPTION The **USER COMMENTS MENU** is accessed by pressing function key **F11**. This menu provides the facility for the operator to enter and edit text on the display. The text entered, is then included on Results print-outs, when the **INCLUDE USER COMMENTS** option is selected on the FURTHER PRESENTATION SETTINGS MENU. Comments are saved in file COMMENTS.CMT, in the current directory (see FILE HANDLING MENU). A new comments file can, therefore, be created for each directory used.

Text is entered by typing in the ordinary manner, the cursor Θ indicating the screen location at which text will commence.

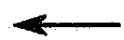
If only one line of text is typed, then terminate the line with a carriage return (the ENTER key).

The key functions are as follows:

↑ ↓ →← Pressing these keys causes the cursor to move in the direction of the arrow, with no effect on

existing text. The arrow keys can be used to place text anywhere on the page .

The enter key is used only when a new line is required. As each line of text fills the width of the screen, a new line is automatically started.



Pressing the backspace key causes the cursor to move one space from right to left deleting the character to the left of the cursor.

SPACE BAR Pressing the space bar causes the cursor to move one space from left to right. Characters are deleted as the cursor moves into its position. Space in the text is created using this key.

DELETE Pressing this key causes the character on which the cursor was positioned to be deleted. Existing text moves in to fill the space of the character deleted. No space in the text is created.

INSERT Pressing this key causes the cursor to flash on and off. In this mode, the arrow keys can be used to position the cursor into existing text, then typing can commence, with existing text being automatically moved to accommodate the new text. Pressing the INSERT key again will deselect the *insert* mode and the cursor ceases to flash. In this mode, new text is not inserted but will overwrite any existing text.

HOME Pressing this key, causes the first page to be displayed with the cursor on the first character.

END Pressing this key, causes the last page to be displayed, with the cursor placed at the start of the last line.

PAGE UP Pages the screen one page up

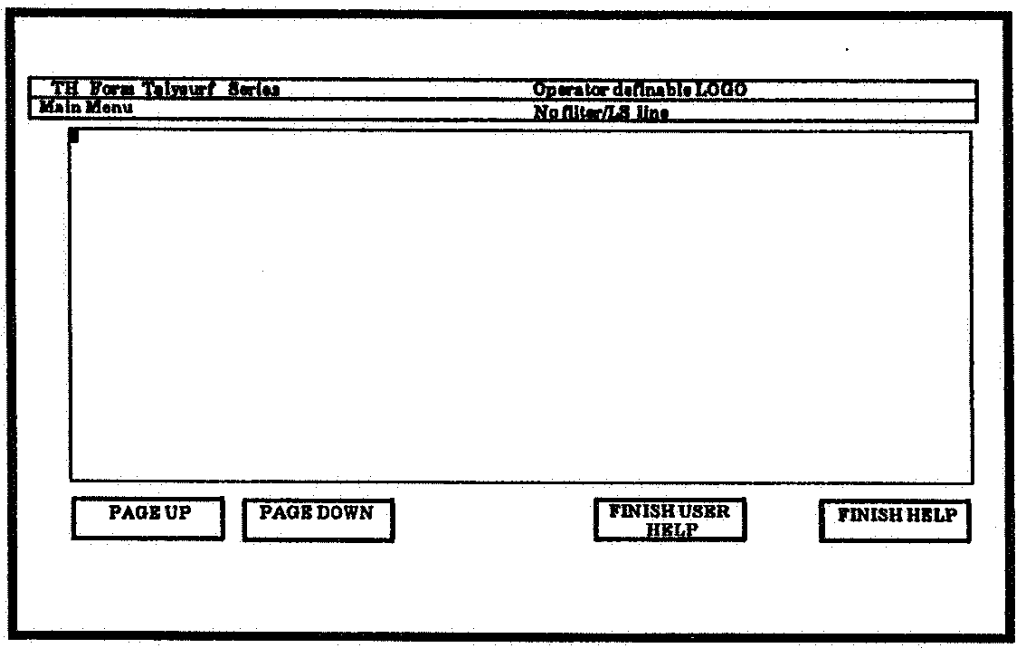
PAGE DOWN Pages the screen one page down.

DELETE COMMENTS Pressing this key, causes all comments to be deleted.

FINISH EDIT Returns the operation to the previously selected menu.

USER HELP MENU

USER HELP MENU



DESCRIPTION The **USER HELP MENU** is accessed from the **HELP MENU** (key F2), This menu provides the facility for the operator to enter and edit text on the display. This text is then included as part of the on screen help facility and is accessed only from the **HELP MENU**.

Text is entered by typing in the ordinary manner, the cursor indicating the screen location at which text will commence.

The key functions are as follows:

↑ ↓ →← Pressing these keys causes the cursor to move in the direction of the arrow, with no effect on existing text. The arrow keys can be used to place text anywhere on the page .

↵ The enter key is used only when a new line is required. As each line of text fills the width of the screen, a new line is automatically started.

← Pressing the backspace key causes the cursor to move one space from right to left deleting the character to the left of the cursor.

SPACE BAR Pressing the space bar causes the cursor to move one space from left to right. Characters are deleted as the cursor moves into its position. Space in the text is created using this key.

DELETE Pressing this key causes the character on which the cursor was positioned to be deleted. Existing text moves in to fill the space of the character deleted. No space in the text is created.

INSERT Pressing this key causes the cursor to flash on and off. In this mode, the arrow keys can be used to position the cursor into existing text, then typing can commence, with existing text being automatically moved to accommodate the new text. Pressing the INSERT key again will deselect the *insert* mode and the cursor ceases to flash. In this mode, new text is not inserted but will overwrite any existing text.

HOME Pressing this key, causes the first page to be displayed with the cursor on the first character.

END Pressing this key, causes the last page to be displayed, with the cursor placed at the start of the last line.

PAGE UP Pages the screen one page up

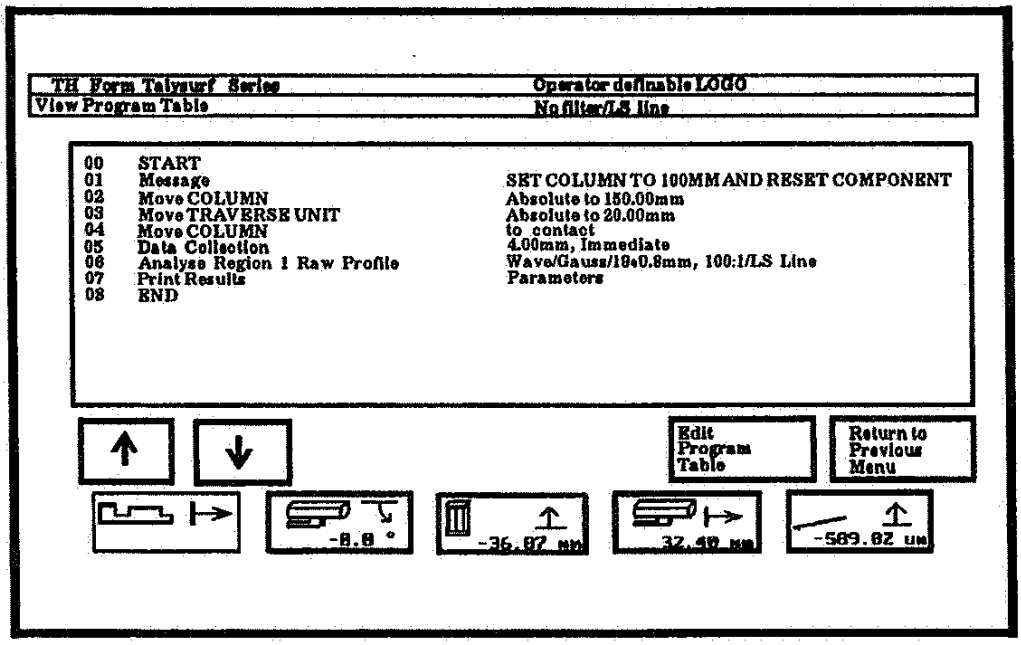
PAGE DOWN Pages the screen one page down.

FINISH USER HELP Returns the user to the **HELP MENU.**

FINISH HELP Returns the operation to the previously selected menu. (key F2 performs the same function).

VIEW PROGRAM TABLE MENU

VIEW PROGRAM TABLE MENU



DESCRIPTION This menu allows the operator to see a longer list of program commands than that shown in the EDIT PROGRAM MENU. It is accessed either from the EDIT PROGRAM MENU or directly on selection from the PROGRAM MENU.

UP ARROW On selection the table will be scrolled up one page.

DOWN ARROW On selection the table will be scrolled down one page.

EDIT TABLE On selection the EDIT PROGRAM TABLE MENU will be displayed. See **EDIT PROGRAM TABLE MENU** for further information.

RETURN TO PREVIOUS MENU Return to the Menu from which the VIEW PROGRAM TABLE MENU was accessed.

CHAPTER 5
SELECTED TOPICS

This chapter provides a step by step guide through various selected topics in the application of the instrument.

CONTENTS OF THIS CHAPTER

CALIBRATING THE AXES

DESCRIPTION The axes positions require calibration only when absolute positional commands are required. Although the positions are stored when 'Terminating' the program, it is good operational practice to perform this function each time the system is switched on, or at the start of a program, since it will reduce the incidence of program malfunction (as may occur if the start point is different to the expected position which may be caused if an incorrect axes calibration has been performed).

1. From the Main Menu select the **CALIBRATE** option.
2. Select the **CALIBRATE AXES** option.
3. Select the **ENTER TRAVERSE UNIT POSITION**, followed by entry of the current position via the keyboard.
4. If the system has a Motorised Column then select the **ENTER COLUMN POSITION option, followed by entry of the current position via the keyboard.**
5. **If the system has a Motorised Y axis table then select the ENTER TRAVERSE TABLE POSITION** option, followed by entry of the current position via the keyboard.
6. Select **F1** to return to the Main Menu. The axes are now calibrated.

Note It is not necessary to calibrate the Column Til position.

MATCHING THE GAUGE

SYSTEMS WITH INDUCTIVE PICK-UP ONLY

DESCRIPTION It is necessary to occasionally run an automatic procedure which tests the electrical characteristics of the gauge and causes its individual resistive and inductive characteristics to be matched to the system electronics.

It is essential to run this procedure when the system has been newly installed, relocated, or when the gauge has been changed.

The procedure requires that a traverse is made over a surface which allows the stylus to start with a positive gauge reading and, during the traverse, the gauge reading must pass through zero and record a stylus movement of at least half of gauge range 2. This must be achieved in the available traverse length (which can be in either the traverse unit extend or retract direction).

Therefore, this procedure requires that the surface, over which the traverse is to be made, contains an appropriate slope or radius. A suitable surface can be made from a tilted glass flat (a smooth portion of the 3 line standard can be used) which is tilted at $6° \pm 1/2°$. However, the calibration ball provides a suitable surface and is particularly convenient as it is required that the gauge is recalibrated after the balances are set.

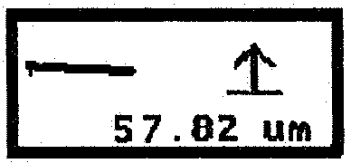
The procedure, described following, assumes the use of the calibration ball.

PROCEDURE This procedure **MUST** be performed with the pick-up **SKIDLESS.** Lock the pick-up stem or hinge unit and remove the pick-up nosepiece.

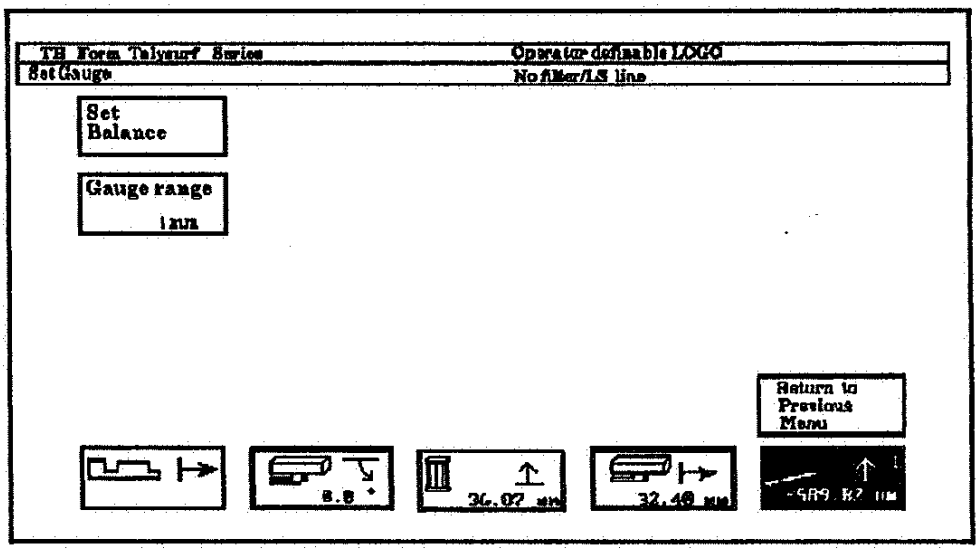
Note Check that the correct details of the pick-up and stylus currently fitted are entered in the **GAUGE INFORMATION MENU.**

Place the ball calibration standard below the stylus with the tip just above the crown of the ball.(accurate crowning of the ball is not necessary).

If the system does not include a motorised column, then lower the stylus into contact with the ball until a gauge reading between 5% and 10% of gauge range 2 (e.g between 0.01mm and 0.02mm, when using the standard inductive gauge).



Select the gauge icon to display the SET GAUGE MENU.



Select the **Set Balance** option. Two options are displayed:

Auto-Balance Extending Traverse unit

Auto-Balance Retracting Traverse unit

Depending on which direction the traverse is to be made, select one of these options.

On systems which do not include a motorised column, the stylus is immediately traversed over the ball. If the system does include a motorised column, then the stylus will automatically contact the ball, adjust the height to the correct gauge setting and make the traverse required.

The message:

Calibrating

is displayed and the adjustments are automatically made.

On completion, the message:

Calibration Successful

is displayed with an **OK** box.

To continue, move the displayed mouse pointer onto the **OK** box and press the left mouse key.

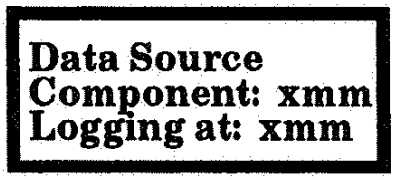
NOTE After running the above procedure, the gauge gain should be calibrated. See CALIBRATION USING THE BALL OR 80mm RADIUS STANDARD, in this section of the handbook.

CALIBRATION USING THE 3 LINE STANDARD

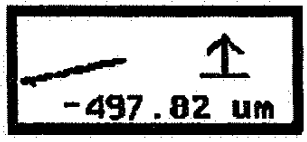
DESCRIPTION Corrections for the gain of the system electronics, are made by the computer. In order that the corrections can be made, a series of constants whose values represent the characteristics of the individual stylus geometry, are required. These constants, if known, can be input directly via the **GAUGE INFORMATION MENU,** or automatically determined and entered by running the CALIBRATION routine.

Note Before calibration, check that the correct details of the pick-up and stylus currently fitted are entered in the **GAUGE INFORMATION MENU** and that the gauge matching routine, has been run for the gauge fitted (see MATCHING THE GAUGE, in this section of the handbook).

PROCEDURE The calibration routine using the three line standard can be made either with or without the skid nosepiece fitted.

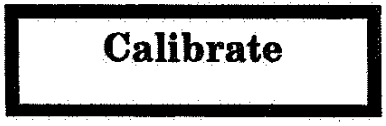


From the **Main Menu**, select the **Data Source icon** and select the **Component** option. Press the ENTER key in response to the requests for *traverse length* and *Data log position* (these items are ignored during calibration).



From the **Main Menu**, select the **gauge position icon** to display the **Set Gauge** menu.

Select the **Gauge Range** option and select **Range #3** (Not applicable for Laser based systems)..



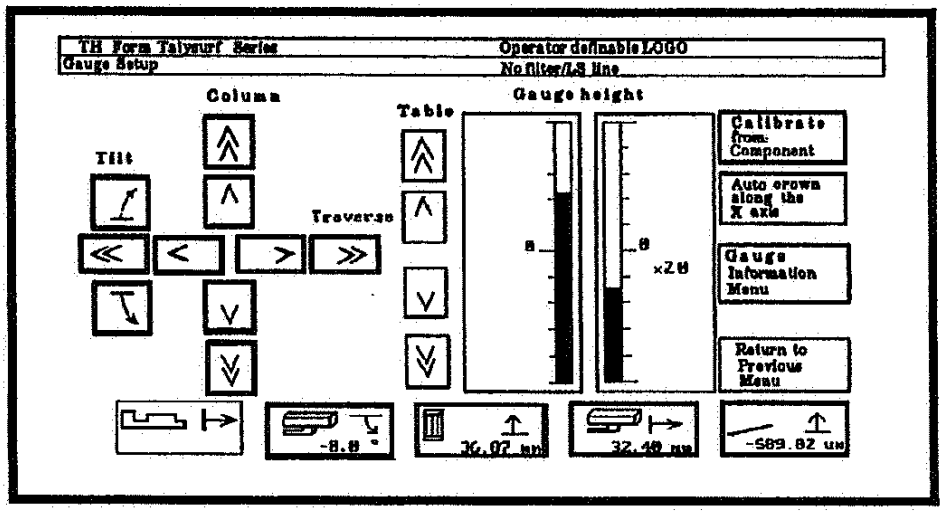
Return to the **Main Menu** by pressing **F1** and select the **Calibrate** option.

The **Calibration Menu** is then displayed.

3 line Calibration Height: 2.35µm

Select the **3 Line Calibration** option. The message *Enter Edge Height* is displayed and the exact value marked on the standard (nominally 2.5µm) should be entered from the keyboard.

Select the **Calibrate Gauge** option. The Gauge Set Up display is then presented



SETTING UP

1. Place the calibration standard below the stylus.
2. Lower the stylus into contact with the standard, at a point just in front of the marked rectangle which contains the three lines to be measured. The stylus should be positioned to bring the gauge reading to approximately mid position.

On systems equipped with the motorised column, this can be performed by selecting the UP/DOWN arrows of the set up menu, or by using the Move Column Contact option, selected from the Column Icon (see Move Column Menu). Gauge contact on free standing systems is performed by using the height adjustment of the hinge unit.

Check that the calibration standard is nominally level with respect to the traverse unit. This can be done initially by eye, and then by observing the gauge height position at the 2 ends of the proposed traverse (approx. 3mm).

If the standard is not sufficiently levelled then reference should be made to 'Selected Topics:- Levelling' and the appropriate levelling action taken.

Calibrate from component

When set up is completed, select the **Calibrate** option. An automatic measurement is then made.

On completion of the measurement, the calibration constants are calculated and the Results Summary is displayed. If the results display indicates that the calibration measurement is acceptable, then select either in the **Modified profile** box or the **Return to Previous Menu** option.

Continue

The options of **Continue** and **Save Calib Info** are displayed.

Save Calib Info

Select the Save Calib Info option. The **Gauge Information Menu** is then displayed.

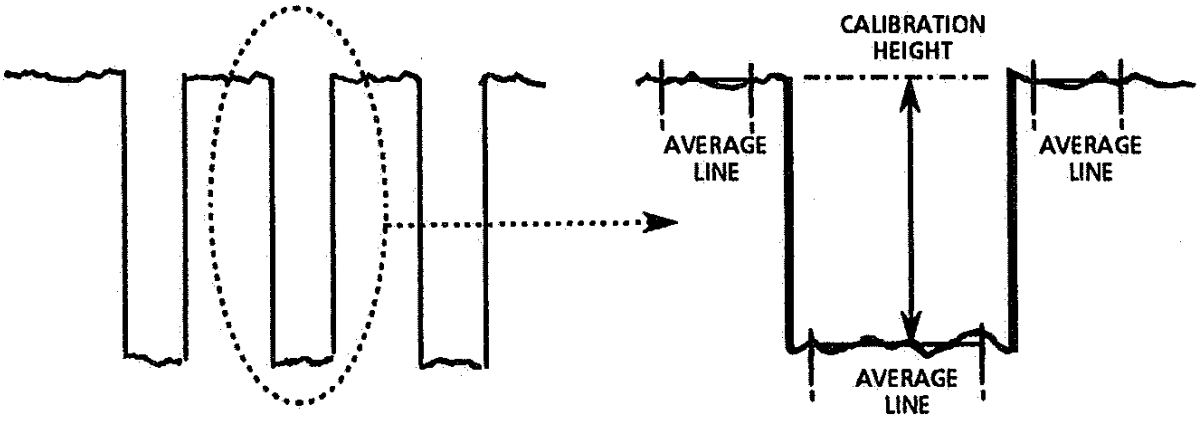
Select the **Save New Calibration Information option. The prompt** *Enter user ID* is displayed. Enter an appropriate title and press the ENTER key. The constants are then stored in the calibration history file and will be used for all future measurements until such time as a new calibration is performed or stored constants are recalled from the calibration file.

Note After a calibration, the system will display the results page appropriate to the calibration just completed. The purpose of this display is to highlight errors which may be cause for performing another calibration.

The R_t value shown on this results page will typically **not** correspond with the value shown on the standard. The R_t value applies to the complet measured profile and is not indicative of how the calibration value is determined.

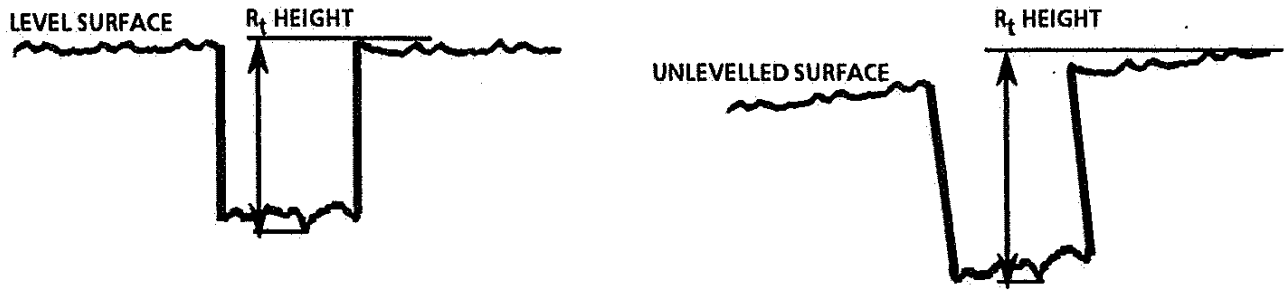
The purpose of the calibration routine is to accurately set the correct *gain* of the stylus displacement. To achieve this, it is necessary to determine a stable average value of the middle step of the standard (the R_t value is the most unstable of peak parameters). This is done as follows:

On either side and at the bottom of the central step, of the standard, average gauge positions are determined. The difference between the upper and lower values is deemed to be the calibrated height (this is NOT the R_t value).



The R_t value is defined as the maximum peak to valley height of the profile in the assessment length, and this will also include any residual component slope.

The difference between the R_t shown in the results, and the value marked on the standard is often accentuated by the high spatial resolution of the Form Talysurf Series, dirt on the standard and the Measurement being performed on an unlevelled profile, e.g.



CALIBRATION USING THE BALL or 80mm RADIUS STANDARD

DESCRIPTION Corrections for the gain of the system electronics, are made by the computer. In order that the corrections can be made, a series of constants whose values represent the characteristics of the individual stylus geometry, are required. These constants, if known, can be input directly via the **GAUGE INFORMATION MENU,** or automatically determined and then entered by running the CALIBRATION routine.

The preferred calibration standard used should be appropriate to the pick-up and stylus type used, as follows:

Stylus Code	Stylus Type	Calibration Radius (mm)	Form Error
Standard inductive pick-up 112/2564			
112/2009	2µm Standard	12.5	≯0.25µm
112/2010	0.5mm ball	22	≯0.5µm
112/2011	2µm recess	12.5	≯0.25µm
112/2012	2µm Small bore	12.5	≯0.25µm
112/2013	Chisel edge	12.5	≯0.3µm
Laser pick-up 112/2033			
112/1834	2µm Small bore	22	≯0.15µm
112/1836	2µm Standard	22	≯0.15µm
112/2041	0.5mm Ball	80	≯0.5µm
112/2042	0.5mm Ball	22	≯0.3µm
112/1846	2µm Right angle	22	≯0.2µm
112/1848	2µm Recess	22	≯0.2µm
112/1959	2µm Right angle	22	≯0.2µm
112/2061	2µm Min. bore	12.5	≯0.15µm
Contour pick-up 112/2613			
112/2024	Conical	80	≯15µm
112/2025	Chisel edge	80	≯15µm
112/2026	0.5mm Ball	80	≯15µm
Wide Range pick-up 112/2628			
501/1684	20µm Chisel edge	*	≯15µm
501/1685	20µmConical tip	*	≯15µm
501/1686	0.5mm Ball	*	≯15µm

*120 mm traverse units - 80mm calibration radius.
50 mm traverse units - 22mm calibration radius.

P.G.I. system 510/941 Calibrated over maximum range.

Stylus Code	Stylus Type	Calibration Radius (mm)	Form Error	Calibrated Range (mm)	Total Range (mm)
112/2619	Standard (60mm arm)	80	⩾0.75µm	±4	±5
112/2620	0.5mm ball (120mm arm)	80	⩾1.30µm	±8	±10
112/2621	0.5mm ball (150mm arm)	80	⩾1.80µm	±10	±12.5
112/2622	Small bore (60mm arm)	22	⩾0.15µm	NA	NA
112/2623	Min.bore (60mm arm)	12.5	⩾0.15µm	NA	NA
112/2624	2µm recess	80	⩾1.5µm	±4	±5
112/2625	Rt angle for.facing	80	⩾0.75µm	±4	±5
112/2626	Rt angle rear .facing	80	⩾0.75µm	±4	±5
112/2689	Standard (60mm arm) *	80	⩾0.75µm	±4	±5

Alternatively, for maximum accuracy over a reduced vertical range, then calibrations that are normally carried out over the 80mm radius glass standard can be made over the 22mm radius ball standard:

Calibrated for max.accuracy.

Stylus Code	Stylus Type	Calibration Radius (mm)	Form Error	Calibrated Range (mm)	Total Range (mm)
112/2619	Standard (60mm arm)	22	⩾0.15µm	±2	±5
112/2620	0.5mm ball (120mm arm)	22	⩾0.35µm	±4	±10
112/2621	0.5mm ball (150mm arm)	22	⩾0.50µm	±5	±12.5
112/2622	Small bore (60mm arm)	22	⩾0.15µm	NA	NA
112/2623	Min.bore (60mm arm)	12.5	⩾0.15µm	NA	NA
112/2624	Recess	22	⩾0.2µm	±2	±5
112/2625	Rt angle for.facing	22	⩾0.2µm	±2	±5
112/2626	Rt angle rear .facing	22	⩾0.2µm	±2	±5
112/2689	Standard (60mm arm) *	22	⩾0.2µm	±2	±5

* Stylus tips comprise a ball or 90° conisphere, except those indicated by * which have a 60° conisphere.

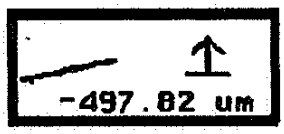
Note Before calibration, check that the correct details of the pick-up and stylus currently fitted are entered in the **GAUGE INFORMATION MENU.**

PROCEDURE Calibration using the ball or radius standard, **MUST** be performed with the pick-up **SKIDLESS.** Lock the pick-up stem or hinge unit and remove the pick-up nosepiece.

Data Source
Component: xmm
Logging at: xmm

From the **Main Menu**, select the **Data Source option and select option Immediate** or **Component** (the selections for **Traverse length** and **Data Logging** position are not important, as these are set by the computer during calibration).

Note: When required, calibration can be made from suitable data from a **file** or **memory.**



Return to the **Main Menu** and select the Gauge position icon to display the **Set Gauge Menu.**

Gauge range
1mm

Select the **Gauge range** option and select **Range #1.** (Not applicable for Laser and P.G.I.based systems).

Calibrate

Return to the **Main Menu,** by pressing **F1** and select the **Calibrate** option.

The options of **Ball Radius** and **3 line Calibration** are then displayed.

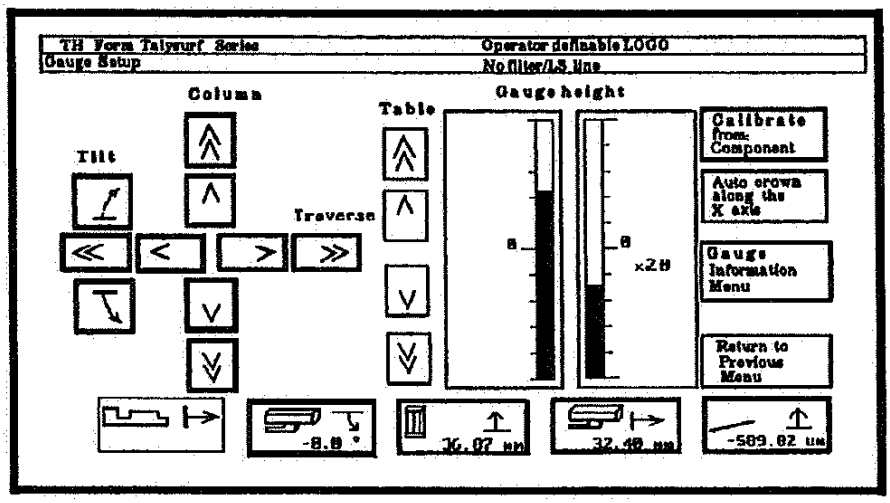
Ball Calibration radius:
xx.xmm

Select the **Ball Radius** option. The Message *Enter Radius* is displayed.

Enter the radius of the Calibration standard (the ball radius is marked on a label mounted on the bottom of the standard base, the radius of the 80mm standard can be seen through the glass hemisphere).

Calibrate Gauge

Select the **Calibrate Gauge** option. The Gauge Set Up display is then presented.



SETTING UP The standard must be crowned in both the Y and X axes before the measurement is made. For this reason, it is preferred that it is mounted on a Y axis table. The crowning procedure is as follows:

1. Place the standard on the Y axis table, so that the crown is approximately below the stylus tip.
2. Lower the stylus into contact with the standard, until the vernier graphic indicates that the gauge is approximately mid range (gauge reading approx. 0).

CROWNING IN THE 'Y' AXIS This is done by turning the knob of the 'Y-Axis' table to move the standard in the direction which causes the 'Z' axis (gauge reading) to rise.

Continue traversing until the stylus peaks and begins to fall. Reverse the direction of traverse and carefully watch the display for the point at which the rise changes to a fall. This position is the crown of the ball in the 'Y' direction.

CROWNING IN THE 'X' AXIS When crowning the 'Y' axis is complete, the 'X' axis must also be crowned. This is done by traversing the pick-up over the crest of the standard and checking the gauge position to determine the turning point (the point at which the reading is a maximum). The stylus can be traversed by using the LEFT/RIGHT arrows of the set up menu.

Observe the displayed vernier scale, and traverse the stylus over the standard in the direction which

causes the 'Z' axis (gauge reading) to rise. Continue traversing until the stylus peaks and begins to fall. Reverse the direction of traverse and carefully watch the display for the point at which the rise changes to a fall. This position is the crown of the standard in the 'X' direction.
The stylus should be left at this position.

AUTO CROWN ALONG 'X' AXIS

After manually crowning in the 'Y' axis, a procedure which automatically crowns the stylus in the 'X' axis can be run. With free standing systems, the stylus must be positioned very close to the crown, otherwise the gauge may go out of range during crowning (with motorised column systems, the column is automatically moved to avoid this happening). The procedure is as follows:

Auto crown along the X axis

Select the **Auto crown along X axis** option from the **Gauge set up menu**. The instrument will then make a series of measurements which automatically adjust the position of the stylus (& column), until the stylus is set on the crown of the standard in the 'X' axis.

Calibrate from component

When set up is completed, select the **Calibrate option. An automatic measurement is then made. On completion of the measurement, the calibration constants are calculated and the Results Summary displayed.**

The radius value shown in the Results Summary may not coincide exactly with the radius value of the standard entered in the Calibration Menu. This is because, from the measurement data, 100 points are selected and used for the calculation of the calibration constants. The new constants are then applied and the radius value given in the Results Summary is calculated from 2000 points of the measurement data.

As these calculations are made from different sets of data, the results may not be exactly the same. Therefore, to establish the validity of the

calibration, from the results, check the form error. The normally acceptable form error values for each stylus type are given at the start of this section.

These values are after exclusion of spurious peaks or valleys. See also the following section in this handbook: CALIBRATION ERRORS.

If the results display indicates that the calibration measurement is acceptable, then select either in the **Modified profile** box or the **Return to Previous Menu** option.

Continue

The options of **Continue** and **Save Calib info menu** are displayed.

Save Calib Info

Select the **Save Calib info menu** option. The **Gauge Information Menu** is then displayed.

Note If, on selection of the **CALIBRATE** option, either of the error messages: *Gauge out of range* or *Insufficient raw data* is displayed, acknowledge the error message. It is likely that the gauge was not correctly crowned, therefore, repeat the X axis crowning procedure. Observe the displayed vernier scale and ensure that the gauge remains within its range.

Select the **Save New Calibration Information option. The prompt** *Enter user ID* is displayed. Enter an appropriate title and press the ENTER key. The constants are then stored in the calibration history file and will be used for all future measurements until such time as a new calibration is performed or stored constants are recalled from the calibration history file.

IMPORTANT NOTES

1. The calibration data **MUST** be saved **before attempting to leave this menu. Failure to save this data will be lost when the system is switched off.**
2. When a standard inductive pick-up is fitted with a **120mm long arm with ball stylus**, the traverse unit must be level (0° tilt).

CALIBRATION FROM MEMORY FOR SPECIAL STYLUS ARMS

When a special stylus arm is fitted to the pick-up, it may not be possible to calibrate in the normal manner. This is because the length of traverse (which is automatically selected by the calibration routine) is unsuitable for the particular geometry of the special stylus. If this is so, then during calibration, the stylus may not remain in contact with the standard or the stylus arm may foul the calibration ball.

In these circumstances, the calibration procedure must be modified, as follows:

1. Set up the standard and Crown in the Y axis then crown (or auto-crown) in the X axis (as on page 5-9).
2. From the crown position, traverse the stylus, over the standard, away from the traverse unit then back again, noting the stylus displacement (as shown in the Gauge icon). Adjust the height of the pick-up so that, over the traverse, the stylus is displaced about the middle part of the gauge range.
3. Note the traverse position, shown in the Traverse Unit icon at which the stylus is crowned, Traverse the stylus over the standard, away from the traverse unit. until the stylus ceases to remain in contact with the standard or the stylus arm fouls the calibration ball. At this point stop the traverse and note the distance from the crown point (using the Traverse Unit icon).
4. Traverse the stylus back again to the crown position, noting the stylus displacement (as shown in the Gauge icon). Adjust the height of the pick-up so that, over the traverse, the stylus is displaced about the middle part of the gauge range.
5. After the pick-up height has been set then, from the crown position, traverse the stylus over the standard (away from the traverse unit) a distance 1mm less than the distance to the point

at which the the stylus ceased to remain in contact with the standard or the stylus arm fouled the calibration ball (found at step 3).

6. Press key **F1** to obtain the **Main menu.**

   Select **Component** as the **Data Source** with a **Traverse Length** of twice the distance from the crown to the position at which the stylus was set at step 5. and enter the current position of the traverse unit as the **Data log Position.**

7. Select the **Data Collection** option, to make a measurement of the standard.
8. From the results display, return to the **Main Menu** and select **Memory** as the **Data Source.**
9. Select the CALIBRATE option.
10. Select the **Ball Radius** option and enter the radius of the measured standard.
11. Select the **Calibrate Gauge** option. The **Gauge Setup Menu** is then displayed.
12. From this menu, select the **Calibrate From Memory** option. The calibration constants are then calculated and the Results Summary displayed.

The radius value shown in the Results Summary may not coincide exactly with the radius value of the standard entered in the Calibration Menu. This is because, from the measurement data, 100 points are selected and used for the calculation of the calibration constants. The new constants are then applied and the radius value given in the Results Summary is calculated from 2000 points of the measurement data.

As these calculations are made from different sets of data, the results may not be exactly the same. Therefore, to establish the validity of the calibration, from the results, check the form error. The normally acceptable form error value for each stylus type is 15µm, after the exclusion of spurious peaks or valleys. See also the section **Calibration Errors**, in this handbook.

If the results display indicates that the calibration measurement is acceptable, then select either in the **Modified profile** box or the **Return to Previous Menu** option. The options of **Continue** and **Save Calib Info menu** are displayed.

Select the **Save Calib info menu** option. The **Gauge Information Menu** is then displayed.

Note If, on selection of the **CALIBRATE** option, the error message: *Insufficient raw data* is displayed, acknowledge the error message. It is likely that the gauge was not correctly crowned, therefore, repeat the X axis crowning procedure. Observe the displayed vernier scale and ensure that the gauge remains within its range.

Select the **Save New Calibration Information option. The prompt** *Enter user ID* is displayed. Enter an appropriate title and press the ENTER key. The constants are then stored in the calibration history file and will be used for all future measurements until such time as a new calibration is performed or stored constants are recalled from the calibration history file.

IMPORTANT The calibration data **MUST** be saved **before attempting to leave this menu. Failure to save this data will cause this calibration to be lost when the system is switched off.**

PROGRAMMING If an automatic program is to be made of this procedure, then some modifications are required. To create a program, it is first necessary to perform steps 1, 2 and 3 to determine the column height adjustment from the crown position and the traverse length required. In program mode, the calibration procedure is then carried out, omitting steps 2 and 3. The column height adjustment required being applied at step 4 and the traverse length at step 5.

Details of producing a program are given in the CREATING A PROGRAM section, later in this handbook.

CALIBRATION ERRORS

Outlined below are some typical effects of incorrect calibration when measuring radii. In many instances these effects can appear to be a genuine form error on the component. It is, therefore, worth noting these typical shapes in order to avoid making a wrong assumption on the form of the component and attempting to take corrective action in the manufacturing process.

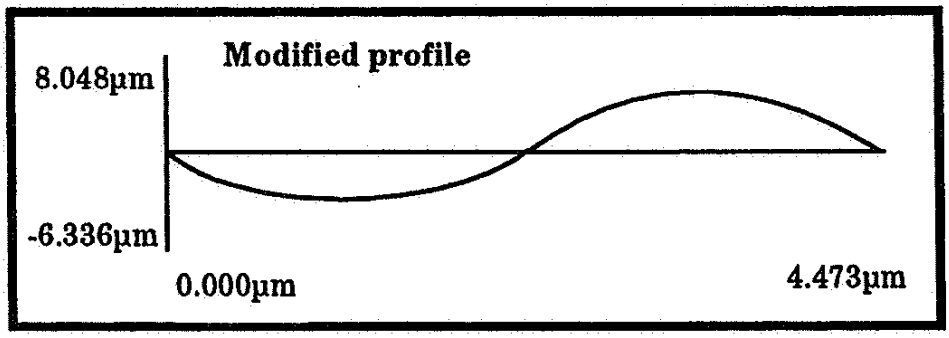
Errors in calibration usually cause 'S', 'W', or 'M' shapes in the profile when measuring radii, as shown following.

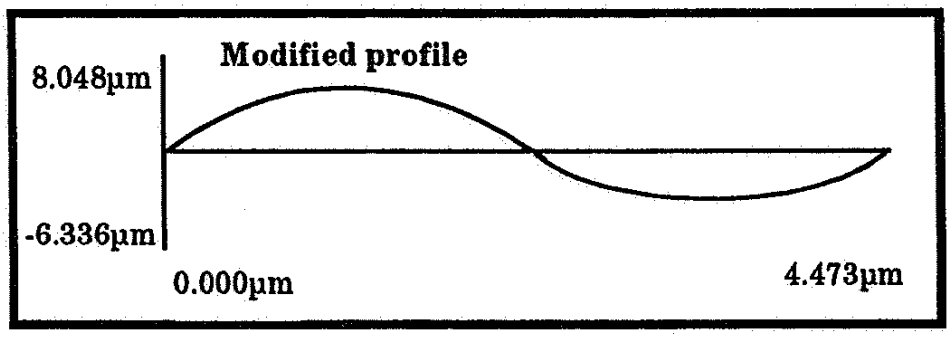
Errors are usually caused by:-

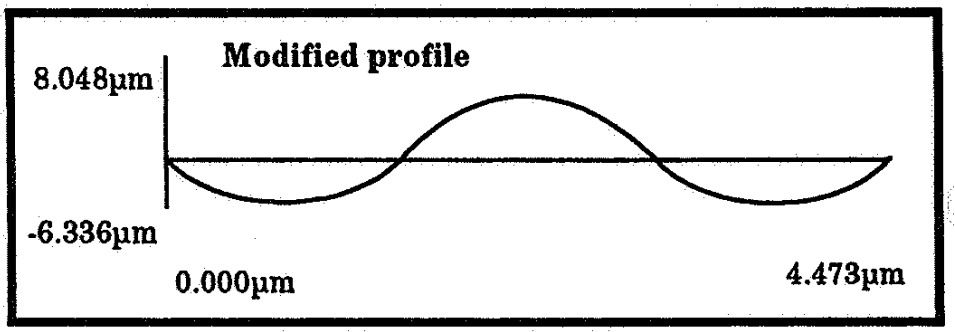
* Lack of calibration.
* Change of stylus without re-calibration.
* Damaged stylus.
* 'Tracking' errors on the stylus signal caused by sudden changes in displacement (e.g. When measuring over a step).

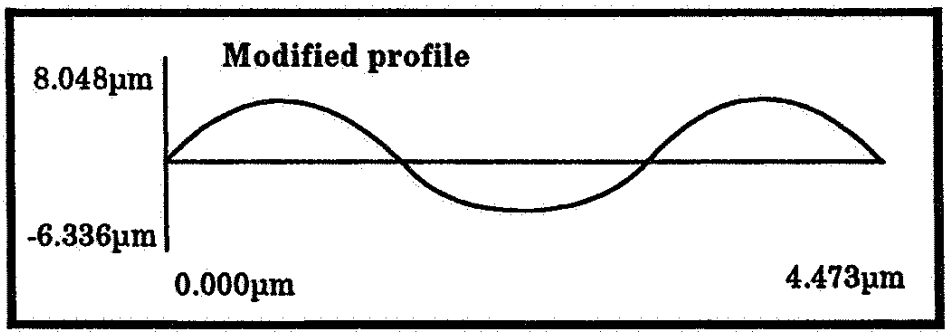
It is recommended that if any of the forms shown are exhibited on a component that the instrument is re-calibrated. If the calibration is acceptable then the component can be measured. If the results are the same then it is likely that the error is a genuine form error and not that of incorrect calibration.

TYPICAL CALIBRATION ERROR EFFECTS ON RADIUS MEASUREMENT









PRISM CALIBRATION

DESCRIPTION When measuring components that have a flat or radiused surface, then calibration using a ball or a radius standard will provide the required correction factors. However, if the surface to be measured includes angular features then, for maximum accuracy of measurements, appropriate refinements can be made to the correction constants.

These refinements are achieved by carrying out the **Prism Calibration** routine **after the system has first been calibrated using a ball or radius standard** (see CALIBRATION USING THE BALL OR 80mm RADIUS STANDARD described previously in this section of the handbook).

The effect of this further calibration, is to refine and modify the correction constants achieved from the ball calibration. This refinement provides the appropriate corrections for the measurement of angular features.

The procedure is as follows:

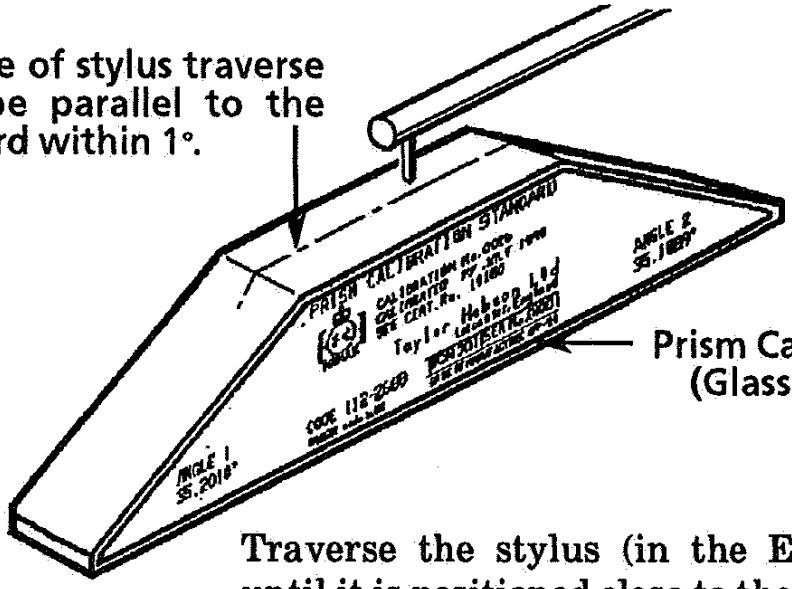
PROCEDURE Calibrate the instrument using the ball or radius standard, as described previously in this section of the handbook.

Raise the stylus well clear and remove the ball or radius standard.

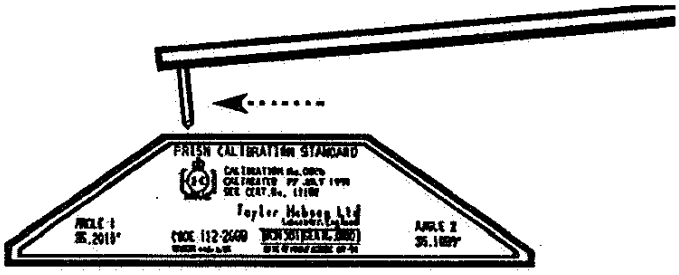
Set the stylus to the centre of the horizontal traverse range and place the prism standard below it. The standard should be positioned so that the label is to the front and the stylus tip is approximately over the mid point of its central flat portion, ensuring that the standard is square to the line of traverse (see diagram).

Nominally level the traverse unit with the top surface of the standard (see LEVELLING THE TRAVERSE UNIT in section 5 of this handbook).

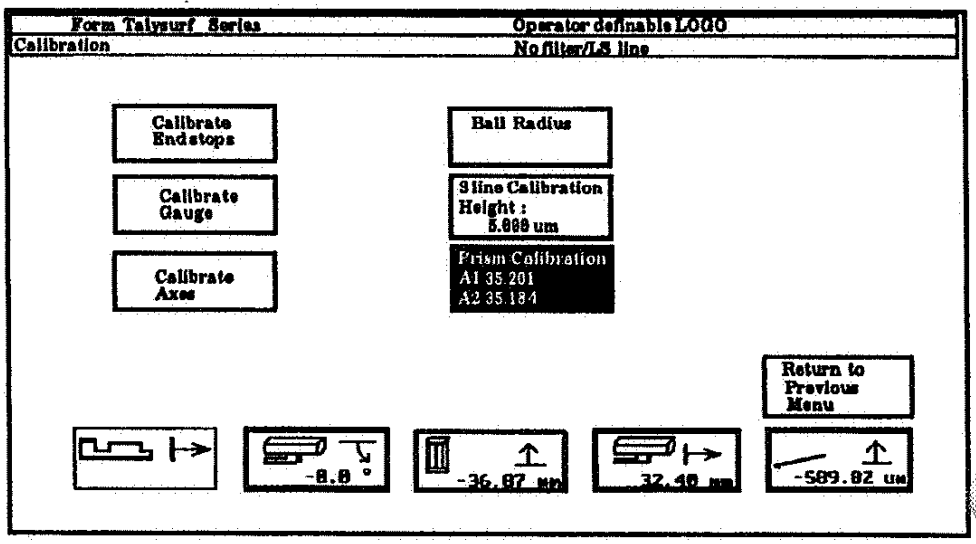
After levelling, reposition the stylus tip (not in contact with the standard) to the approximate mid point of the central flat surface of the standard.



Traverse the stylus (in the EXTEND direction) until it is positioned close to the start of the sloping surface on the left-hand end of the standard.



From the **Main Menu**, select the **Calibrate option. The Calibration** menu is then displayed.



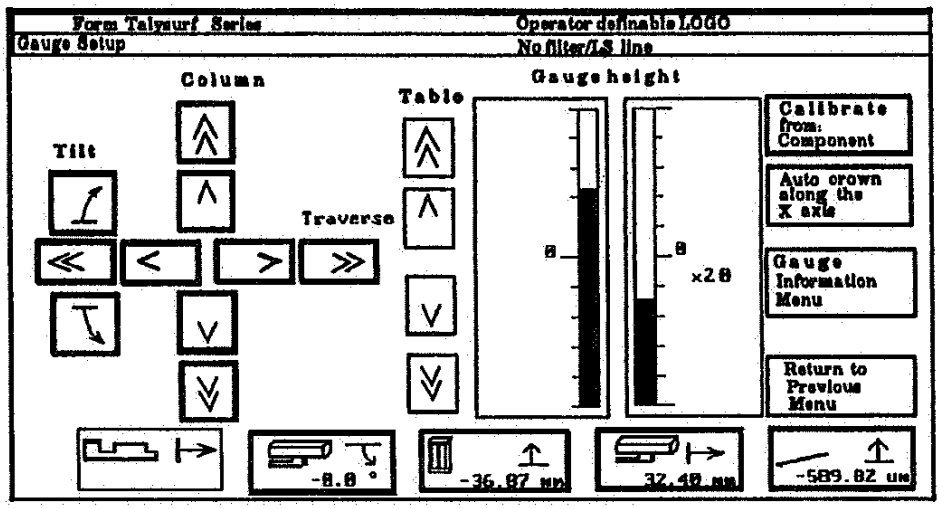
From the **Calibrate menu**, select the **Prism Calibration** option.

The request to: ***Enter Angle 1***
is then displayed. Enter the value for the angle marked on the left side of the label on the standard.

The request to: ***Enter Angle 2***
is then displayed. Enter the value for the angle marked on the right side of the label on the standard.

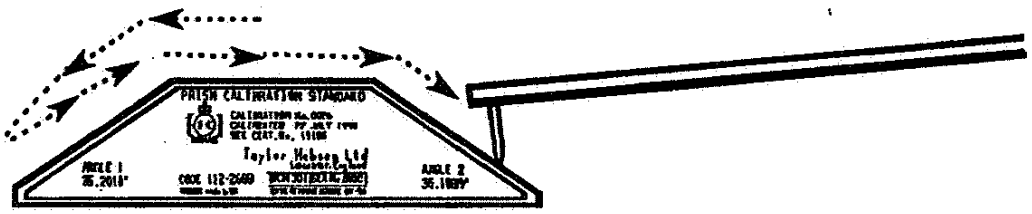
NOTE The angle values are normally given to four places of decimal. The entered value is rounded to three places of decimal, for display purposes only.

Select the **Calibrate Gauge** option. The Gauge Set Up display is then presented.



Select the **Calibrate** option.

An automatic measurement is then made, in which the stylus is brought into contact and traversed, in the extend direction, upto and over the sloping surface on the left-hand end of the standard. The direction of traverse is then reversed and the stylus is traversed up the left-hand slope, over the top flat and down the right-hand sloping surface.



On completion of the measurement, the calibration constants are calculated and the Results Summary is presented. This will display a straight line, which is the profile of the right-hand sloping surface of the standard.

If the displayed Rt value is 0.15µm or less, then the calibration is considered acceptable. In which case, select either the **Modified Profile** box or the **Return to Previous Menu** option. The options of Continue and **Save Calib info** menu are then displayed.

Select the **Calib info menu** option. The **Gauge Information Menu** is then displayed.

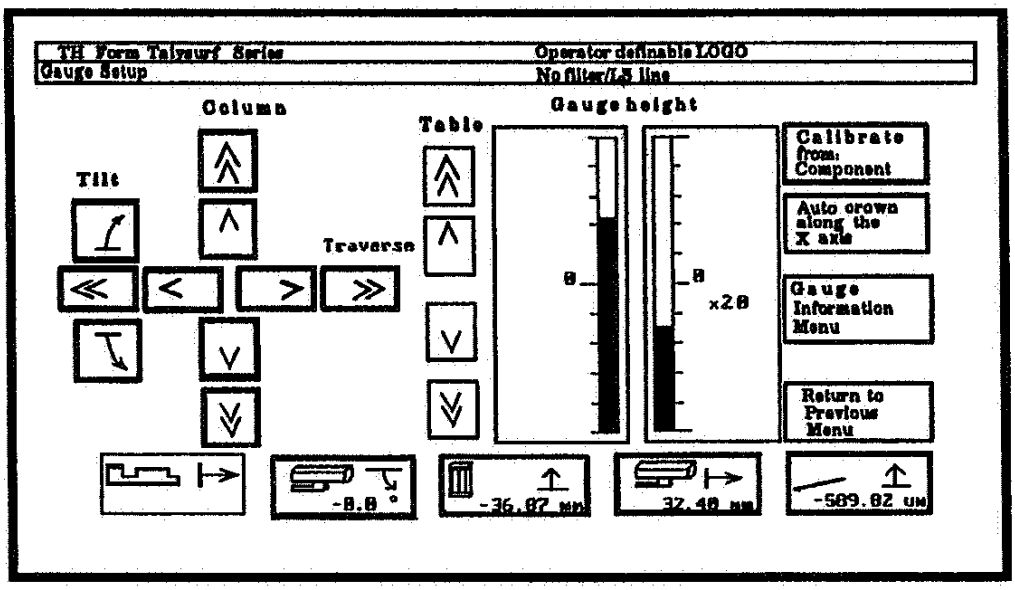
Select the **Save New Calibration Information option. The prompt** *Enter user ID* is displayed. Enter an appropriate title and press the ENTER key. The constants are then stored in the calibration history file and will be used for all future measurements until such time as a new calibration is performed or store constants are recalled from the calibration history file.

The calibration data **MUST** be saved before attempting to leave this menu. Failure to save this data will cause it to be lost when the system is switched off.

COMPONENT SET-UP

DESCRIPTION The Gauge Set Up menu provides an aid in gauge positioning and setting up of the component, and is obtained by pressing function key F4 (this menu is presented automatically during gauge calibration).

GAUGE SET UP MENU (Press F4)



This menu provides a vernier style gauge position indicator and direct control, by menu selection, of the traverse unit, column, and traverse table where applicable.

SETTING UP ON A FLAT SURFACE When setting up on a flat surface the LEFT/RIGHT arrows of the set up menu can be used to move the pick up into position. During set up of the workpiece, note the reading given by the traverse unit icon at the position where the measurement is to be commenced as this will be required when making a measurement.

A check that the component is nominally parallel to the traverse unit datum can be made by traversing the stylus over the region to be measured, and by observing the gauge position in the gauge icon.

If the component is not sufficiently parallel to the traverse unit datum for the measurement concerned then perform a levelling operation as indicated in 'Selected Topics:- Levelling'.

SETTING UP ON A CURVED SURFACE

When setting up on a curved surface, the LEFT/RIGHT arrows of the set up menu can be used to move the stylus into position. The gauge must remain within range over the measurement traverse.

If the radius of the surface is to be determined, then the pick-up **must** be used skidless, with the hinged stem (120mm traverse units only) or hinge unit **locked**. Preferably the stylus should be crowned. If the component is of a spherical form it should be crowned in both 'X' and 'Y' axes.

The procedure is to traverse the stylus over the region to be measured while observing the gauge position reading for it's turning point (either a maximum or minimum).

When at the desired position the height position of the stylus should be adjusted to ensure that the measurement is performed with the stylus remaining in range throughout it's measurement.

AUTO CROWN ALONG THE 'X' AXIS

The pick-up **must** be used skidless with the hinged stem (120mm traverse units only) or hinge unit **locked**.

When measuring a spherical surface or across a diameter , a further setting up aid is available. This option will automatically position the stylus at either the Maximum or Minimum height of the stylus on a curved surface (e.g Convex or Concave) after a series of measurements.

Note This option is designed for contiguous curved surfaces, and the automatic sequence will assume that there are no obstructions in the path of the gauge during measurement, and that the theoretical centre of it's test measurement will lie

within the bounds of the instrument axes. It should therefore only be used on such items as Spheres, Cylinders, or Ball races.

CAUTION **Care should be taken when using this option in restricted spaces, since the Column will drive automatically.**

LEVELLING THE TRAVERSE UNIT

This procedure is not applicable for the 50mm traverse unit supplied with Form Talysurf series E instruments (as no tilt facility is included with this unit).

MANUAL LEVELLING

DESCRIPTION Manual levelling can be performed on all systems through use of either the tilting screw on the free standing systems or the manual tilt adjustment on column mounted systems.

PROCEDURE For either system configuration the same procedure outlined below can be followed:

1. Select the Gauge Set Up menu by pressing **F4.**
2. The stylus should be positioned just above the surface and the traverse unit actuated (via Hand Held Controller, Joystick or Gauge Set Up Menu arrows) over the length to be measured.
3. By observing the gap between stylus and workpiece the tilt adjustment knob should be turned so that the gap remains constant.
4. Using the height adjustment mechanism bring the stylus into contact with the workpiece with the gauge indication nominally mid range (or on column mounted systems use the **Contact option on the Move Column Menu).**
5. At the traverse start position note the gauge reading shown in the Gauge Position Icon or on the Set Up menu vernier.
6. At the traverse end position note the gauge reading shown in the Gauge Position Icon or on the Set Up menu vernier.
7. Return the stylus to the traverse start position.

8a. If the traverse start gauge position reading is **GREATER** than the traverse end reading then turn the tilting screw on the free standing systems in an anti-clockwise (counter-clockwise) direction, or the manual tilt adjustment on column mounted systems clockwise. The amount by which the knob must be turned is dependent on various factors but in general it must be turned until the gauge reading is LESS than the traverse end reading.

8b. If the traverse start gauge position reading is **LESS** than the traverse end reading, then turn the tilting screw on the free standing systems in a clockwise direction, or the manual tilt adjustment on column mounted systems, anti-clockwise (counter-clockwise). The amount by which the knob must be turned is dependent on various factors but in general it must be turned until the gauge reading is **GREATER** than the traverse end reading.

9. Repeat steps 4 to 8 until an acceptable difference in readings is obtained.

MOTORISED LEVELLING

DESCRIPTION Motorised levelling can be performed on column mounted systems only.

PROCEDURE

1. Select the Gauge Set Up menu by pressing **F4**.
2. The stylus should be positioned just above the surface and the traverse unit actuated (Joystick or Gauge Set Up Menu arrows) over the length to be measured.
3. By observing the gap between stylus and workpiece the motorised tilt switch on the Column Control Module should be actuated so that the gap remains constant.

4. Using the UP/DOWN column arrows on the Gauge Set Up menu contact the stylus on the workpiece with the gauge indication nominally mid range (or use the Contact option on the Move Column Menu).
5. At the traverse start position note the gauge reading shown in the Gauge Position Icon or on the Set Up menu vernier.
6. At the traverse end position note the gauge reading shown in the Gauge Position Icon or on the Set Up menu vernier.
7. Return the stylus to the traverse start position.

8a. If the traverse start gauge position reading is **GREATER** than the traverse end reading then **PUSH FORWARD** the motorised tilt switch. The amount by which the switch must be actuated is dependent on various factors but in general it must be actuated until the gauge reading is **LESS** than the traverse end reading.

8b. If the traverse start gauge position reading is **LESS** than the traverse end reading then PULL BACK the motorised tilt switch. The amount by which the switch must be actuated is dependent on various factors but in general it must be actuated until the gauge reading is **GREATER** than the traverse end reading.

9. Repeat steps 4 to 8 until an acceptable difference in readings is obtained.

AUTOMATIC LEVELLING

DESCRIPTION On systems equipped with the motorised column, selecting the traverse unit tilt icon gives access to the **AUTOMATIC LEVEL** facility to aid in setting up on a tilted surface. The pick-up **must** be used skidless with the hinged stem (120mm traverse units only) or hinge unit **locked**.

PROCEDURE

1. From the **MAIN MENU,** select the **TRAVERSE TILT** icon. The Move Tilt Menu is then displayed.

2. If the measurement traverse length requires changing, select the **Datalog Source option.**

3. On selection, the request to 'Enter Traverse Length' is displayed. this is the length of surface over which the stylus is traversed in order to determine the tilt of the traverse unit datum to the surface to be measured. The currently selected value will be displayed and can be selected by pressing the 'Enter' key.

   If this selection is not made then the datalog parameters used will be as those shown on the Main Menu in the **DATA SOURCE** icon.

Note If the datalog details are altered from the default values, then the new datalog parameters will also be entered into the **Data Source** Icon on the Main Menu.

4. Select the **Automatic Level** option. A measurement is then made over the entered traverse length from the current position (the stylus automatically makes contact with the component). On completion, the traverse unit column position will be moved and the motorised tilt function actuated to compensate for the tilt error calculated.

CAUTION This option is not intended for use inside bores due to the column movement function. It should also be noted that any change in traverse tilt position will affect the position of the stylus in relation to the workpiece. Care should be exercised to ensure the new position is considered in any future measurement.

MAKING A MANUAL MEASUREMENT

CAUTION Before measurements are made, there are a few general points of procedure which should be applied whenever relevant.

When the system is first switched on, select the Configure option from the main menu. From the displayed Configuration menu check that the equipment is correctly configured and that the desired results presentation requirements are selected.

Ensure that the gauge is calibrated. If it is not, run the calibration routine.

If measurements are to be made using the pick-up skidless, ensure that the hinge of the hinged pick-up stem (120mm traverse units only) or the hinge, of the hinge unit, is locked.

If measurements are to be made using the pick-up with a skid nosepiece fitted, ensure that the pick-up stem (120mm traverse units only) or the hinge, of the hinge unit, is free.
Before a measurement can be made it is necessary to set up the workpiece with respect to the line of traverse of the stylus. The surface to be measured should be generally parallel to the line of traverse and when measuring along the length of a cylindrical component, the crest of the workpiece must be directly under the stylus.

1. From the main menu, select the **DATA SOURCE** option.
2. From the three options then offered, select **COMPONENT**. In response to the displayed prompts, enter the traverse length required

and the position on the traverse unit scale from which the traverse is to start. Alternatively, select the IMMEDIATE option.

3. Select the **FILTER & PARAMETER OPTIONS** icon.

4. Select the appropriate Filter required together with the Cut-Off (if Roughness or Waviness is requested).

5. Select the **ASSESSMENT LENGTH (unfiltered) or NUMBER OF CUT-OFFS (filtered), note that each of these icons are inter-related and only one needs to be selected.**

6. If unfiltered is selected then it is advisable that a reduced set of data points are used in the calculations, typically a value of between 2000-4000 is acceptable for roughness measurement,considerably less is acceptable for Form measurement.

7. If required select the **PARAMETER** option and select the necessary parameters.

Notes: **a.** Calculation time is dependent on the parameters selected, therefore, select only those actually required.

b. The selection of the Rk parameters will considerably increase the calculation time since it requires the data to be filtered several times.

8. Select the **RETURN TO PREVIOUS MENU** option.

9. Select the **FORM OPTIONS** icon.

10. Select the appropriate reference line required, this will normally be the **LS STRAIGHT LINE**, or **DATUM LINE** on systems not equipped with any of the Form options.
11. Select the **RETURN TO PREVIOUS MENU** option (or Press F1).
12. Select the Gauge Set Up menu by pressing the **F4** function key.
13. Ensure the component is correctly set up as detailed in the Selected Topics: Workpiece Set up' section of this manual.
14. When the component is correctly set up then return to the Main Menu (F1).
15. Select the **DATA COLLECTION, ANALYSE** option. On completion of the measurement traverse, the results summary page is displayed.

NOTES

1. In order that operational speed and stability are achieved before starting the collection of measurement data, at the commencement of each measurement, the traverse unit moves to a position 0.3mm in front of the specified start position. This distance provides the required run-up, and data collection is then commenced from the specified start position.
2. If more data is available from the traverse than is actually required for a filtered assessment, then slightly more data (0.1 x cutoff length) will be selected for processing. This minimises the possibility of insufficient data being available for processing after calibration correction. The additional data is discarded after filtering is completed.

CREATING A PROGRAM

DESCRIPTION The **PROGRAM MENU** controls the creation and operation of programmed measurements, permitting the operator to program and execute under full computer control all major functions of the instrument.

The method of program creation is very similar to that of making a manual measurement, the system learning all of the main operation (steps) performed including screen dumping, printing and display of results.

NOTES

1. During the programming of measurement sequences, pressing the "**Insert**" key will cause the current position of the Column and Traverse unit to be entered directly into the measurement program. These positions are recorded as **RELATIVE** moves from the previously recorded position and **NOT** as **ABSOLUTE** positions.
2. When a Results Summary or Data Selection menu is displayed in Program Run mode it is not possible to select any of the icons other than the 'Continue Program' option. The display will remain on the screen until the spacebar or ENTER key is pressed, or the 'Continue Program' icon is selected. If the measurements are to be made 'Hands Off' consideration should be given to de-selecting the **DISPLAY DATA** option in the Results Configuration Menu. This would cause the analysis to be completed and results printed without the need to display the Raw Data, which would require operator intervention.

GENERAL When creating a program the following points should be carefully considered so as to increase the efficiency of the program and to reduce the risk of error.

1. Make a note preferably on a drawing of the component of the areas requiring measurement.
2. Make a note, for each location, of the Filter & Parameter options to be used.
3. Note any useful dimensional values (e.g Clearance heights etc.).
4. If the program is likely to be used by non skilled personnel, consider including within the program some method of referencing the system and a calibration routine which suits this referencing.
5. It is often worthwhile returning the column and traverse unit to the same starting point as used in the program. This will reduce set-up time and errors.
6. To avoid possible errors when running programs with different operators it is worthwhile including at the start of any program a few messages (and possibly commands) to ensure either that the system axes are calibrated or that the system is currently at the position expected for initiation of the measurement program. It is always possible that a previous operator has used a different reference for system axes, therefore doing either a positional reference or an axes calibration will ensure smooth running of the program each time.

PROCEDURE The following describes how the axes can typically be calibrated in a program, before measurements begin.

1. From the Main Menu select the **PROGRAM option. The Program Control Menu is displayed.**

2. Select the **Create Program** option. A request will be made to enter an **OUTPUT PROGRAM name. A suitable program name should be entered. This is the name which will be used to store the program under and must be a unique name of 8 or less characters and the following characters are not permitted [.(period or full stop), *, ?, /, \,].**

3. **The Main Menu will now be displayed, but the option to 'Terminate Program' has been changed to 'PROGRAM MESSAGE'.**

4. Select the **PROGRAM MESSAGE** option and enter an instruction to the operator to position the Traverse Unit (and Column if available) to a defined start position. e.g. "Set Traverse Unit to 50mm on Scale, Set column to 100mm on Scale".

5. From the Main Menu select the **CALIBRATE option.**

6. From the Calibrate menu, select the **CALIBRATE AXES** option.

7. To avoid accidental axes movement when running a program, the joystick, tilt button or hand held controller can be turned off, using the F9 key, when creating or editing the program. This would normally be the first command of the program.

8. Select the **SET TRAVERSE UNIT POSITION** option and enter the current value (e.g 50mm).

9. If a column is available select the **SET COLUMN POSITION** option and enter the current column position (e.g. 100mm).

Note The above steps are often redundant if the system is already calibrated, however they often ensure a greater level of program integrity in the event of use by a less experienced operator.

The remaining steps are performed just as any manual measurement, each step being learned by the computer as it is performed. In addition, the joystick may be used in combination with the "Insert" key to control axis movements.

This is carried out in the following way:-

Use the joystick to position the stylus to the next location of the sequence and press the **"Insert"** key. Ensure that the message "SAVED MARKED POINT" is displayed on screen, confirming acceptance of this as a control point. This should be carried out after all axes and the cursor are stationary.

The necessary steps to perform the movement sequence will now have been inserted in the program. **PLEASE NOTE** combined column and traverse unit movements, carried out using the joystick, are interpreted as individual axis movement commands when the program is run, the traverse unit movements being performed prior to column movements. Care should therefore be exercised in avoiding possible component collisions when running the interpreted program.

All movements defined using the joystick and the **"Insert"** key are compiled as RELATIVE moves. In addition, it should be noted that during the editing of programs (See Section "Editing a Program") only one movement command can be inserted or modified at a time. Multiple axis movements, such as may be instructed via the joystick, should not be used in the **EDIT** mode.

When the program is completed the **PROGRAM option should be selected from the Main Menu and the option SAVE CREATED PROGRAM selected.**

The program is now completed and available for editing or running.

PROGRAMMED GAUGE CALIBRATION

The gauge calibration routine can be included in a program. This can be either as part of a component measurement program or just as a gauge calibration routine.

A programmed calibration routine can be particularly useful when using special stylus arms. In this case, the calibration from memory routine described for use with special stylus arms in the CALIBRATION USING THE BALL OR RADIUS STANDARD earlier in this section of the handbook, can be run for the special stylus arm and saved as a program. This can then be run whenever the special stylus arm is fitted.

METHOD

If a calibration routine is carried out during the creation of a measurement program. then when the **Calibrate Gauge** option in the **GAUGE SET-UP MENU** is selected, a program step is learned. The details of the current calibration ball or 3 line standard and the measurement data source (COMPONENT, MEMORY etc) are saved as part of the step.

When the program is run and the calibrate gauge step is carried out, the **GAUGE SET-UP MENU is displayed. If the GAUGE SET-UP MENU** has been learned as a program step, then, when the program is run, a pause occurs at this menu.

The **Calibrate Gauge** option is highlighted with the relevant data source and the calibration proceeds. The program waits until the **Continue option is selected, to enable the calibration ball or three line standard to be positioned below the stylus.**

After making the calibration measurement, the calibration data and results are displayed on the Results Page. The program will pause at this page, enabling the operator to assess the measured profile.

If the program is being run from the **Run** option of the **PROGRAM MENU** (single run mode), the program will pause until the **Continue** option is selected by the operator. This pause is not made when the program is run from the **Run Continuous** option (run continuous mode),.

The options to **Continue** or **Save Calib Info** are then displayed.

If **Continue** is selected, then the calibration information is not saved, the current calibration constants are retained and the program continues with the next step.

If the calibration information is to be saved, then the procedure will depend on whether the program is being run in the single run or the continuous mode. Alternatively key F10 can be pressed to abandon the program (and not save the calibration results).

Run mode

When **Save Calibration Constants** is selected, the **GAUGE INFORMATION MENU** is displayed and a prompt is given to enter a user ID. When this is entered the program will continue with the next step.

Run Continuous mode

When **Save Calibration Constants** is selected, the **GAUGE INFORMATION MENU** is displayed and the ID: **AUTO** is automatically entered, the calibration information is saved and program continues with the next step.

NOTES

1. The Auto crown routine can also be included in a program.
2. The pick-up or stylus type cannot be changed as part of a program.

IMPORTANT It is essential, that the same calibration ball or 3 line standard is used when creating and running the program.

EDITING A PROGRAM

DESCRIPTION It is necessary in some instances to modify (e.g. add or change operator commands) or correct a previously created program. It is, however, also possible to write a completely new program via the edit facility.

PROCEDURE

1. From the Main Menu select the **PROGRAM option to display the Program Control Menu.**
2. **Select the Input Program** icon and enter the name of the program requiring editing.
3. Select the **EDIT PROGRAM** option.
4. If the resulting edited program is to be saved with a name different to the original program, enter a new name in the **OUTPUT PROGRAM** icon. This is a recommended philosophy since errors can be ignored and the original program can be retrieved.
5. The Edit Program Table is then displayed. A tabular form is used to display the program steps. The step number, step description and relevant parameters are all given. Scrolling up and down the table is achieved by using the UP/DOWN arrows. In the edit mode steps can be inserted as well as deleted or changed.

NOTE When a data collection or analysis step has been learned, option identifiers are included at the end of the relevant line in the program. table. These are shown as:

/L = Auto Liftoff
/R = Auto Reverse
/S = Skid present
/A = Right Angled gauge present

e.g. /LRSA

INSERTING or MODIFYING A STEP

When a step is to be inserted or changed the option to **INSERT** or **MODIFY** is selected.

1. A request is then made whether this should be at or before the current marker (highlighted) position or at or before a specific step number.
2. Select the **Current Marker** Position or Step Number, if Step number is selected then enter the number via the keyboard.
3. The **Main Menu** will now be displayed. At this point any new command will be learned and will be inserted into the table as a new step or as a modified step.
4. If further insertions, deletions, or modifications are required continue from the Edit Program Menu.
5. If all amendments have been completed select the **END EDIT** option. The Program Menu will now be displayed with the option to **SAVE or ABANDON** the modified program.
6. If the Output name has been left the same as the Input name or the output name already exists, then the operator will be requested to confirm whether the existing file should be over written.

NOTE Edit operations are **NOT** interactive, and as such if a modification is required to an analysis function then it is necessary to re-measure the component to ensure that the appropriate data is available for analysis.

However, if some data already exists from the previous measurement and the modification does not require specific data (i.e Data Exclusion or Inclusion) then just the parameter or filter options can be modified.

EXCLUDING DATA

DESCRIPTION The Exclusion of data can be very useful for the assessment of radius on interrupted or worn components, assessing Wear measurement and for levelling profiles via software.

This is performed after making a measurement using either the **Data Selection- Raw Profile** or **Data Selection- Modified Profile** options.

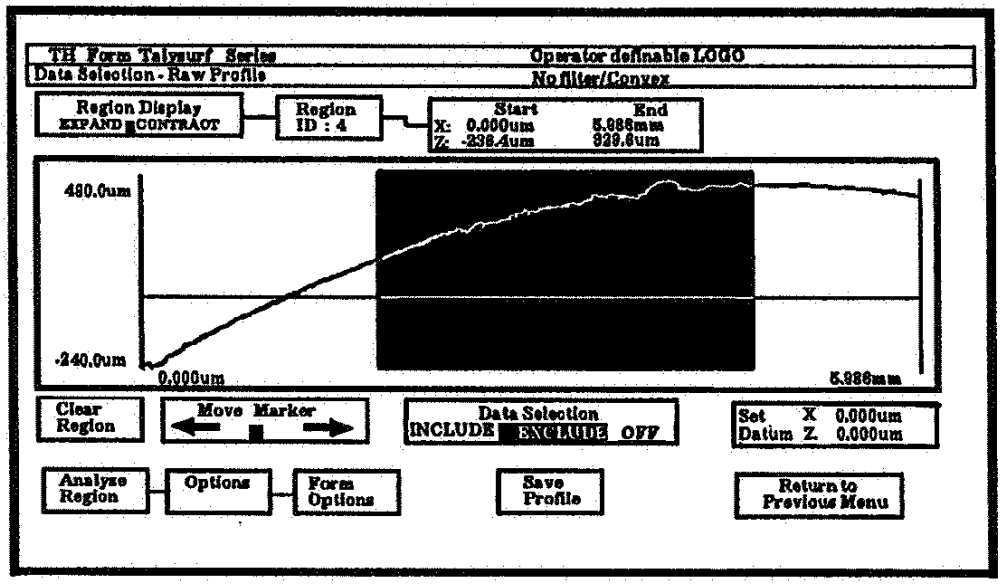
The procedure is as follows:

RADIUS

Assuming a suitable measurement has been obtained, then from the Data Selection- Raw Profile menu.

1. Select the **CLEAR REGION** option to ensure that all data is displayed.
2. With the **MARKER OFF** position the marker (cursor) using the arrow keys to the left of the data requiring exclusion.

DATA TO BE EXCLUDED FROM LS ARC FIT IS SHOWN SHADED



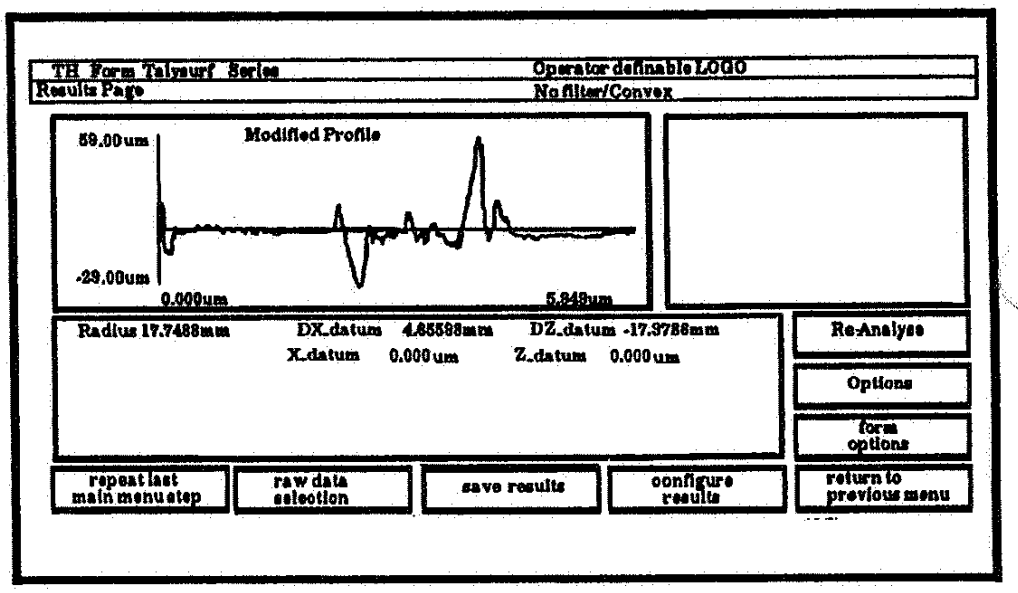
3. Select the marker **EXCLUDE** option, and using the move marker arrows position the cursor to the right of the data requiring exclusion. The excluded data should be shown shaded.

4. If further areas require exclusion then repeat steps 2 and 3. this can be done up to a maximum of 7 exclusion areas.

5. Select the **ANALYSE REGION** option (assuming the correct filter, Parameter and form options have been set).

6. The Results Summary page will then be displayed.

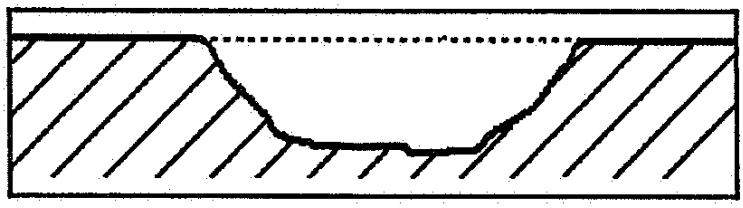
MODIFIED PROFILE (with data excluded from LS form fit)



Note The excluded data is still shown on the modified profile but it has not been used for the calculation of the 'Best Fit' reference line. The excluded data has however been used in the calculation of the selected parameters. (There is no way of excluding data from Parameter calculation).

Note The Ra value multiplied by the Lo parameter gives an indication of the area of the deformation e.g. Wear, Material Flow etc., provided that the area of wear is contained below the reference line.

e.g.

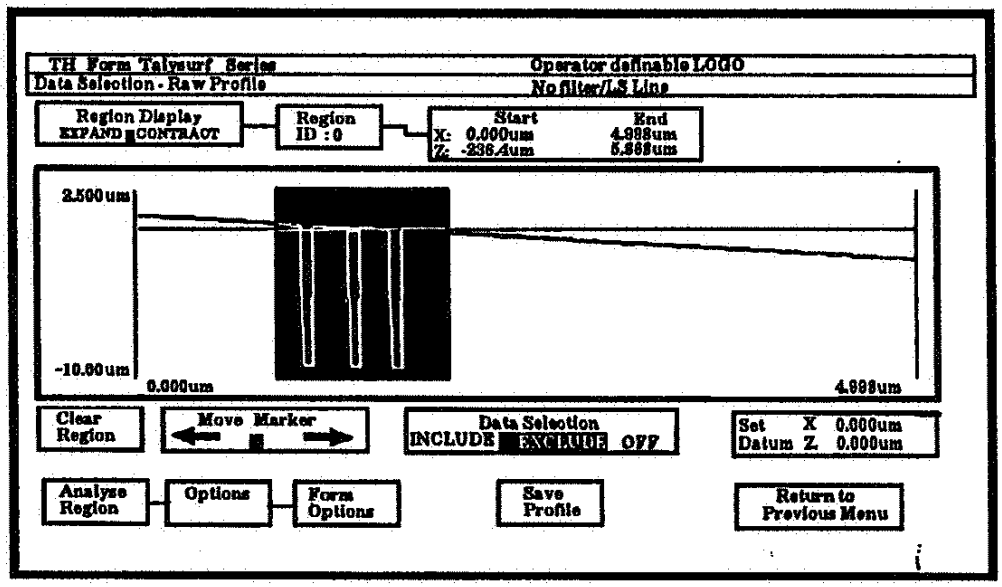


SOFTWARE LEVELLING

A good example of this can be shown by using the 3 Line Calibration standard (if available).

1. First make an unfiltered Least Squares measurement on the 3 Line Calibration Standard, and ensure that the 3 lines are towards one end of the traverse length. This will ensure that after analysis the Modified Profile is not level.
2. Select the **DATA SELECTION- RAW PROFILE** option.
3. Select the **CLEAR REGION** option to ensure that the full measurement is displayed.

UNLEVEL 3 LINE STANDARD PROFILE (Excluded Data shown shaded)



4. With the **MARKER OFF** position the marker (cursor) using the arrow keys to the left of the first groove.

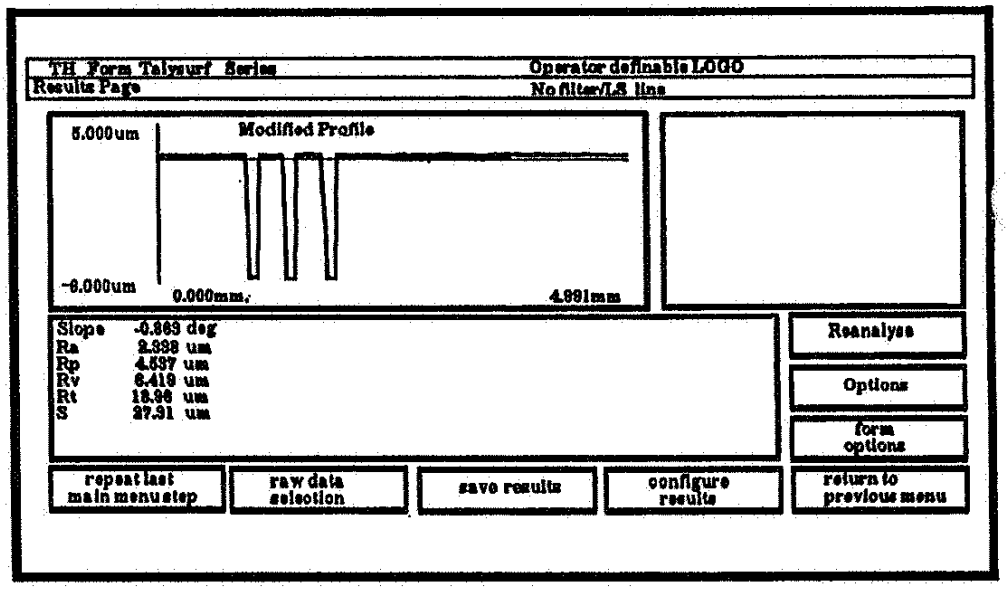
5. Select the marker **EXCLUDE** option, and using the move marker arrows position the cursor to the right of the third groove. The excluded data should be shown shaded.

6. If further areas require exclusion then repeat steps 2 and 3. this can be done up to a maximum of 7 exclusion areas.

7. Select the **ANALYSE REGION** option (assuming the correct filter, Parameter and form options have been set.

8. The Results Summary page will then be displayed, where since the 3 lines have been excluded from the reference line, the modified profile should be based on the mean line generated on the top section of the standard.

BY EXCLUDING DATA, THE PROFILE CAN BE LEVELLED TO THE DATUM SURFACE



Note The excluded data is still shown on the modified profile but it has not been used for the calculation of the 'Best Fit' reference line. The excluded data has however been used in the calculation of the selected parameters. (There is no way of excluding data from Parameter calculation).

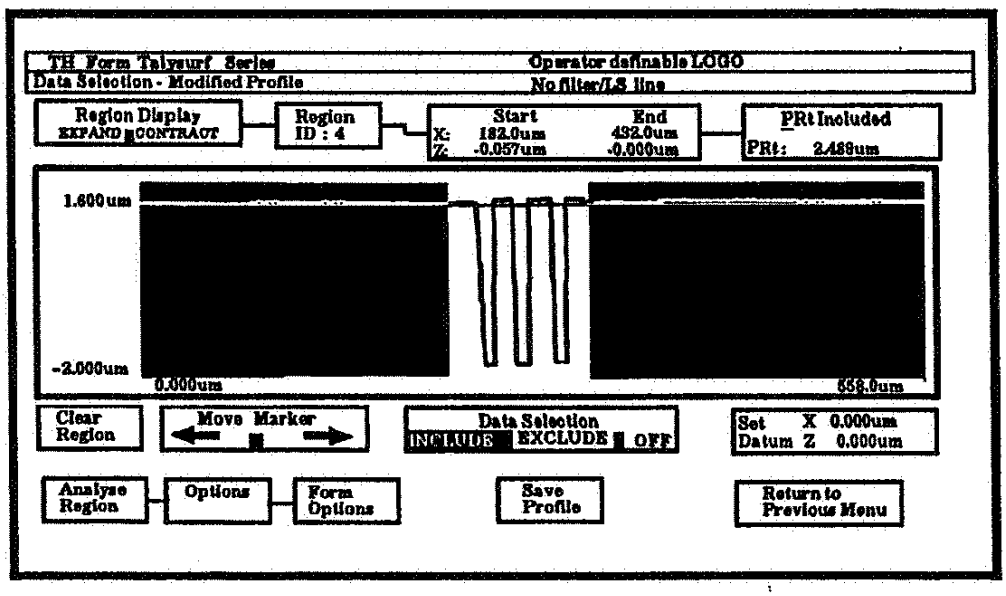
Note The Ra value multiplied by the Lo parameter gives an indication of the area of the deformation e.g Wear, Material Flow etc.

STEP MEASUREMENT

The technique described in Software Levelling can be used to obtain a levelled profile, and by following the procedure below an assessment of step height can be obtained.

1. Perform a measurement as described in the section 'Software Levelling' to level the reference surface of the step to be measured.
2. From the Results Summary page select the **MODIFIED PROFILE** box to display the DATA SELECTION- MODIFIED PROFILE menu.
3. Select the **CLEAR REGION** option to ensure that the full measurement is displayed.

STEP HEIGHT ANALYSED ON INCLUDED AREA ONLY



4. With the **MARKER OFF** position the marker (cursor) using the arrow keys to the left of the step to be analysed.

5. Select the marker **INCLUDE** option, and using the move marker arrows position the cursor to the right of the step to be analysed. The excluded data should be shown shaded.

6. Select the **Rt INCLUDED** option, the value of the Step will then be displayed.

Note This is not a true measurement of Step Height since Rt will be sensitive to dirt or scratches, but will typically be indicative of the actual step.

SAVING DATA

DESCRIPTION Data saving can be performed from the Results or Data selection pages. When saved, the measurement data is stored by the computer in a directory under a filename which comprises a feature name and number. The names of the directories and the feature names and numbers are specified by the operator. The feature name can be up to 5 characters long and the measurement number can be from 00 to 99. Each directory can contain many feature names and each feature name can have up to 100 sets of data, each stored as a feature number.

The limit to the number of directories and feature names is set only by the computer storage capacity. Data can also be copied to floppy discs for further storage or to another computer via the serial port. Data is stored with regard to its feature type. These are:

Raw Data
Modified Profile
Parameter Results

The procedure for saving measurement data and results is as follows:

1. Select the **FEATURE NAME** option and enter a name of up to 5 characters, under which the file is to be stored.
2. If required, select the **MEASUREMENT NUMBER** option and enter a two digit number.
3. If required, select the **AUTO INCREMENT option to automatically increase the feature number each time a file is saved.**
4. **Select the DESTINATION** to which the file is

to be saved. The data can be saved on any of the available disc drives or sent to the RS232 communications port. If the file is to be saved on the host computer hard disk, it will be saved in the current directory, selected on the File Control menu.

5. Select the **DATA TYPE** to be saved.

6. Select the **SAVE DATA** option to save the data.

BATCH MODE When an automatic measurement program is run, measurement data can be stored, under a selected filename, to a specified directory. If the same program is run again, or repeatedly run, in the Run Continuous mode, then existing data files are overwritten each time a save operation is made.

When it is required to save all of the data files from a repeatedly run program, then the **BATCH MODE** facility of the SAVING DATA MENU should be used.

This facility can only be brought into operation during the running of a program. In this mode, any files which are saved are also saved to a batch directory. On subsequent passes through a program, the saved files are placed into different numbered batch directories and are not overwritten. Batch directories saved to the hard disk, are at the same level as other directories (including directory RTH). Also, on completing a program run, the destination directory will contain a copy of the last saved data files.

The batch directory name comprises the current batch name and the batch sample number (e.g. BATCH.000). The batch name and sample start number are entered by the operator in the SAVING DATA MENU. The sample number is automatically incremented after each run through the program, thereby creating a new batch directory name for each pass of a program.

Batch directories are **not** created for files saved to a **floppy disk.** Therefore, as programs remember and restore the **same** filename and number at each pass, only **one set of files** can be saved per disk .

On the first pass through a program, in which batch data is saved to a floppy disk, the files are saved normally. In subsequent passes through the program, the option to overwrite the saved files or to continue (without overwriting) is displayed. To save data from a program in the run continuous mode, a programmed pause is required, to enable a new disk to be inserted for each pass through the program.

OPERATION Although this facility can only be brought into operation during the running of a program. the batch mode itself, cannot be switched on or off as a program step. Also, the batch name and number cannot be stored as part of a program. Therefore,when required, the **BATCH MODE must be manually selected to ON** and the batch name and start number entered prior to running the measurement program.

This enables programs to be run and store data under different batch directory names. However, the selection of the **CURRENT** and **DESTINATION DIRECTORIES,** on the FILE MANIPULATION MENU and the data **DESTINATION,** selected on the **SAVING DATA MENU,** are all stored as part of a program. Therefore, these items must be appropriately selected at the time of creating or editing a program. The **FEATURE NAME** and **MEASUREMENT NUMBER** options of the SAVING DATA MENU, are also stored as part a program. However, although these items will be restored and applied when the program is run, they do not prevent proper operation of the routine.

SAVING BATCH FILES

The requirements for operating the batch file facility during the running of a measurement program are as follows:

From the FILE MANIPULATION MENU, select:

1. **CURRENT DIRECTORY,** this must be the directory which will contain the measurement program.

From the SAVING DATA MENU, select:

1. At the **DESTINATION** option, select:

   WORK DISK

2. The **BATCH MODE** option to **ON.** Options for entering the **BATCH NAME** and **START NUMBER** are then displayed.

   Enter a batch name.

   If the batch files are to be saved to the **hard disk,** then this can be any name, up to 8 characters long: except the names :

   DISK_A or **DISK_B**

   If batch files are to be saved to a **floppy disk in drive A:** then the batch name **MUST** be:

   DISK_A

   If batch files are to be saved to a **floppy disk in drive B:** (when included) then the batch name **MUST** be:

   DISK_B

   Batch numbers cycle from 0 to 999. Enter the start number required.

NOTES

1. Data saved via the batch facility is in addition to the normal data saving routine. Therefore, if care is not taken, identical sets of data can be directed to the same location from more than one source and conflict can occur. E.G. If the object is to save batch files to a disk in drive A: and the SAVING DATA MENU options are selected as follows:

DESTINATION option is set to: **DISK_A**
BATCH NAME is entered as: **DISK_A**

Although this combination appears appropriate, it is not acceptable and will generate the error message:

Batch directory and current directory are the same.

The correct selections for this operation (as described previously) are:

DESTINATION option set to: **WORK DISK**
BATCH NAME entered as: **DISK_A**

2. If, during a program run, the number of batch files stored reaches 999, then the next batch file number will be the same as a that of an already saved file. The option to overwrite or continue is then displayed.

MEASURING AN ASPHERIC COMPONENT

Note **This facility is only applicable to users with EXTENDED FORM SOFTWARE.**

When measuring an Aspheric surface, the following points: should be considered.

* The Aspheric axis must always be contained within the traverse length. Off-Axis aspheres can not be measured nor can partial elements of aspheres.

* It is essential, when measuring aspheres, that the component is levelled orthogonally to the direction of traverse.

* There is no sign convention to the polynomial terms of the aspheric equation. Therefore if satisfactory results can not be obtained then applying the opposite sign to the "A" terms should be tried, i.e. +ve values should be changed to -ve and visa versa. Note that only the "A" terms should be adjusted as the sign convention for both the "k" constant and radius terms have specific meanings.

* Any residual curvature of the resultant profile should be corrected, by adjusting the radius term and re-computing.

Best results are normally obtained using a symmetrical traverse on either side of the aspheric axis.

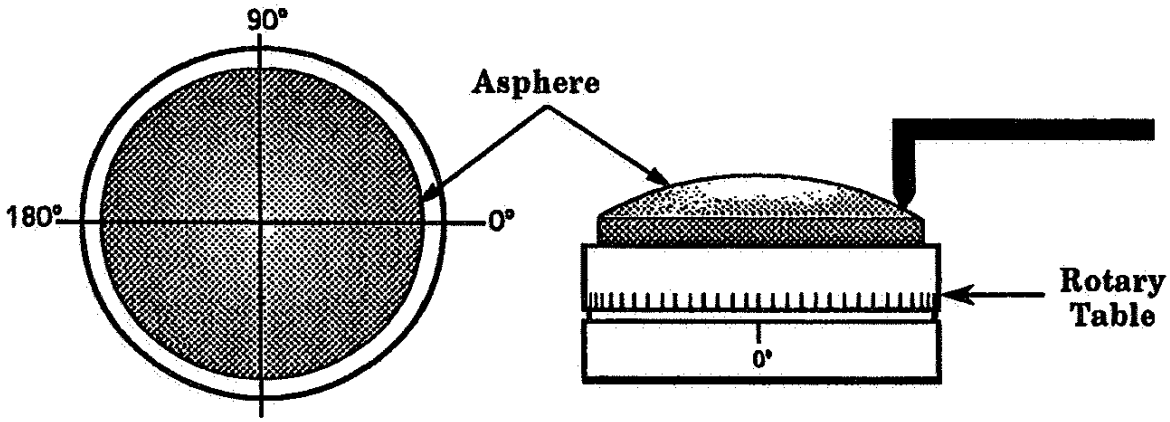
SETTING UP Unlike measuring spherical surfaces, where there are an infinite number of axes, aspheres have only one unique axis. This axis is used by the polynomial terms of the equation to specify the degree of departure from the base form. It is therefore essential, for accurate results, that the measurement data includes the axis.

In order to achieve this, it is necessary to correctly align the component in the axis orthogonally to the traversing direction. If this is not done correctly then the measurement will be subject to inaccuracy.

Note Crowning in the "Y" axis is not sufficient for the measurement of aspheres, they must also be levelled such that the stylus passes through the aspheric axis.

There are several ways of aligning the component in the orthogonal axis, however, probably the best methods are either to use fixturing and rely on an accurate datum face on the component, or use a rotating table, which has centring and levelling adjustment, and measure the surface displacement as follows:

Centre the component on the rotating table. Rotate the table and using the GAUGE SET UP MENU (press key F4), measure the stylus displacement at the four orthogonal positions,. Adjust the table levelling screws until the deviation at each position is within 5µm (approx).



When the alignment has been completed, crown the component in the "Y" axis, as for normal spherical components.

MAKING A MEASUREMENT

Select the appropriate traverse length and set up the component such that the traverse will be symmetrical about the aspheric axis, and that the stylus will remain in range.

Ensure that the appropriate constants have been set on the **'Form Options'** menu, and that reference line selected is **'ASPHERIC'**.

Perform a measurement as normal, by selecting either **'Data Collect, Analyse or Data Collect'**. Note that if the latter option is used, then on completion of the measurement, the **'Raw Data Selection'** menu is displayed, and the include or exclude data facility can be used as required. On completion of analysis the results summary is displayed.

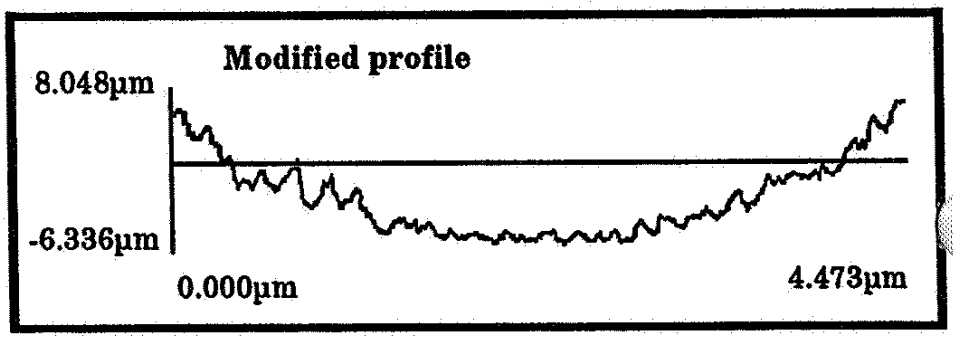
REFINING THE RESULTS

Typically some residual curvature is exhibited, and is often due to a small error in the base radius value of the aspheric form. It should be noted that this error may be acceptable by virtue of the tolerance applied to the radius term, but it may have had an unacceptable effect on the Form error. Therefore, it is sometimes necessary to refine the radius value to determine the minimum form error.

Radius errors are are typically caused by:

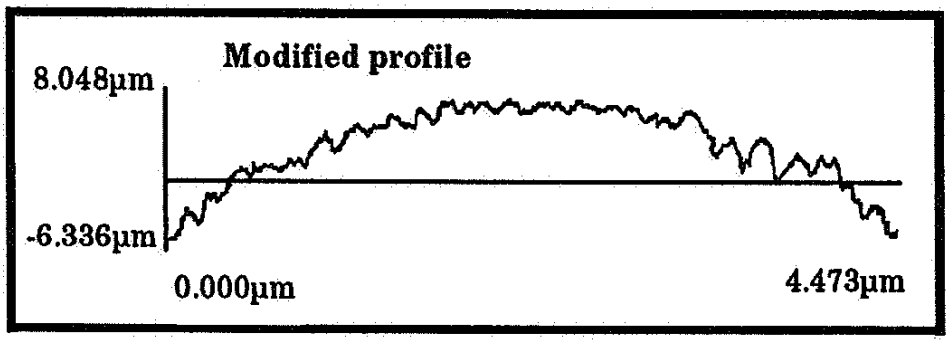
* An error in the programmed tool path.
* An error in the radius of the cutting tool.
* Shrinkage of the Mould.
* A combination of the above.

It is often worthwhile, therefore, to determine the optimum form error and hence the radius error, in order to allow a feedback into the manufacturing cycle.



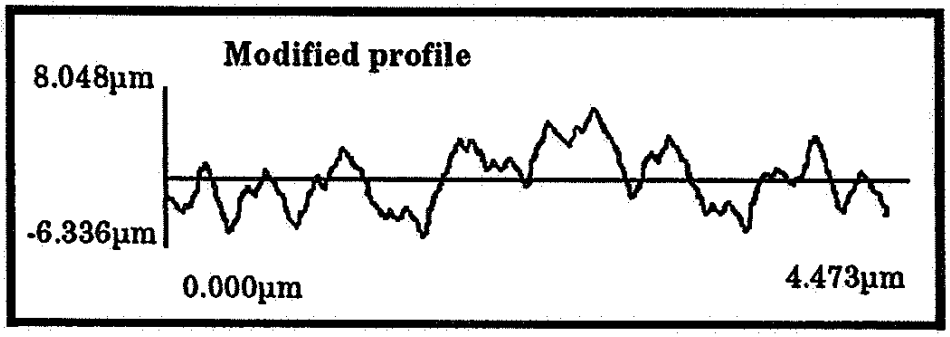
By establishing whether the residual curvature is convex or concave, the radius can be adjusted and the form re-calculated.

For example, when the measurement results obtained from a convex component exhibit a concave residual curvature, then the input base radius value could be increased slightly (determined by trial and error or experience). If the radius value is increased too much then the following result could be achieved.



By adjusting the radius value and re-calculating, it should be possible to achieve a form error which is nominally parallel to the reference line.

RADIUS VALUE CORRECT



The following table indicates the various error types and should assist in refining the radius term, in order to obtain the minimum form error.

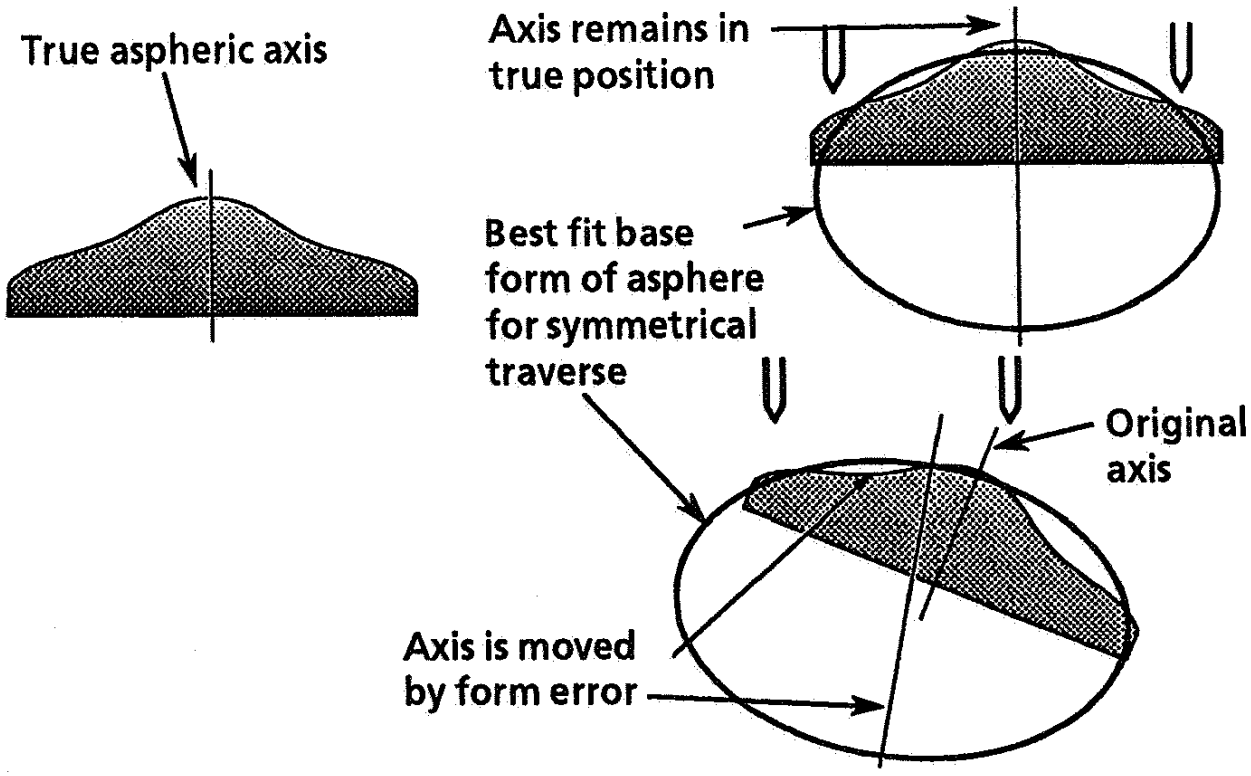
BASE FORM OF COMPONENT	RESIDUAL FORM ERROR	ACTION
CONVEX	CONVEX	DECREASE RADIUS
CONVEX	CONCAVE	INCREASE RADIUS
CONCAVE	CONCAVE	DECREASE RADIUS
CONCAVE	CONVEX	INCREASE RADIUS

NON SYMMETRICAL TRAVERSE

When it is impossible to measure an asphere symmetrically about the aspheric axis, as when the 'SAG' of the asphere is greater than that of the range of the instrument, then the component must be 'tilted' or 'angled' to enable at least a section to be measured. Non symmetrical traverses can be performed subject to the limitation of actually traversing over the aspheric axis, however the results obtained can be subject to increased error.

This is due to the method of the 'Least Squares' fit on the aspheric data, which is subject to non symmetrical form errors. These errors will tend to move the aspheric axis from its true position, and since the axis is used in the calculation of the form, then errors will be introduced.

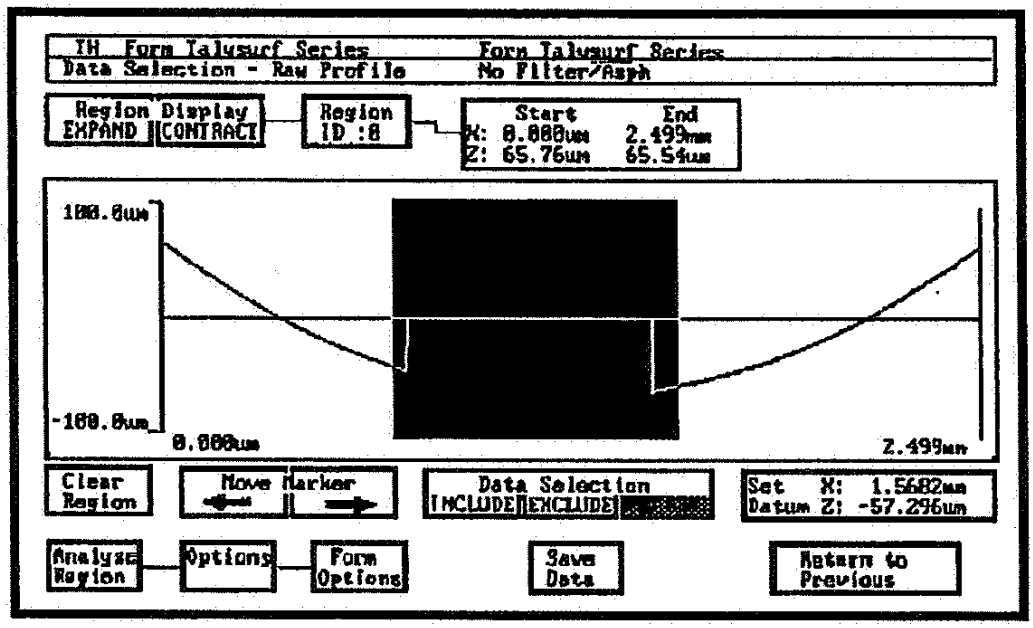
In the diagrams following, the effect of form errors on the aspheric axis is shown, although it should be noted that where the form errors are small in magnitude there is little effect on the aspheric axis or the measurement in general.



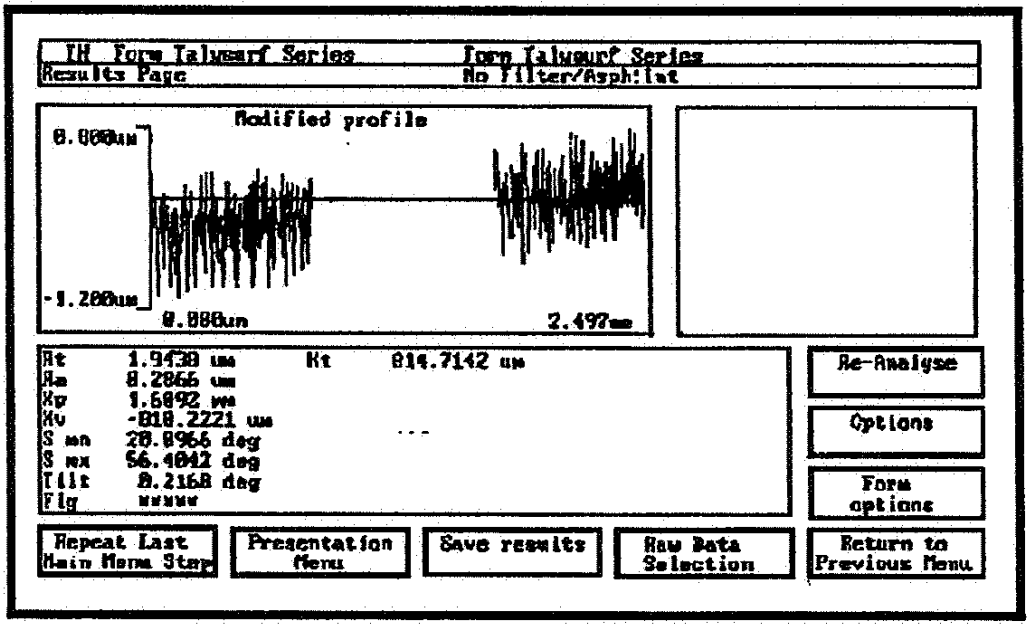
INTERRUPTED SURFACES

When the measured asphere has an interrupted surface, the procedure is as follows:

From the DATA SELECTION menu, use the EXCLUDE option to define the area of the interruption.



Select the ANALYSE REGION option. The RESULTS PAGE is then displayed.



This is as for a normal aspheric measurement, excepting that where the excluded region was defined, a discontinued profile (a hole) is displayed. The Fig parameter is invalid for this analysis and

asterisks are displayed instead of a value. Also the modified profile box is not selectable.

The menu title bar is updated with the text **Int appended to the Aspheric form details, to indicate that the results have been obtained from the analysis of an interrupted surface.**

Note If, on the Raw Data Selection menu, the interruption was defined to be at the start or the end of the Raw Profile, then the Modified Profile, on the results page, will not contain an interruption but the modified profile and parameter boxes will still be unselectable and the title bar will still be updated.

RESTRICTIONS The following restrictions apply to the analysis of interrupted aspherics:

1. The analysis is valid for one interruption only. Therefore, if more than one exclude area is selected, the error message:

   [184/6097] Too many interruptions in the data

   is displayed.

2. The Dual Profile facility is not valid for interrupted aspheric surfaces. Therefore, if it is attempted to use an interrupted TEST or DATUM profile, the message:

   [126/6092] Invalid dual test or datum profile

   is displayed when Dual Profile mode is selected.

MAKING A DUAL PROFILE ASSESSMENT

The Dual profile facility enables two sets of measurement profile data to be displayed and compared. One set of data is used as a datum, against which the other set is tested.

To implement the dual profile facility, a number of procedures must be followed in addition to those required for an ordinary measurement. These are:

1. From the MAIN MENU, select the **Configure option.**
2. **From the CONFIGURATION MENU, select the Presentation Menu** option.
3. The PRESENTATION MENU has three **Dual Profile** options: **Off, Continuous** or **Template.** When **Off** is selected, the dual profile facility is **not** available. Select either **Continuous** or Template, as required:

   Continuous: This facility must be selected when the Datum profile is to be obtained from direct measurement or is to be frequently changed. When **Continuous** is selected, a **Store Profile** option is included in the DATA SELECTION MENUS. This option enables the profile displayed on the DATA SELECTION MENU to be stored as the Datum Profile.

   Template: This facility must be selected when repeated measurements are to be compared with the same Datum Profile. The Datum Profile is derived from previously stored measurement data.

   The **Store Profile** option will not be included in the DATA SELECTION MENU.

   When **Template** is selected, a filename is requested. Enter the filename of the stored

measurement data, which is to be the Datum Profile. The filename should include the extension .prf if raw data is to be compared (e.g. test_00.prf) or the extension .mod if modified profile data is to be compared (e.g. test_00.mod).

Note: The Dual Profile facility will only compare data of the same type, i.e. Raw Profile with Raw Profile and Modified Profile with Modified Profile.

4. Return to the MAIN MENU, set up and make a measurement of the surface.

   If the Dual Profile option **Continuous** was selected from the PRESENTATION MENU, the measurement should be of the surface to be used as the Datum Profile.

   If the Dual Profile option **Template** was selected from the PRESENTATION MENU, the measurement should be of the surface to be compared with the Datum Profile. Continue from step 6.

5. If the Dual Profile option **Continuous** was selected from the PRESENTATION MENU, the DATA SELECTION MENU now has the additional option, **Store Profile.** If the measurement results are satisfactory, select the **Store Profile** option. The profile is now stored as the Datum Profile, and will remain stored until changed by re-selection of the **Store Profile** option or the program is terminated. Return to the MAIN MENU and make a measurement of the surface to be compared with the datum Profile.

6. Obtain the DATA SELECTION MENU and select the **Dual Profile** option, which is now shown. This menu displays the datum profile and the profile under test. For details of this menu, see the DUAL PROFILE MENU.

GOTHIC ARCH ANALYSIS

This facility allows the measurement of a Gothic Arch Bearing and the display of the measured profile. The left and right hand sections of the Arch can be analysed by using the two sets of cursors.

The analysis simulates the manual method of using blue marking ink to show the contact points on the bearing. In this case the radius of the test ball is entered via the keyboard and a mathematical fit is made to the measured profile.

The test ball contact angle and the displacement of the arc centres in the X and Z axes will be related to one of four defined axes.

CALCULATIONS

The axes are calculated as follows.

Contact

Bisect the line between contact points CP_L and CP_R and construct an axis through the bisection point and the calculated centre of the test ball - AXIS a, Figure 1.

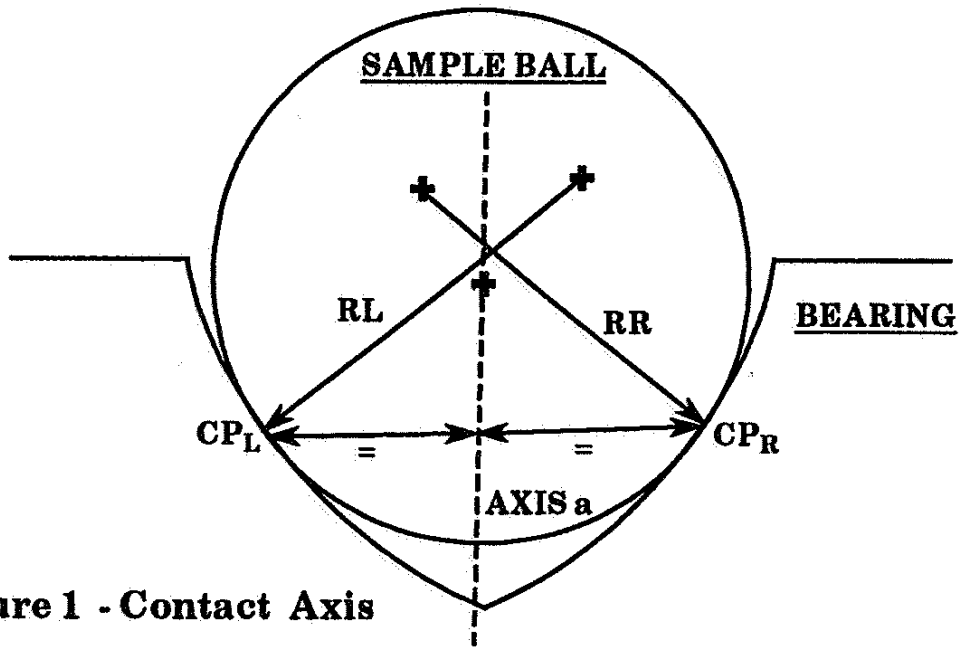


Figure 1 - Contact Axis

Radius Bisect the line through the left and right radius centres and construct an axis through the bisection point and the calculated centre of the test ball - AXIS b, Figure 2.

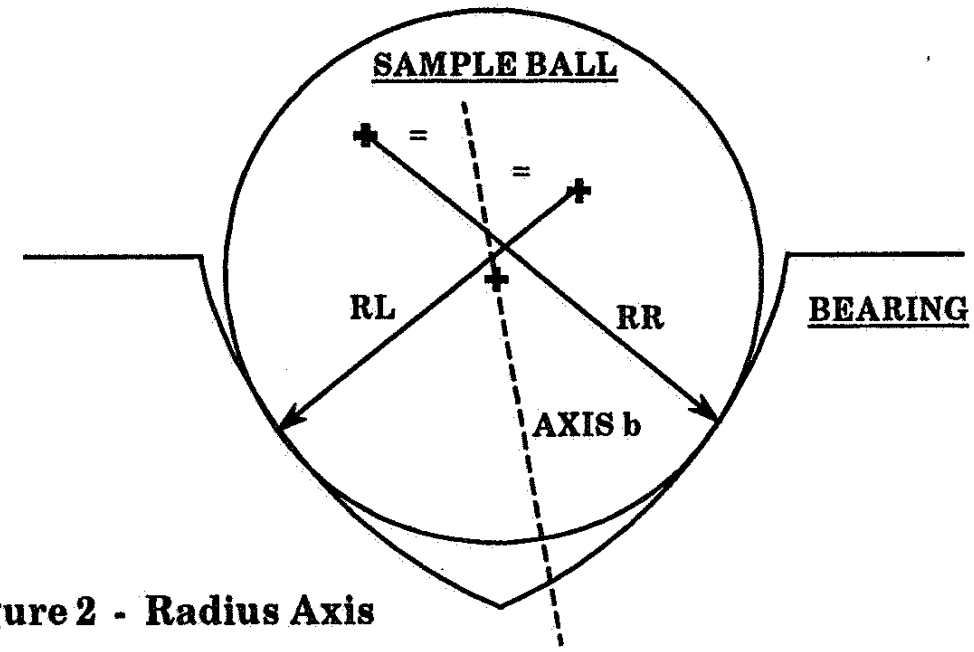


Figure 2 - Radius Axis

Cursor Construct an axis through a cursor selected reference point (A_1) and the calculated centre of the test ball - AXIS c, Figure 3. Using this cursor to define the axis, allows it to be positioned where required. Thus the axis can always be through the bottom of the bearing if preferred, i.e. A_2.

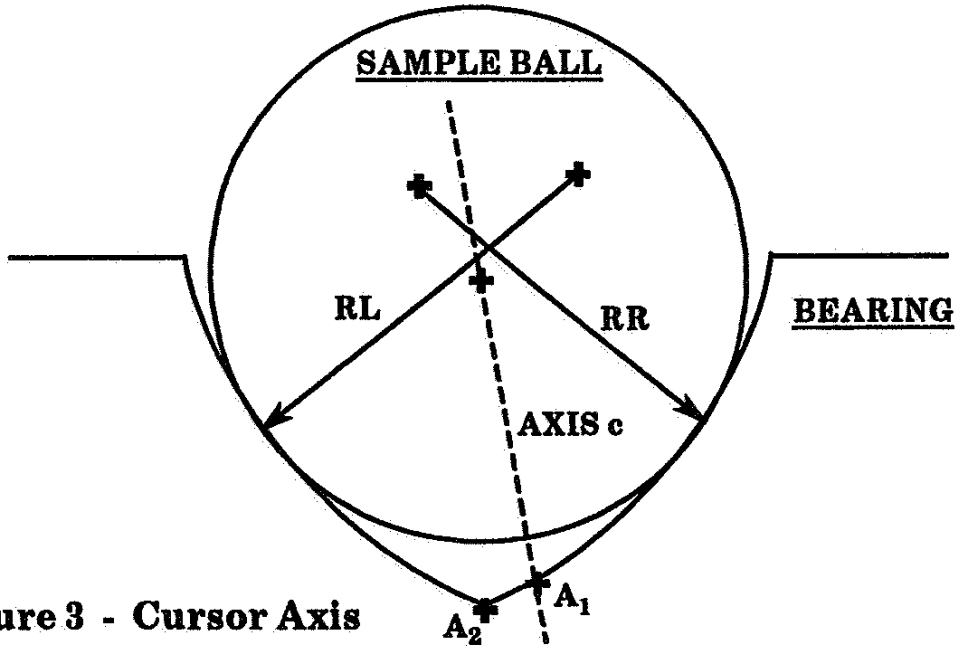


Figure 3 - Cursor Axis

Vertical Construct an axis which passes through the calculated centre of the test ball and is perpendicular to the datum bar of the instrument.

METHOD FOR MAKING A GOTHIC ARCH ANALYSIS

From the Main menu, select FORM OPTIONS. From the FORM OPTIONS MENU, select GOTHIC and then RETURN TO PREVIOUS MENU.

From the DATA SOURCE option, select the source of data for analysis. This can be a new measurement, using the IMMEDIATE or COMPONENT options, or data residing in the Memory (i.e. the last measurement made) or from a stored file.

Select DATA COLLECTION. This will initiate a measurement from the DATA SOURCE selected and display the raw profile in the DATA SELECTION - RAW PROFILE MENU.

From the DATA SELECTION - RAW PROFILE MENU, select the GOTHIC ARCH MENU option. The menu then displayed (Figure 4), allows various Gothic Arch analysis variables to be set, e.g. LEFT and RIGHT ARCS, AXIS etc., before the Gothic Arch analysis is carried out. All the cursor and arc co-ordinates are displayed in this menu.

A Gothic Arch analysis will always be performed if GOTHIC form type has been selected.

N.B. There are two methods available for making a Gothic Arch Analysis, these are: *Surface* and *Arcs*. The choice of method is left entirely to the preference of the user.

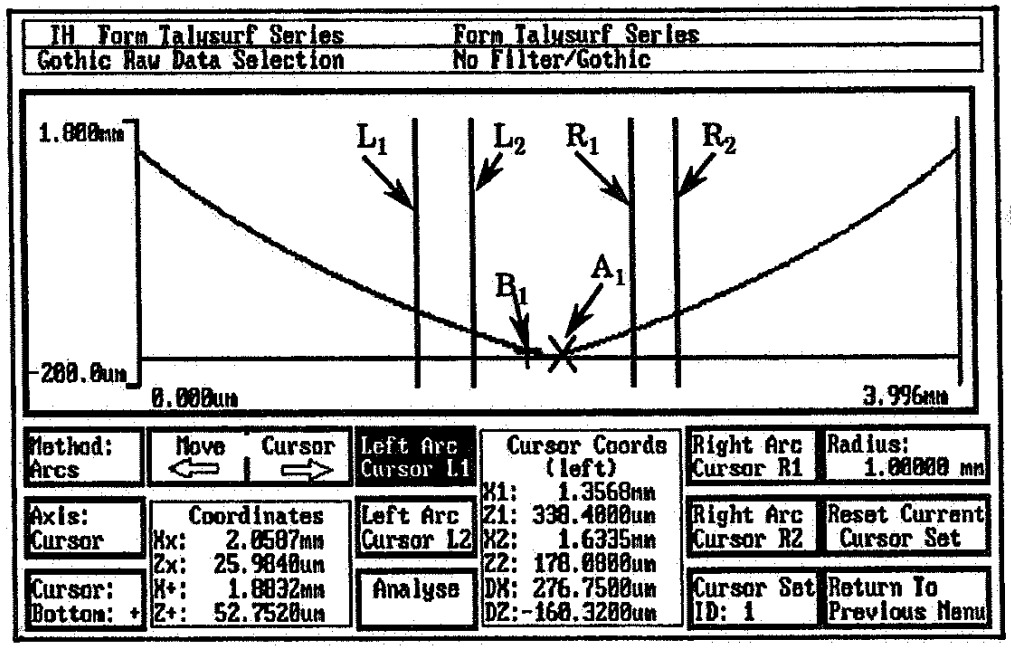


Figure 4 - Gothic Arch Menu

The various pre-analysis options are listed following:

METHOD This allows the selection of one of the two methods available for making a Gothic Arch analysis. The option toggles between SURFACE and ARCS, one of which must be selected for computing the contact points. The Surface method is the default method.

AXIS This option allows you to toggle through the four available options CONTACT, RADIUS, CURSOR and VERTICAL. The default axis is RADIUS.

CURSOR Two options are available by toggling this box, they are: BOTTOM:+ and AXIS:X. With BOTTOM:+ selected, the cursor, shown as B_1, in Figure 5, is used to define the bottom of the Gothic Arch. The symbol + indicates the position of the cursor on the profile, this cursor is only used for the Surface method of calculating the results. The default position is

the minimum position on the measured profile. **N.B. THIS WILL NOT NECESSARILY DEFINE THE BOTTOM OF THE GOTHIC ARCH.** Use the Move Cursor box to ensure that the + cursor is positioned at the bottom of the Gothic Arch, the Z+ co-ordinate will help to show when this position is reached.

When Axis X is selected, the cursor shown as A_1 in Figure 3, is used to select a reference point for an axis which runs through the calculated centre of the test ball. This is shown as Axis c in Figure 3. The cursor X can always be positioned where required. Therefore, if preferred, the axis can always be through the bottom of the bearing. This cursor may be used in both the Arcs and Surface method of results calculation.

MOVE CURSOR The selected cursor or arc cursor can be moved left or right by clicking on this window. The range is the length of the profile.

CO-ORDINATES (Axis and Bottom Cursor) This box displays the X and Z co-ordinates of the Axis and Bottom cursor.

LEFT ARC CURSOR L1 Selecting this box makes the Left Arc Cursor L1 the current cursor and highlights the box.

LEFT ARC CURSOR L2 Selecting this box makes the Left Arc Cursor L2 the current cursor and highlights the box.

RIGHT ARC CURSOR R1 Selecting this box makes the Right Arc Cursor R1 the current cursor and highlights the box.

RIGHT ARC CURSOR R2 Selecting this box makes the Right Arc Cursor R2 the current cursor and highlights the box.

N.B. The left and right arc cursors should be set to include as much of the relevant profile as possible.

ANALYSE When selected, the input conditions will be used for a Gothic Arch analysis. A Gothic Arch results page is then displayed, if the analysis is successful.

CURSOR COORDS (LEFT AND RIGHT) This box displays the left and right arc cursor co-ordinates. The delta X (DX) and delta Z (DZ) co-ordinates will also be displayed if relevant. Left or right is shown in brackets indicating to which cursor pair the co-ordinates refer.

CURSOR SET ID Allows the operator to select one of the three pre-defined sets of cursors. A cursor set consists of Left Arc cursors L_1, L_2, Right Arc cursors R_1 and R_2, and Bottom and Axis cursors. To set the cursors select 0, 1 or 2 in the Cursor Set ID window and then move the cursors to the required position.

The cursors will take up these preselected values each time the related number is selected. The cursors can be reset by clicking on the Reset CURRENT CURSOR SET box. The 0 set is the default condition and will appear when the program is first switched on. The cursor positions for set 0 will always be reset after a data collection has been made.

RADIUS On selection, the operator is prompted to input the Test Ball radius, the minimum is 1mm. and maximum 10,000mm. The default value is 1mm.

RESET CURRENT CURSOR SET Resets the positions for the current cursor set.

The left and right arc pair are automatically centred around the bottom cursor position. The bottom position will be the minimum data point (e.g. valley of the selected data). The axis cursor position will be set to the bottom position.

RETURN TO PREVIOUS MENU Routes to previous menu.

RESULTS ANALYSIS

Surface method

The operator input for this method is:

1. Select an axis cursor from Radius, Contact, Cursor or Vertical. When Cursor is used, the axis cursor X must be positioned on the measured profile, see Figure 3.
2. Position the cursor Bottom:+ on the profile at the bottom of the Gothic Arch.
3. Enter the radius of the test ball.

   The input test ball radius RTB, the cursor B_1 and the measured profile, are all used in the calculation of the contact points CP_L and CP_R.

   The contact points CP_L and CP_R are defined as the first points of contact either side of the cursor B_1 (Figure 5).

   The correct positioning of B_1 is essential for valid results. Use the left and right cursor keys to move B_1.

Arcs method

The operator input for this method is:

1. Select an axis cursor from Radius, Contact, Cursor or Vertical. When Cursor is used, the axis cursor X must be positioned on the measured profile, see Figure 3.
2. Select the left and right Arc cursors and position them on the profile.
3. Enter the radius of the test ball.

   Two circle fits, as defined by the L_1, L_2 and R_1, R_2 cursors for the left and right arcs respectively will be be computed. For these two radii R_L, R_R and two centres C_1 and C_{RA} of the fitted left and right arcs will be (Figure 5).

The cursor pairs should be moved so that they include as much of the surface as possible to give arc fit results.

The input ball radius B and the fitted left and right arcs, defined by the L_1, L_2, and R_1 and R_2 cursors are used in the calculation of the contact points CP_L and CP_R - See Figure 5.

TEST BALL CENTRE

From the contact points (CP_L and CP_R) the true centre, CTB (Figure 5), of the test ball will be calculated for use in further analysis.

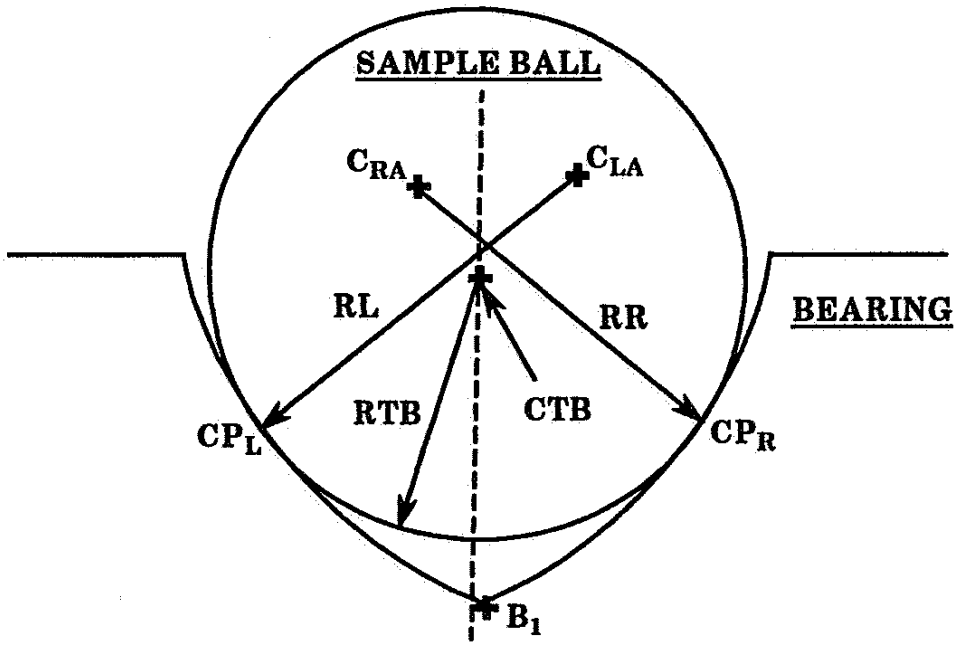


Figure 5 - Centre of Test Ball (CTB)

RESULTS OUTPUT

A sample results page is shown in Figure 6, this should be related to Figure 7.

N.B. Dimensions and angles in Figure 7 are exaggerated for clarity.

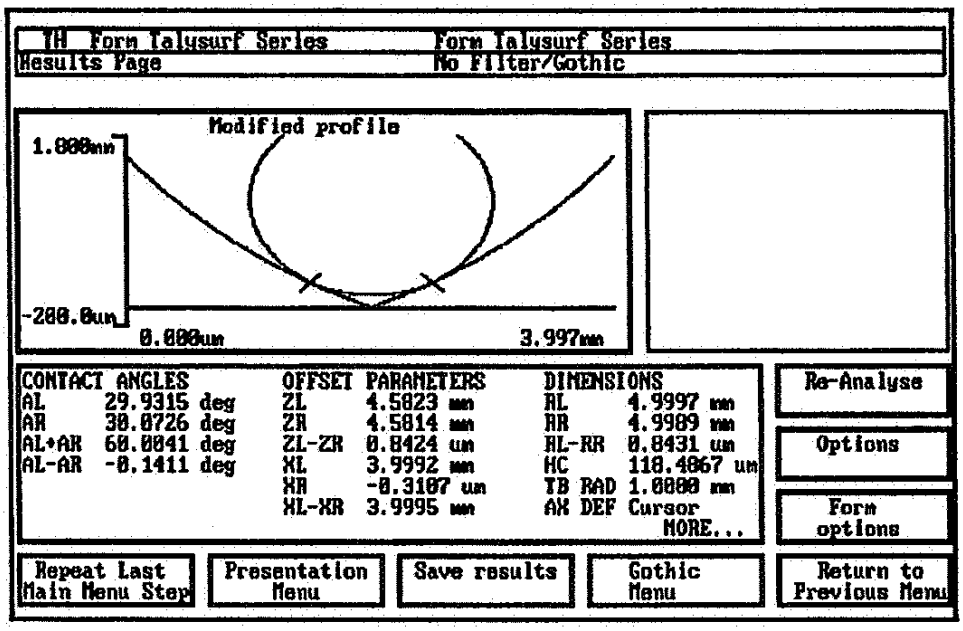


Figure 6 - Gothic Arch Results Parameters (Page 1)

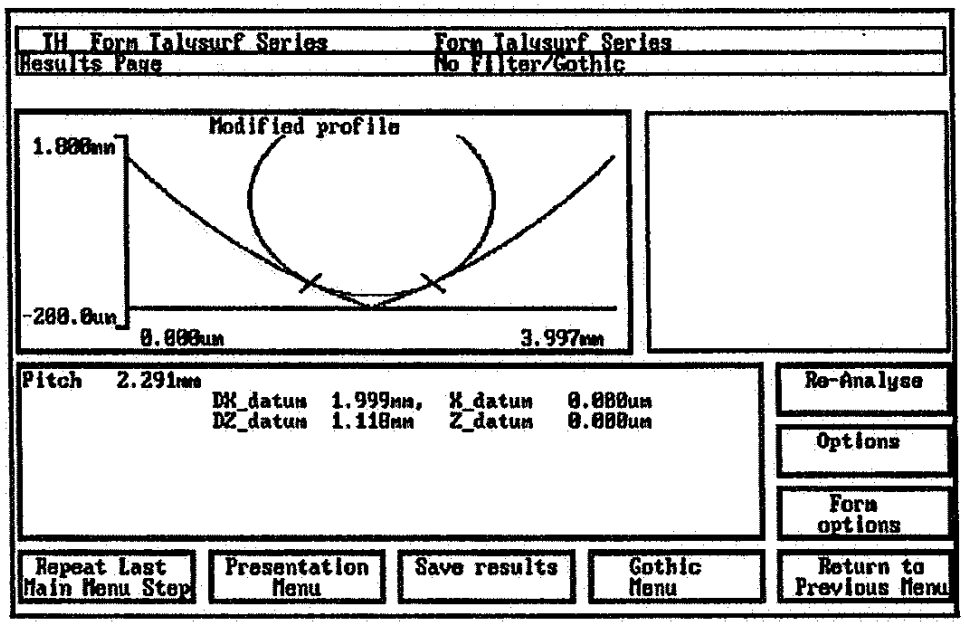


Figure 6a - Gothic Arch Results Parameters (Page 2)

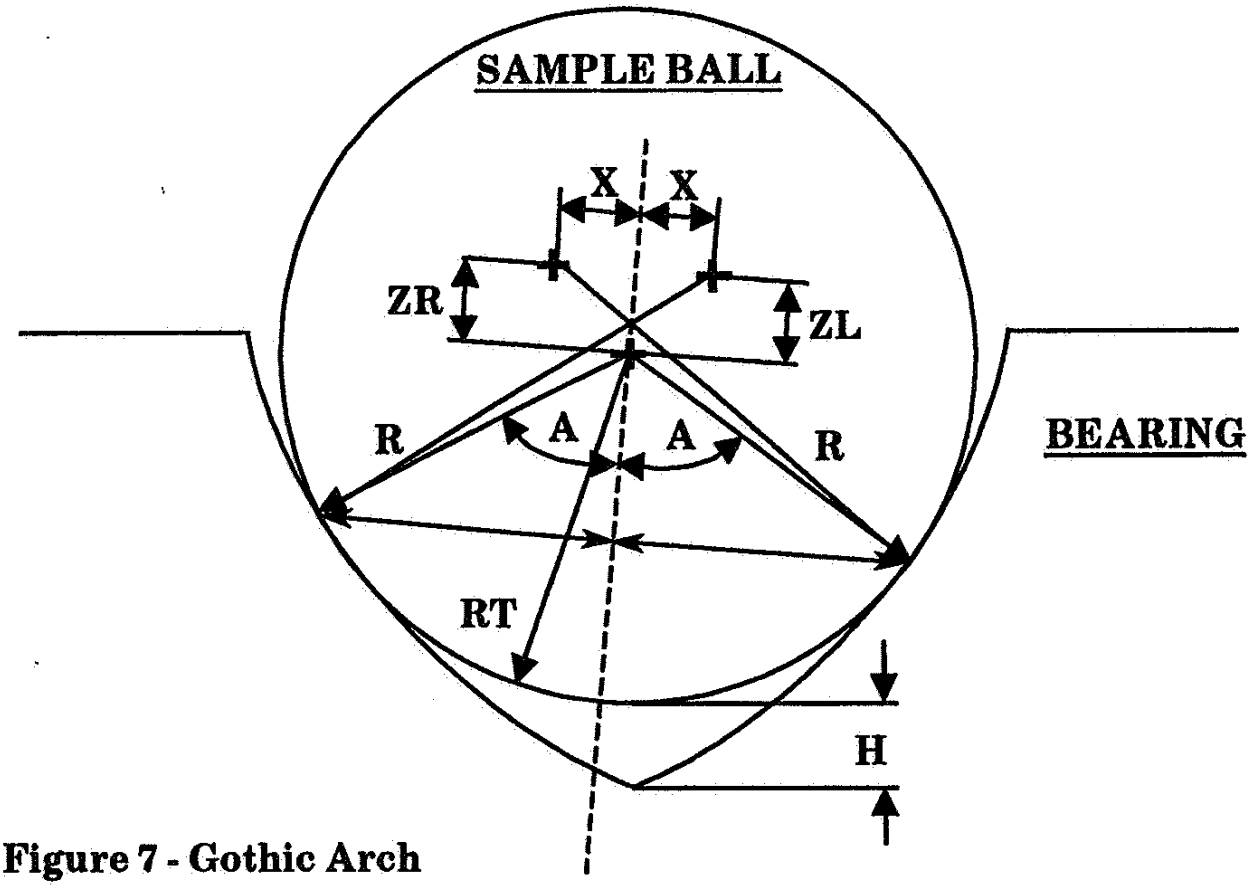


Figure 7 - Gothic Arch Results Parameters

DIMENSION CALCULATIONS

From a single measurement containing two bearing surfaces (Figure 8) it is possible to calculate the *pitch* between two sample balls located in the bearings as follows:

RAW DATA MENU

Expand to select required position.

GOTHIC MENU

Position cursor pairs and analyse.

RAW DATA MENU

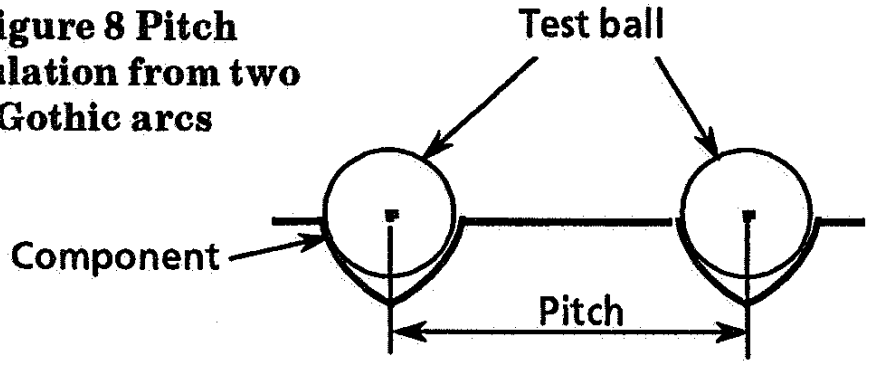
Expand to select second position.

GOTHIC MENU

Position cursor pairs and analyse.

Refer to PARAMETERS, DEFINITIONS AND THEORY, Chapter 6 of this handbook, pitch is explained on page 16.

Figure 8 Pitch calculation from two Gothic arcs



CONVEX SURFACES

Gothic Arch analysis is not valid for convex surfaces. Selecting REPLICA mode (see FORM OPTIONS MENU) can be used to change the surface to a concave form and the apply the gothic arch analysis.

PROGRAM SWAP FACILITY

DESCRIPTION The program swap facility enables the user to temporarily leave the Form Talysurf program and move to MS-DOS operation, or for a Form Talysurf measurement program to cause the execution of a DOS shell or program. A return to the Form Talysurf program can be executed when required.

MANUAL OPERATION A DOS shell can be accessed from the Form Talysurf program, whenever a key input is allowed, by entering CTRL -X (holding down the CTRL key and then pressing the X key) .

To return to the Form Talysurf program, enter **EXIT** at the MS-DOS command line.

AUTOMATIC OPERATION The program swap function can be invoked from a Form Talysurf measurement program. This is achieved by inserting a message at the appropriate program step. The message must start with the characters **XQ:**. When required, the switch /N can be used with the **XQ:** command (e.g. **XQ:/N**). In which case, the screen image will not be saved. See under the heading OPERATION later in this section.

Program swap is invoked when these characters are output, at the measurement program step. The remainder of the program message is then passed to DOS as a command line and is executed as if it had been entered at the DOS prompt. If no command is included, i.e. the entire message was **XQ:**, then the DOS shell is executed without clearing the screen. In this circumstance, entering the command **EXIT** will cause a return to the Form Talysurf program..

The termination of a program being run under DOS will cause a return to the Form Talysurf program. If this is a batch file, then it should terminate with the command **EXIT**

OPERATION On executing the program swap facility, an image of the current DOS memory is saved: enabling a return be made to the same location in the Form Talysurf program. An image of the current screen display is saved separately. A DOS shell is then invoked.

If the program swap function was **automatically executed from a measurement program, then any user program or batch file included in the program message is then run.**

If the program swap function was manually executed, then the batch file EXTERNAL.BAT is automatically run (see heading PROGRAM MESSAGE AND BATCH FILES, later in this section). User specified programs can then be executed.

Note In addition to **EXTERNAL.BAT,** if any program **EXTERNAL.COM** or **EXTERNAL.EXE** is present these could also be executed on entering CTRL -X.

OPTION /N The option not to save the screen image (in order to save disk space) is available when executing the program swap facility from within a Form Talysurf measurement program. This is achieved by adding the switch /N to the **XQ:** command (e.g. **XQ:/N**).

Note This switch should only be used if subsequently run programmes do not output to the screen and alter the Form Talysurf program display.

PROGRAM MESSAGE AND BATCH FILES The Form Talysurf software is executed using command **FTS >NUL.** Therefore, all of the output is redirected to nul and will not normally be displayed. Therefore, if the display is required, in order to run a user program, then the program to

be run should be directed the display by including the redirection **>CON:** on the program message line, e.g.:

XQ: UTILITY PROF_00.PRF >CON:

This will invoke program **UTILITY** with input parameter **PROF_00.PRF** and redirect the output to the screen.

When it is required to output text to the screen, the message line could read:

XQ: MODE CO80 TYPE UTILITY .TXT >CON:

Command **MODE CO80** sets up a text screen and **>CON:** redirects the output from the **TYPE** command to display the contents of file **UTILITY.TXT** on to the screen.

In manual mode, the file **EXTERNAL.BAT (supplied on the installation disk) handles this by executing the following commands:**

mode co80	Set standard screen mode
cls	Clear screen
set prompt =p_fts$g	Set prompt
command >con:	Execute command shell output to the screen

This file is user configurable and can be tailored to suit specific requirements.

EXTERNAL UTILITY The external utility (user program) is responsible for handling all error conditions applicable to its function. This will require all applicable DOS errors to be trapped and dealt with in a suitable fashion, e.g. by returning a suitable exit code.

EXIT CODES Exit codes may be returned from a DOS program to the Form Talysurf program. The exit code must ≤15. A zero exit code will be ignored, all others will result in an error message being displayed and, where applicable, the measurement program is terminated.

3D TOPOGRAPHY ANALYSIS

This facility is not available for use in conjunction with an instrument running Form Talysurf Series E software

DESCRIPTION Form Talysurf can be used to provide measurement data which can be analysed to provide assessments of 3 dimensional surfaces.

The actual 3D Topography analysis is performed by computer software that is specifically designed for the processing of measured surface data that has been logged in three dimensions. This software enables the data to be processed, analysed and manipulated in many ways to characterise and identify particular features of the surface. The graphical presentations and analyses available will depend on the analysis package used.

THE 3D DATA COLLECTION SYSTEM The collection of data for analysis by a topography package is achieved by logging a number of parallel profiles. The profiles are logged at a pre-defined trace length and sample spacing as specified by the user. The number of data points in a single trace and the number of traces are dependent on the analysis package.

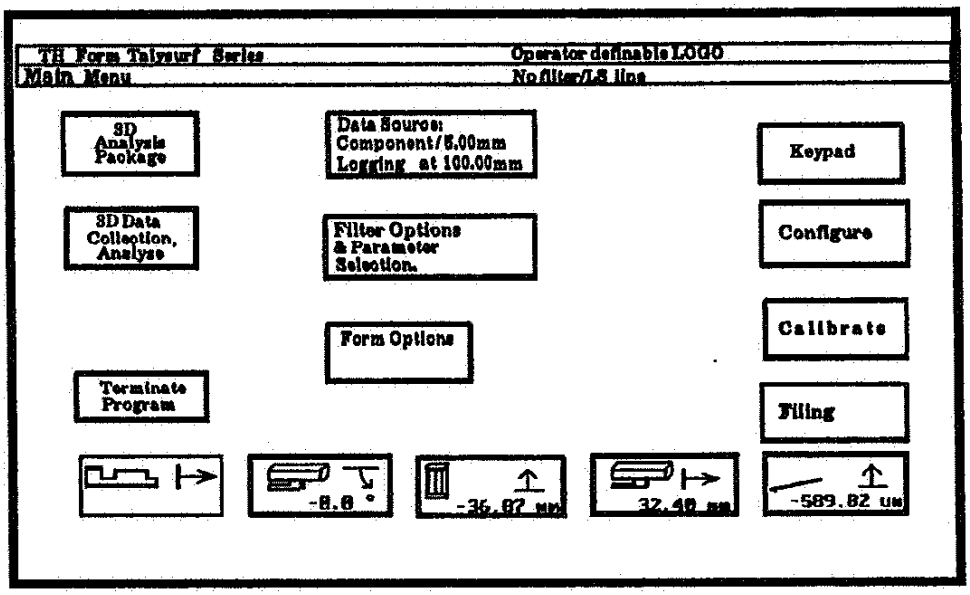
This operation is preferably performed automatically, by using Form Talysurf in conjunction with a translation stage (details of the optional accessory Y Axis Stage are given in the ACCESSORIES section of this handbook).

The 3D data collection, analysis step can be learned and run as a part of a Form Talysurf program.

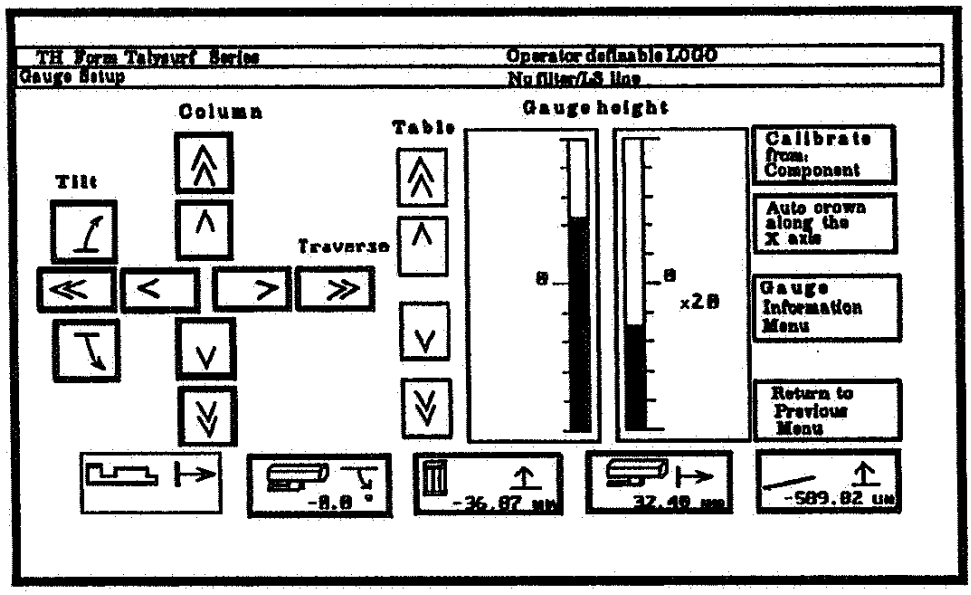
IMPORTANT **In order to maintain a reference plane throughout a series of measurements, the stylus AUTO LIFTOFF facility of the Form Talysurf Series instrument must not be selected.**

METHOD OF MEASUREMENT

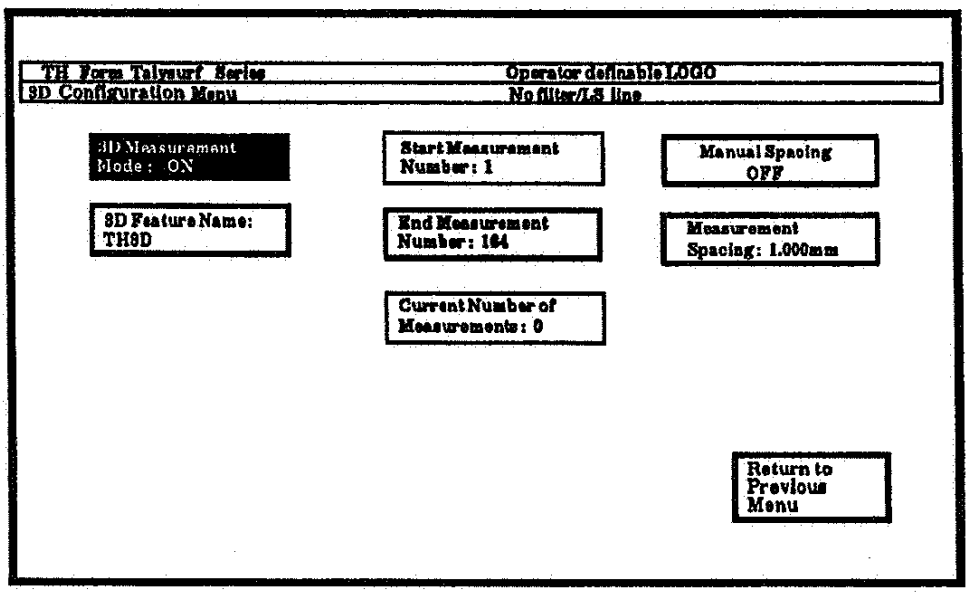
With the component located on the Y axis table, select **Calibrate** from the Main Menu.



From the displayed Calibration Menu, select **Calibrate Gauge.** This will cause the Gauge Setup menu to be displayed. Carry out the gauge calibration procedure as described in chapter five of this handbook.



From the Main Menu, select **Configure.** The Configuration Menu is then displayed. From this menu, select **3D Configuration Menu.**



Select **3D Measurement OFF** and enter the **3D Feature Name.** Enter the required number of measurements in **End Measurement Number.**

Select, **Manual Spacing OFF** or **ON**, as appropriate. OFF is selected, when it is required to control the operation of a Y axis stage automatically from the Form Talysurf; when ON is selected, the Form Talysurf waits, after each measurement, for the component to be manually repositioned.

Select the required spacing between measurements in **Measurement Spacing.**

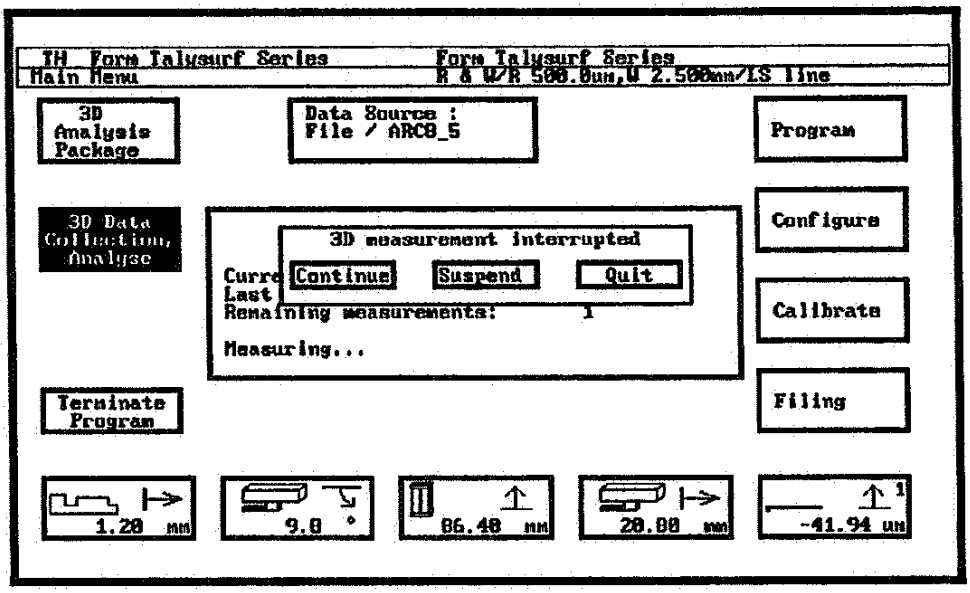
Select, **3D Measurement ON** and return to the Main Menu.

To start the measurement, select **3D Data Collection, Analyse.** On completion of the measurement, run the 3D Analysis Package to display the analysis.

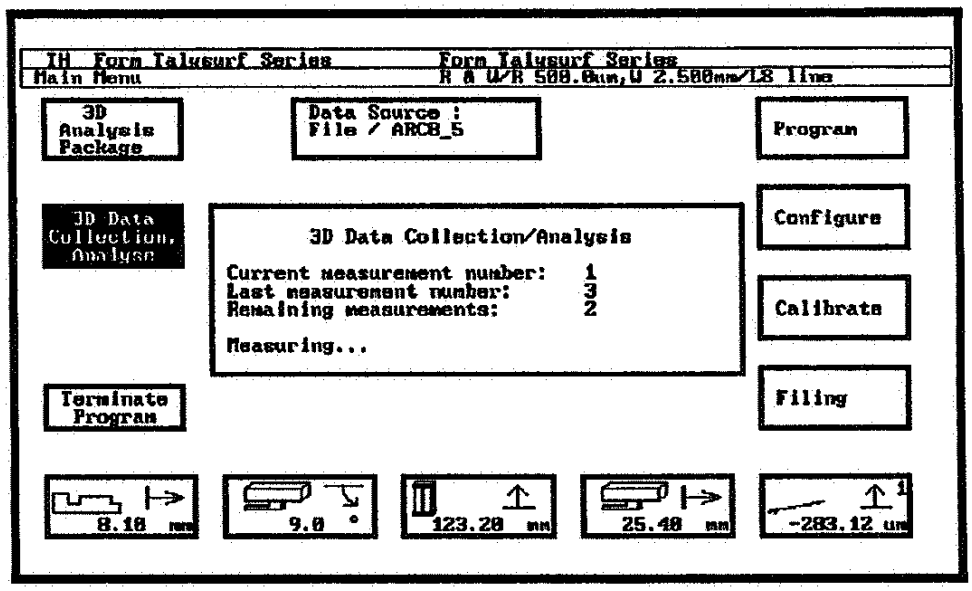
INTERRUPTED MEASUREMENT

A measurement can be stopped by pressing ⟨F10⟩.

With **3D Data Collection, Analyse** selected, the screen display will be as the example shown following.



Pressing ⟨F10⟩ will then produce the screen display shown below.



Continue - When selected allows the immediate continuation of the program.

Suspend - Allows the measurement to be suspended while other operations are performed. On re-selection of the 3D Data Collection, Analyse the measurements will be continued.

The symbol * is displayed in the 3D Data Collection, Analyse window, if a set of 3D measurements has been suspended.

Quit - Cancels the current measurements and returns you to the Main Menu.

PROGRAM MODE

The 3D Data Collection, Analyse step, can be learnt as part of a Form Talysurf Series program. When running the program the series of 3D measurements will always be executed as programmed and not continue from any suspended status.

INSTALLATION DISK FOR USE WITH 3D SURFACE ANALYSIS SOFTWARE

Measurement data, collected from a Form Talysurf Series instrument, can be processed using the 3D Surface Analysis software package from Taylor Hobson. This package can be supplied in versions for use on either an IBM compatible or an Apple Mackintosh computer.

After installing a version of the 3D Surface Analysis software, it is essential that the software on the disk marked:

INITIALISATION DISK FOR 3D SOFTWARE

is also installed.

To load the initialisation software proceed as follows:

Insert the disk into the floppy drive A:.

From the MS-DOS prompt C:\>. Type A: and press the return key.

After the prompt A:.\> has appeared, type 3DUPDATE and press the return key.

The initialisation software will be run and on completion the user is returned to the A:.\> prompt.

The Surface Analysis software can now be run.

CHAPTER 6
PARAMETERS, DEFINITIONS & THEORY

What surface texture is and why it is necessary to measure it are subjects covered in the book Exploring Surface Texture, from Taylor Hobson. The user is advised to read this book to obtain background information on surface texture in general and on stylus-type measuring instruments in particular. It also gives useful information on parameters: their derivation and use.

CONTENTS OF THIS CHAPTER

DESCRIPTION Surface texture is quantified by parameters which relate to certain characteristics of the texture. These parameters can be classified into three groups, according to the type of characteristic that they measure.

AMPLITUDE PARAMETERS Are measures of the vertical displacements of the profile (Z axis).

SPACING PARAMETERS Are measures of irregularity spacings along the surface, irrespective of the amplitude of these irregularities (x axis).

HYBRID PARAMETERS Relate to both the amplitude and spacing of the surface irregularities (z and x axis).

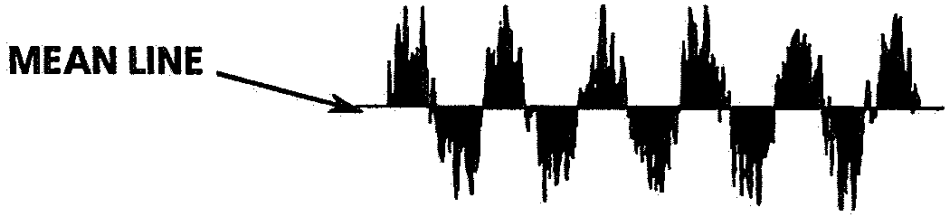
LENGTHS There are three characteristic lengths associated with the numerical assessment of surface texture.

SAMPLING LENGTH (or cut-off length) This is the length of the reference line used for identifying the irregularities characterising the surface roughness.

EVALUATION LENGTH (or data length) The length over which the values of surface roughness parameters are assessed: it is also known as the assessment length or data length. It may contain one or more sampling lengths.

TRAVERSE LENGTH The complete length of the pick-up movement along the surface being measured. It is normally greater than the evaluation length, due to the necessity to make an allowance at either end to ensure that mechanical and electrical transients are excluded from the measurement.

MEAN LINE The Mean Line is commonly used in surface texture measurement and it is nominally based on a least squares method. In basic terms it is normally a line which bisects the profile such that the area above it and below it are equal and a minimum, as shown below.



MINIMUM ZONE (MZ) The minimum zone reference is defined by a pair of straight, parallel lines which just enclose the entire profile such that the distance between the lines (the zone) is a minimum. The displayed reference line is the mean position between these two lines and to which all parameter calculations are referenced.

Note: The reference line is fitted prior to any filtering and cut-off removal. Displays can therefore, occasionally appear misleading.

PARAMETERS Parameter analyses are as follows:

UNFILTERED PRa, PRq, PRp, PRv, PRt,, PRsk, PRku, Dela, Delq, Lamq, S, Sm, PRz (ISO), Lo.

ROUGHNESS FILTERED Ra, Rq, Rp, Rv, Rt, Rt_i, Rsk, Rku, Dela, Delq, Lamq, Ry, Rz (ISO), Rz (DIN), Rpm, R3y, R3z, Rk, Rpk, Rvk, Mr1, Mr2, S, Sm, Lo.

WAVINESS FILTERED Wa, Wq, Wp, Wv, Wt, Wt_i, Wsk, Wku, Dela, Delq, Lamq, Wy,Wz (DIN), Wpm, S, Sm, Lo.

R&W Pt, R, Ar, Rx, SR, SAr, Wt, W, Aw, Wx. SW, SAw.

OTHER PARAMETERS HSC, Pc, tp%, Htp, Vo, Power Spectrum analysis and Aspheric analysis. Graphical output includes the Bearing ratio, Amplitude distribution and the Power Spectrum graphs.

As the Roughness and Waviness parameters are derived by applying similar filtering techniques, described later in this section under the heading BANDWIDTH, FILTERING AND DATA POINTS, only the roughness parameter is described in the following definitions. The waviness analysis is identical but with the corresponding short wave cut-off filter applied. The R&W analysis applies a

different technique which is described later in this section.

The parameters are defined as follows:

Ra Ra is the universally recognised, and most used, international parameter of roughness. It is the arithmetic mean of the departures of the profile from the mean line.

$$Ra = {}^{1}/_{L}\int_{0}^{L} |z(x)|\, dx$$

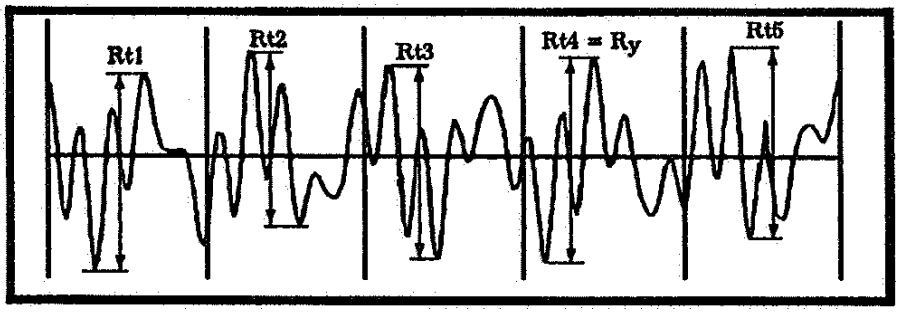
Rq Rq is the rms parameter corresponding to Ra.

$$Rq = \sqrt{{}^{1}/_{L}\int_{0}^{L} |z^2(x)|\, dx}$$

Rt Rt is the maximum peak to valley height of the profile in the assessment length.

Rti Rti are the largest peak to valley heights within each cut-off (sample) length analysed.

Rti and Ry PARAMETERS



Ry Ry is the largest Rti value of the assessment.

Rtm (Rz Din) Rtm (also known as the Rz (DIN) parameter is the average of all the Rti values in the assessment length.

$$R_{tm} = Rz\,(DIN) = \frac{(R_{t1} + R_{t2} + R_{t3} + \ldots . R_{tn})}{n} = \frac{1}{n}\sum_{i=1}^{i=n} R_{ti}$$

Rz - Rz(JIS) Also known as the ISO 10 point height parameter, is the average height difference between the five highest peaks and the five lowest valleys within the sampling length.

Rv Rv is the maximum depth of the profile below the mean line within the assessment length.

Rp Rp is the maximum height of the profile above the mean line within the assessment length.

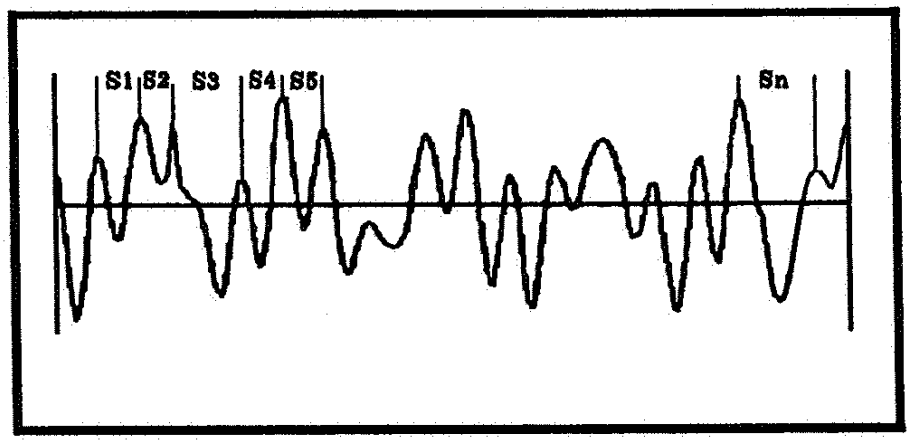
Rpm Rpm is the mean of Rp values obtained for each sampling length of an assessment.

$$R_{pm} = \frac{1}{n} \sum_{i=1}^{i=n} R_{pi}$$

S S is the mean spacing of adjacent local peaks, measured over the assessment length. (A local peak is the highest part of the profile measured between two adjacent minima, and is only included if the height between the peak and its preceding minima is at least 1% of the overall peak to valley of the profile).

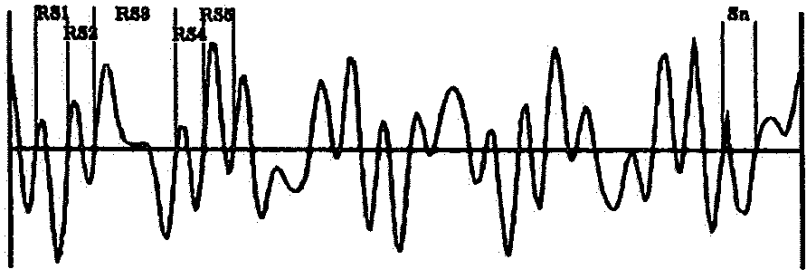
$$S = \frac{1}{n} \sum_{i=1}^{i=n} S_i \qquad S = \frac{(S_1 + S_2 + \ldots . S_n)}{n}$$

S
LOCAL PEAK SPACING



Sm Sm is the mean spacing between profile peaks at the mean line, measured over the assessment length. (A profile peak is the highest part of the profile between an upwards and downwards crossing of the mean line).

Sm
MEAN LINE PEAK SPACING



$$Sm = \frac{1}{n}\sum_{i=1}^{i=n} S_i \qquad Sm = \frac{(S_1 + S_2 + \ldots . S_n)}{n}$$

Δa Δa (Dela) is the arithmetical mean slope of the profile: Δa is the arithmetical average of the absolute values of the rate of change of the profile within the sampling length.

$$\Delta a = {}^{1}/_{L}\,{}_{0}\!\int^{1} \left|{}^{dy}/_{dx}\right| dx$$

Where ${}^{dy}/_{dx}$ is an instantaneous slope of the profile, or approximately

$$\Delta a = \frac{1}{n}\sum_{L=1}^{n}\left|\frac{\Delta y_L}{\Delta x_L}\right|$$

Δq Δq (Delq) is the rms slope of the profile throughout the assessment length.

$$\Delta q = \sqrt{{}^{1}/_{L}\,{}_{0}\!\int^{L}(\theta\,(x) - \bar{\theta})^2 dx}$$

Where $\bar{\theta} = {}^{1}/_{L}\,{}_{0}\!\int^{L}\theta\,(x)\,dx$ and where θ is the slope of the profile at any given point $\theta = y'(x)$

λq λq (Lamq) is the rms measure of spatial wavelength content of the surface. Numerically:
$\lambda q = 2\pi Rq \,/\, \mathrm{Tan}\,\Delta q$ (with Δq in Radians)

R_{3z} R_{3z} is the vertical mean from the third highest peak to the third lowest valley for each sample length.

$$R_{3z} = \frac{1}{n}\sum_{i=1}^{i=n} R3zi = \frac{(R_{3z1} + R_{3z2} \ldots R_{3zn})}{n}$$

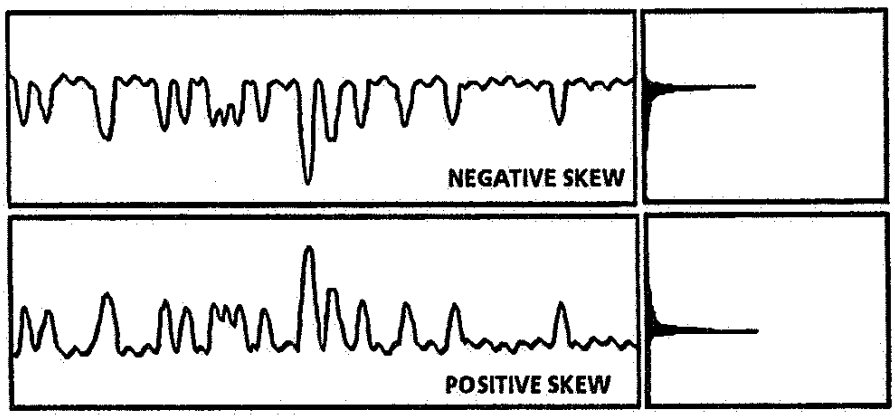
R_{3zi} R_{3zi} is the deviation from the third highest peak to the third lowest valley in each sample length.

R_{3y} is the largest of the R_{3zi} values.

Lo Lo is the developed length of the reference line fitted to the measured profile.

R_{sk} Skewness is a measure of the symmetry of the amplitude distribution curve about the mean line.

COMPONENTS WITH THE SAME Ra BUT WITH +ve AND -ve SKEW



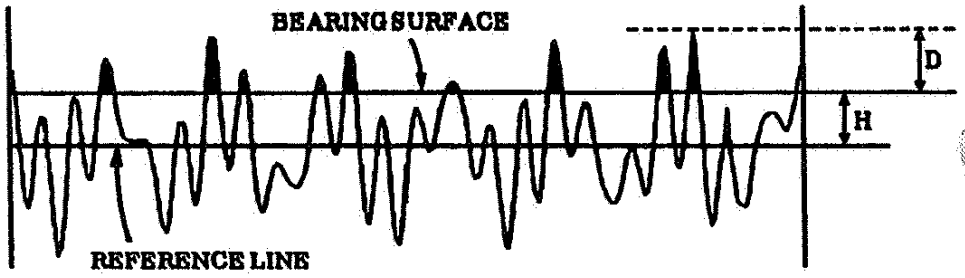
$$R_{sk} = \frac{1}{LRq^3} \int_0^L Z^3(x)dx$$

R_{ku} Kurtosis is a measure of shape (sharpness) of the amplitude distribution curve.

$$R_{ku} = \frac{1}{LRq^4} \int_0^L Z^4(x)dx$$

HSC The high spot count is the number of complete profile peaks (within the assessment length) projecting above the reference line, the reference line being parallel to the mean line. The reference line can be set to a selected depth below the highest peak, at a selected distance above or below the mean line or at a a tp% height.

HIGH SPOT COUNT



tp% The bearing ratio is a measure of the length of bearing surface (expressed as a percentage of the assessment length), where the profile peaks have been cut off at a line which runs parallel to the mean line of the profile.

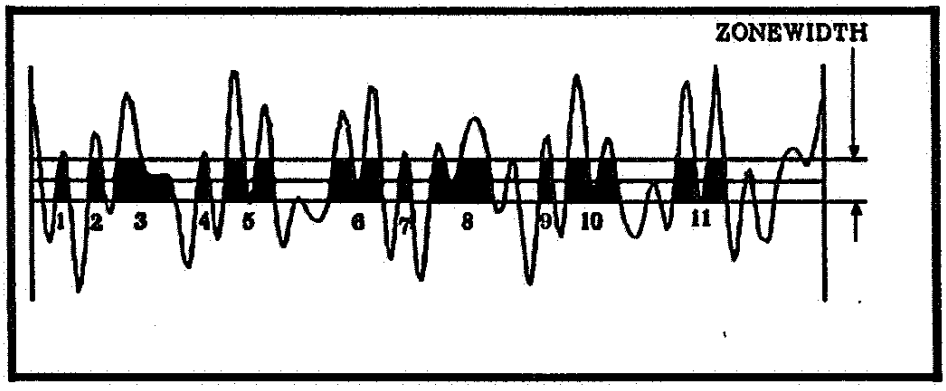
The line defining the bearing surface, can be set at a selected depth below the highest peak or at a selected distance above or below the mean line of the profile. When this line is set to the depth of the largest profile valley, then tp is 100% because all the profile is above the bearing line. By plotting the tp% value against depth below the highest profile peak (or distance from mean line) between the 0% and 100% limits, then the bearing ratio (or Abbott-Firestone) curve is obtained.

Htp Htp is the distance between two tp% values.

Pc The peak count is the number of peaks which project through a selectable band centred about a defined reference line, the reference line being parallel to the mean line. The reference line can be set to a selected depth below the highest peak, at a selected distance above or below the mean line or at a a tp% height. The bandwidth value is selectable

The result is expressed as peaks/cm or peaks/inch.

PEAK COUNT
Pc



Rk PARAMETERS To assist the Automotive Industry in the assessment of Plateau Honed surfaces (e.g. cylinder bores), Metrology experts and certain

European Instrument Manufacturers devised Surface Texture Height Parameters which show working values for such surfaces, i.e.

a) The top portion of the surface which will quickly be worn away when the engine begins to run. This is known as the Reduced Peak Height = R_{pk}.

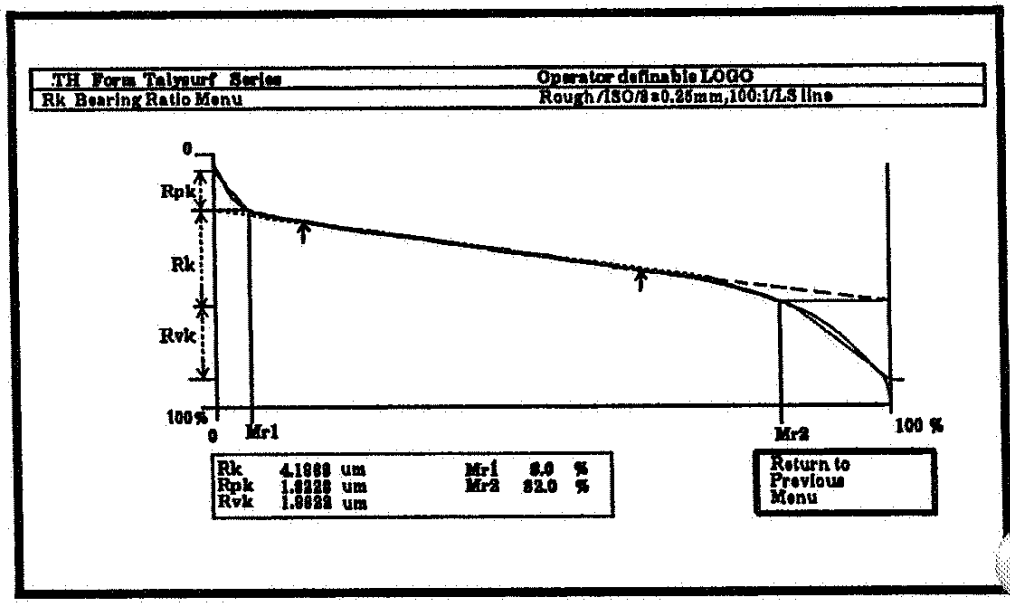
b) The long term running surface which will influence the performance and life of the cylinder. This is known as the kernal Roughness Depth = R_k (R_k = The depth of the Roughness Core Profile).

c) The oil retaining capability of the deep troughs which have been machined into the surface. This is known as the Reduced Trough Depth = R_{vk}.

d) The Material Component Mr1 (in %) is determined from the line of intersection coinciding with the upper limit of the Roughness Core Profile.

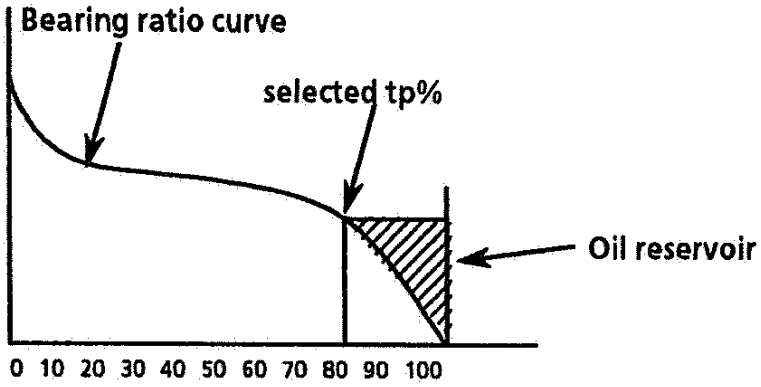
NOTE The filter applied to the data, during analysis, is specific to the cut-off length selected.

Rk MATERIAL RATIO GRAPH

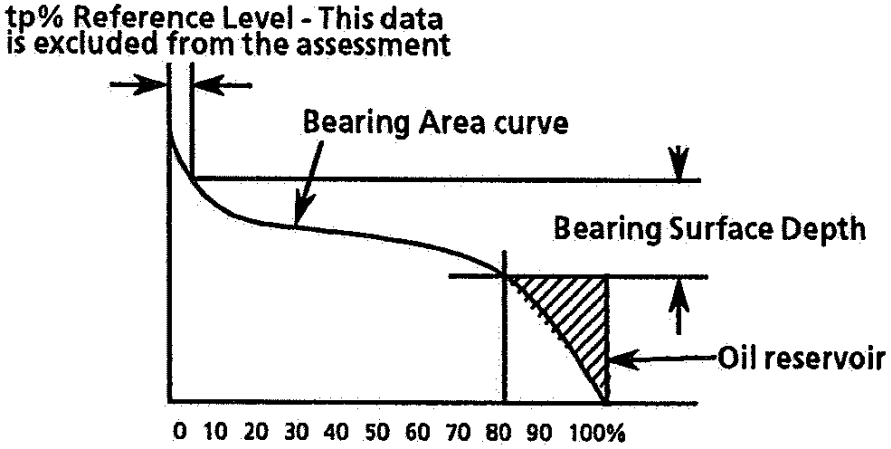


Vo Vo is used to determine the oil retention volume of a surface at a selected Bearing area. The evaluation requires the determination of an area bounded by the Bearing ratio curve. Two methods of selecting the portion of the Bearing ratio curve that is to be evaluated are provided.

1. By tp% value (see diagram below).



2. By tp% Reference Level and the Bearing Surface Depth. The tp% Reference Level specifies a portion of the bearing area curve that is to be excluded from the evaluation and the Bearing Surface Depth determines the tp% level. This method enables unwanted data to be excluded from the assessment (see diagram below).



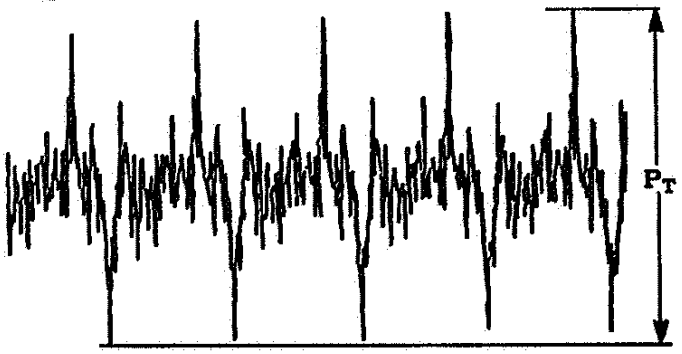
NOTE Results are given in mm^3 / cm^2 or min^3 / in^2. In inch units, the parameter value is divided by 10000 for display on the results page and in the print out of parameter results.

R&W PARAMETERS The method of filtering and analysis of R&W parameters is different and not directly comparable with parameters evaluated using the other assessment modes available from the FILTER AND PARAMETER OPTIONS MENU.

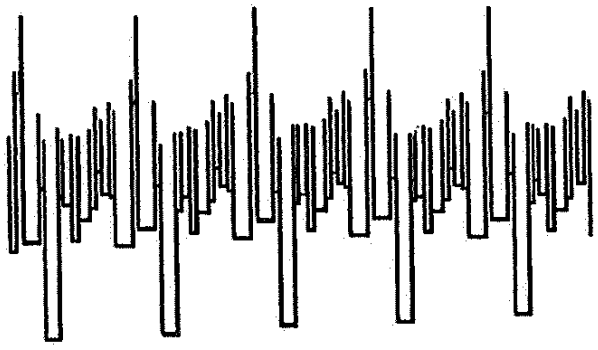
NOTE If R&W analysis is attempted with form type DATUM selected, then the form type will be automatically changed to LS line. This is because a reference line must be fitted for a valid R&W analysis.

Three profiles are used in the R&W analysis:

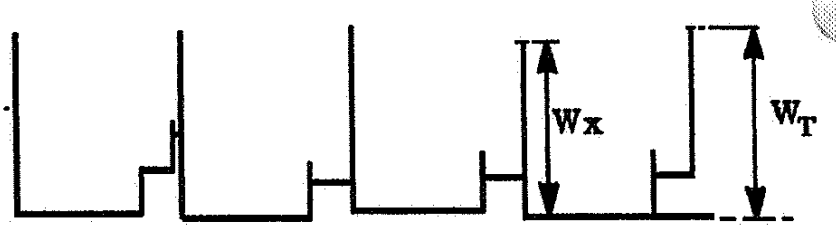
1. The unfiltered profile with slope correction (i.e. out of level has been removed with respect to a least squares straight line), gathered by traversing the stylus, skidless over the workpiece.



2. The corrected roughness envelope



3. The waviness envelope



In addition to the slope of the profile, the standard parameters evaluated are:

Pt This is the maximum peak to minimum valley of the primary roughness envelope (i.e. the envelope before correction).

R The mean height of roughness steps, calculated from the corrected roughness envelope.

Ar The mean spacing between individual roughness steps.

Rx The maximum peak to adjacent minimum valley (maximum individual step) of the primary roughness envelope (i.e. the envelope before correction).

SR The standard deviation of R.

SAr The standard deviation of Ar.

Sw The standard deviation of W.

SAw The standard deviation of Aw.

Wt The maximum peak to minimum peak of the corrected roughness envelope (in practice, calculated from the waviness envelope).

W The mean height of waviness steps.

Aw The mean spacing between individual waviness steps. Waviness spacings greater than the waviness cut-off length are not considered for Aw calculations.

Note The default roughness and waviness cut-off lengths are 0. 25mm

Wx The maximum individual step of the waviness envelope.

METHOD OF CALCULATION The sampling points collected from the measured slope corrected profile are subjected to a filtering process, from which the roughness envelope is constructed.

During this process, each peak contained within the data is detected and subjected to four tests. The peaks that pass these tests are eliminated from the envelope, the procedure being repeated until no further peaks can be eliminated. The residual envelope is designated the **roughness envelope** from which the Pt, Rx, AR and provisional R values are calculated.

Individual peaks are assessed once again for correction of amplitude (attenuation of isolated peak). When this is completed, the **corrected roughness envelope** is derived, from which the final value of R is calculated.

The peaks only of the corrected roughness envelope are then filtered again to form the **waviness envelope**, from which the W, Wx, W_T and AW values are calculated.

Notes: As with all graphical methods, there are occasions when parameter calculation can fail. Two examples of this are described below:-

1. Due to the algorithms method of peak elimination, it is possible to obtain slightly different parameter results from the same surface turned through 180 degrees. This is due to a different set of peaks and valleys being used for envelope construction, based on the first peak encountered. This envelope is then used for final parameter assessment which can show this condition, however, differences will be small.

2. If a surface is of periodic nature (i.e. Sinusoidal), some parameter results can be indeterminate, depending on the surface wavelength and the number of points used for calculation. If a purely periodic surface is measured with sufficient data points to represent that surface, all peaks will be in line leaving no waviness envelope and hence no Waviness parameters. In this condition the results are shown as: Aw = ******

If the number of data points is reduced causing an aliasing condition (See section on "Aliasing" further in this chapter) then a waviness profile may be created from the same data set. In this condition the Waviness parameter will be based on the sampled data criteria and not the surface undulations.

3. The surface should satisfy the criterion that the roughness peak to valley, PT, should not exceed 150 times the resolution of the gauge.

REFERENCE POSITIONS Reference positions, such as the centre coordinates of a least squares circle, the intercept point of two straight lines and any single data point (using the SET DATUM option) are represented in the instruments coordinate system in terms of their X and Z positions. Comparison of the radius co-ordinate centres reveals the pitch of two partial arcs, and, as mixing reference position evaluations is permissible, single or multiple centres can be referenced to an intersecting pair of lines or any single data point, in any combination.

It is not always necessary to determine all the reference positions on a component, as fixtures can also include a known reference position. Two pairs of results are presented:

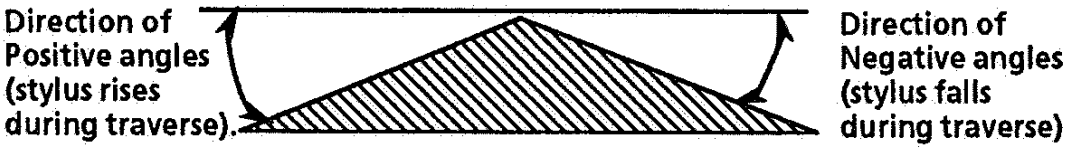
a. **X_Datum** and **Z_Datum** which is the current dimension being referenced.

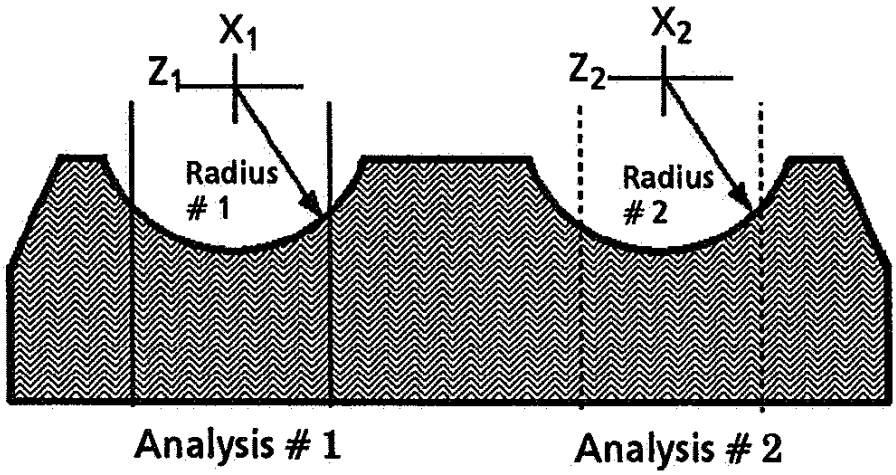
b. **DX_Datum** and **DZ_Datum** which is the difference between the current feature and the reference point.

The diagrams on the following page show two examples of multiple reference position calculations.

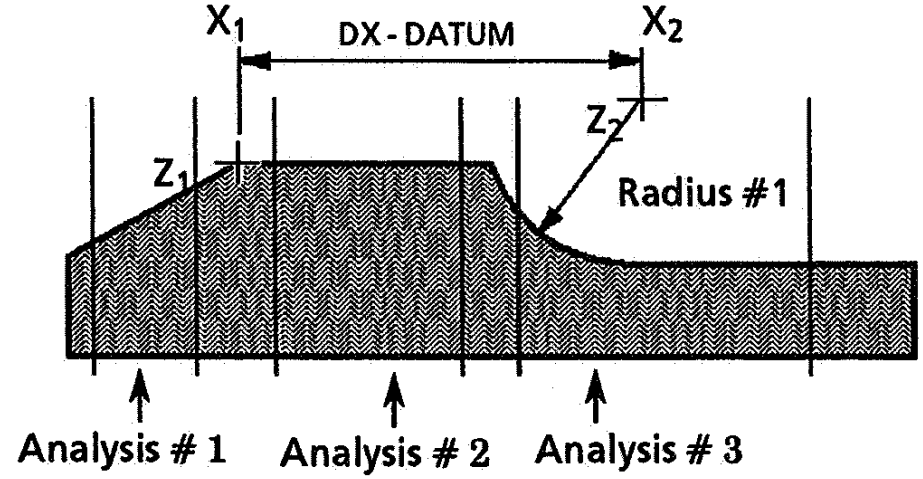
PITCH When the DX Datum and DZ Datum results are calculated, a value for **Pitch** is also given. Pitch is calculated from the square root of DX^2+DZ^2 and represents the linear distance between the two reference positions.

SLOPE / DSlope When measuring components which have angled features, the Slope of the angle through which the measured profile is rotated in order to fit the reference line is included in the results. The INCLUDE/EXCLUDE facilities of the DATA SELECTION MENU can be used to isolate an angled portion to evaluate the actual slope angle. The parameter **Dslope** is the difference between successive slope measurements. The angle sign convention, for results, is as shown in the diagram on the following page.





X_1 and Z_1 = Radius #1 Centre (Analysis # 1)
X_2 and Z_2 = Radius #2 Centre (Analysis # 2)
X.Datum = X_1
Z.Datum = Z_1
DX. Datum = X_2-X_1
DZ. Datum = Z_2-Z_1



X_1 and Z_1 = Intersect of analysis # 1 and analysis # 2.
X_2 and Z_2 = Radius # 1 Centre (analysis # 3).
X.Datum = X_1
Z.Datum = Z_1
DX. Datum = X_2-X_1
DZ. Datum = Z_2-Z_1

The method of determining reference positions is as follows:

From the DATA SELECTION MENU (usually the raw profile), use the INCLUDE/EXCLUDE facilities to select a region which includes a particular feature for analysis. EXPAND and then ANALYSE the defined region.

If the analysis has been made to a Straight Line reference, then the RESULTS PAGE will show the Slope value of the current surface.

If the analysis has been made to an Arc reference then the RESULTS PAGE will show the distance from the arc centre of the current analysis to the Set Datum position.

Return to the DATA SELECTION MENU and use the INCLUDE/EXCLUDE facilities to select another region which includes a particular feature for analysis with respect to the feature in the previous analysis (this can be on a different measurement but, in this case, problems of alignment may occur). EXPAND and then ANALYSE the defined region.

If this analysis and the previous analysis have been made to a straight line reference, then the RESULTS PAGE will now show the intercept value, the Slope value of the current surface and the DSlope value with respect to the Slope of the previous analysis.

If this analysis and the previous analysis have been made to an arc reference then the RESULTS PAGE will now give the distance from the arc centre of the curved feature of the current analysis to the arc centre of the curved feature of the previous analysis.

If an intercept has been calculated and then an analysis to an arc reference is performed, the RESULTS PAGE will show DX and DZ values which are the horizontal and vertical distances from the arc centre to the intercept position

ASPHERIC ANALYSIS

An Aspheric form is generated from a surface that has as a basic conic section (see Conics), onto which a symmetrical deviation is superimposed. This form can be described by a symmetrical polynomial expression, as follows:

$$Z = \frac{x^2}{R + \sqrt{R^2 - (1+K)x^2}} + A_1|X| + A_2x^2 + \ldots A_{20}x^{20}$$

Where: x is the horizontal distance from the aspheric axis and z is the corresponding vertical distance.

The first term describes the conic section form with:

R= The base radius of curvature (see diagram A) $^1/_{Curvature}$ may be substituted for R when curvature is specified.

Concave base forms should be entered with a negative (-ve) radius value. Convex base forms should be entered with a positive (+ve) radius value.

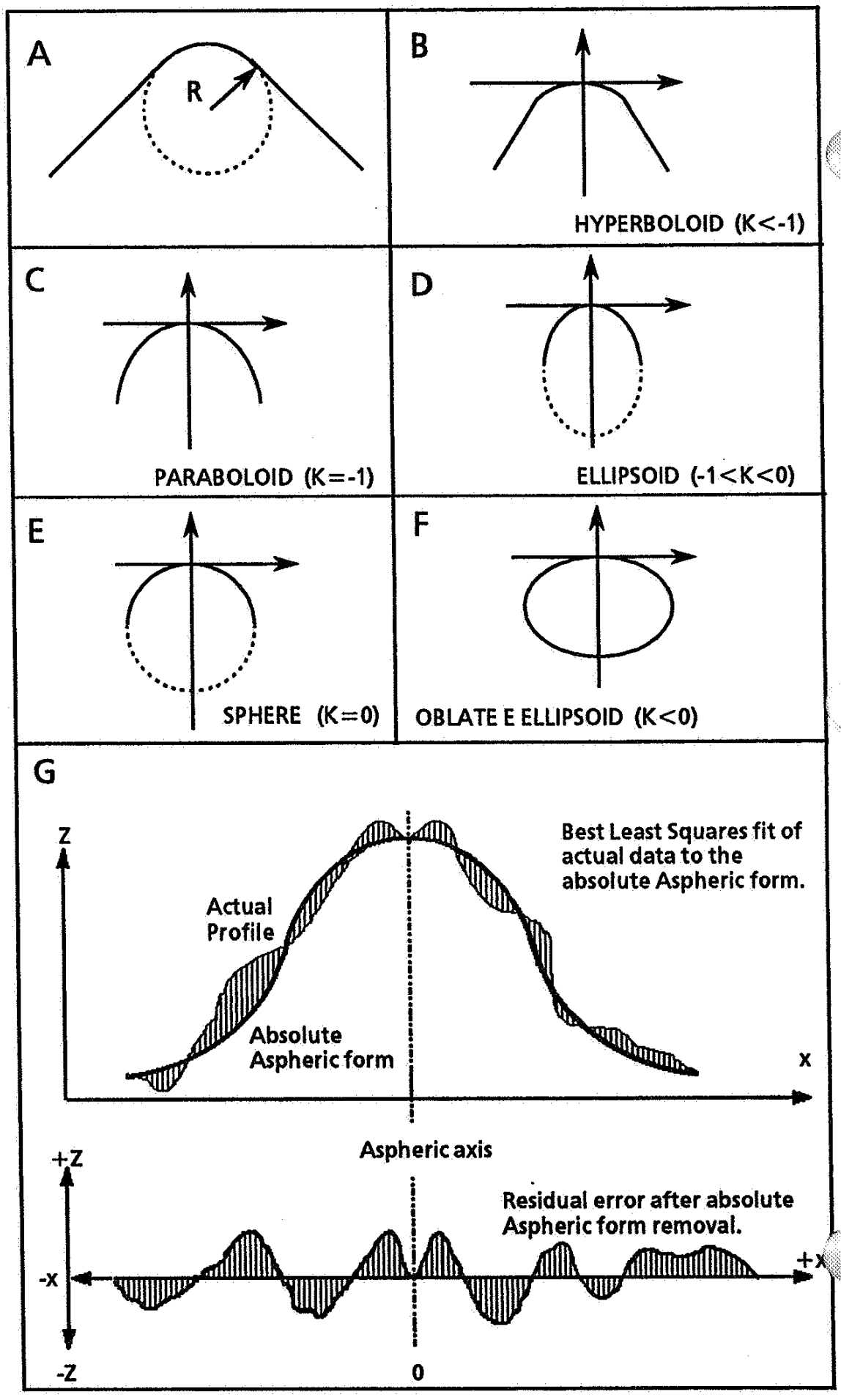
K = The conic constant is as below:

K <-1	HYPERBOLOID	(see diagram B)
K =-1	PARABOLOID	(see diagram C)
1<K<0	ELLIPSOID	(see diagram D)
K =0	SPHERE	(see diagram E)
K >0	OBLATE ELLIPSOID	(see diagram F)

The remaining terms describe the symmetrical polynomial deviation from the basic conic form.

Residuals

An Aspheric, described by the above equation, with known physical form is first fitted to the measured profile using a best least squares fit technique, compensating for tilt and dual axis shift (due to set up error).


A
R
B
HYPERBOLOID (K<-1)
C
PARABOLOID (K=-1)
D
ELLIPSOID (-1<K<0)
E
SPHERE (K=0)
F
OBLATE E ELLIPSOID (K<0)
G
Z
Actual Profile
Absolute Aspheric form
Best Least Squares fit of actual data to the absolute Aspheric form.
x
Aspheric axis
+Z
-x
-Z
0
Residual error after absolute Aspheric form removal.
+x

The residuals are then calculated parallel to the Aspheric axis (not perpendicular to the local tangential slope), hence, all x-axis co-ordinates remain unchanged (see diagram G).

Parameters When the residuals have been calculated, the following parameters are determined:

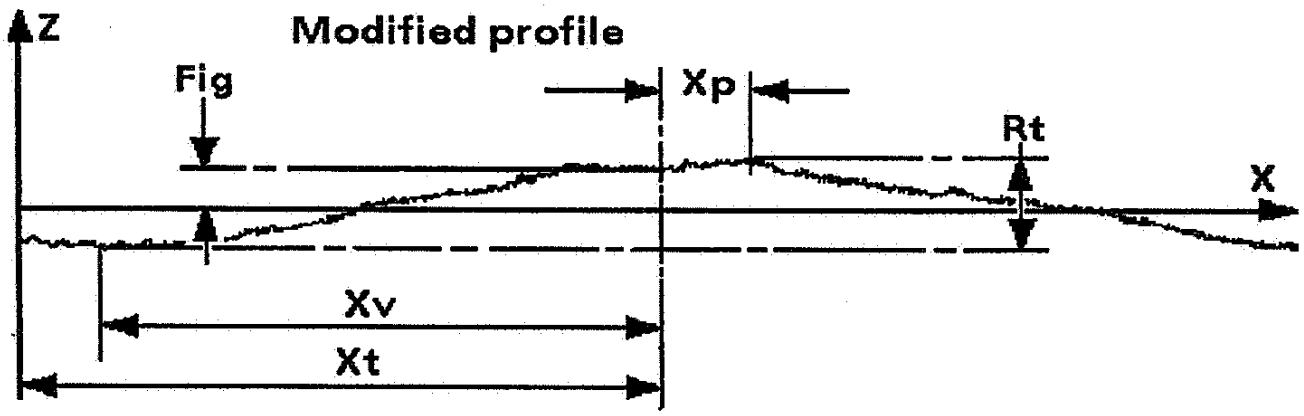


Fig The vertical distance between the least squares fit line and the profile height intersected by the Aspheric axis.

Ra The average absolute deviation of the residuals from the mean line. Analogous to unfiltered Ra.

Rt Rt is the maximum peak to valley height of the profile in the assessment length.

Smx Maximum surface slope error. This is the maximum difference in angular slope between any two adjacent data points and the best fit least squares reference line: calculated from the total profile.

Smn The mean surface slope error. This is the average difference in angular slope between any two adjacent data points and the best fit least squares reference line, calculated from the total profile.

Tilt This is the angle of the calculated horizontal axis of the component, relative to the traverse unit datum axis.

Xp Distance of the highest peak from the aspheric axis.

Xt Distance of the aspheric axis from the start of the measured data.

Xv Distance of the lowest valley from the aspheric axis.

Application When analysing the results of a measurement of an aspheric surface, a curvature can sometimes be observed superimposed onto the residual error. If this occurs, the following method can be used to eliminate the effect:

a. Note the total peak to valley value and return to the Aspheric Coefficients table of the FORM OPTIONS MENU and adjust the radius value by a small amount.

BASE FORM OF COMPONENT	RESIDUAL FORM ERROR	ACTION
CONVEX	CONVEX	DECREASE RADIUS
CONVEX	CONCAVE	INCREASE RADIUS
CONCAVE	CONCAVE	DECREASE RADIUS
CONCAVE	CONVEX	INCREASE RADIUS

b. Recompute the data and check if an improvement has been made. Repeat the process, increasing the change in the radius value in the required direction, until the curve inverts. From this point, make fine adjustments to the radius value to obtain results that are the closest to a straight line.

c. Using this iterative technique, a new radius value can be found to a high accuracy, which is directly related to the amount of adjustment required on the aspheric generator or the tip of the cutting tool.

RADIUS, ELLIPSE AND HYPERBOLA

The evaluations of Radius, Ellipse and Hyperbola are performed on curves belonging to the *Conics group. These are generated by the intersection of a single plane and a double cone (see diagram H).*

The five forms obtained by the above method are:

1. Circle - plane parallel to the cone base (see diagram I).
2. Parabola - plane parallel to slope of cone side (see diagram J).
3. Line pair - vertical plane passing through apex of cones (see diagram K).
4. Ellipse - plane between circular and parabolic planes (see diagram L).
5. Hyperbola - plane between parabolic and line pair planes (see diagram M).

The most general equation of a conic being:

$$Ax^2 + 2Bxz + Cz^2 + 2Fx + 2Gz + H = 0$$

where:

x is the horizontal distance from the origin

z is the vertical distance from the origin.

A, B, C, F, G and H are constants applicable to any one conic section.

Each of the above five forms has a *Standard Form which simplifies the general equation, any particular conic section can be transformed into a standard form by mathematically rotating the conic and adjusting the "x" and "z" axes.*

Throughout this description the Standard Form notation is adopted.

Circle The Standard Form of a circle is: $\frac{z^2}{R^2} + \frac{x^2}{R^2} = 1$

where: R is the radius of the circle (see diagram I).

Parabola The standard form of a parabola (see J) is:

$z = Ax^2$ where: A is a constant which is related to the physical dimensions of the form.

Pair of Lines The standard form of a pair of lines (see diagram K) is:

$z^2 = (Ax)^2$ where: A is directly related to the slope of the lines .

Ellipse The Standard Form of an ellipse (see diagram L) is:

$$\frac{z^2}{R_2^2} + \frac{x^2}{R_1^2} = 1$$ where: R_1 is the *x -axis* radius.
R_2 is the "z-axis" radius

Note: The larger of R_1 and R_2 is always referred to as the major axis radius and the smaller value as the minor axis radius. If they are equal, then we have a circle; which is a special case of the ellipse where: $R_1 = R_2 = R$.

Hyperbola The standard form of a hyperbola (see M) is:

$$\frac{z^2}{R_2^2} + \frac{x^2}{R_1^2} = 1$$ where: R_1 is the *conjugate x -axis* radius.
R_2 is the "z-axis" radius

Note: R_1 is **NOT** a direct physical dimension, unlike R_2, though an indirect interpretation of R_1 with R_2 can be given as follows:

As z and x become large the hyperbolic form approaches the pair of lines (see diagram N)

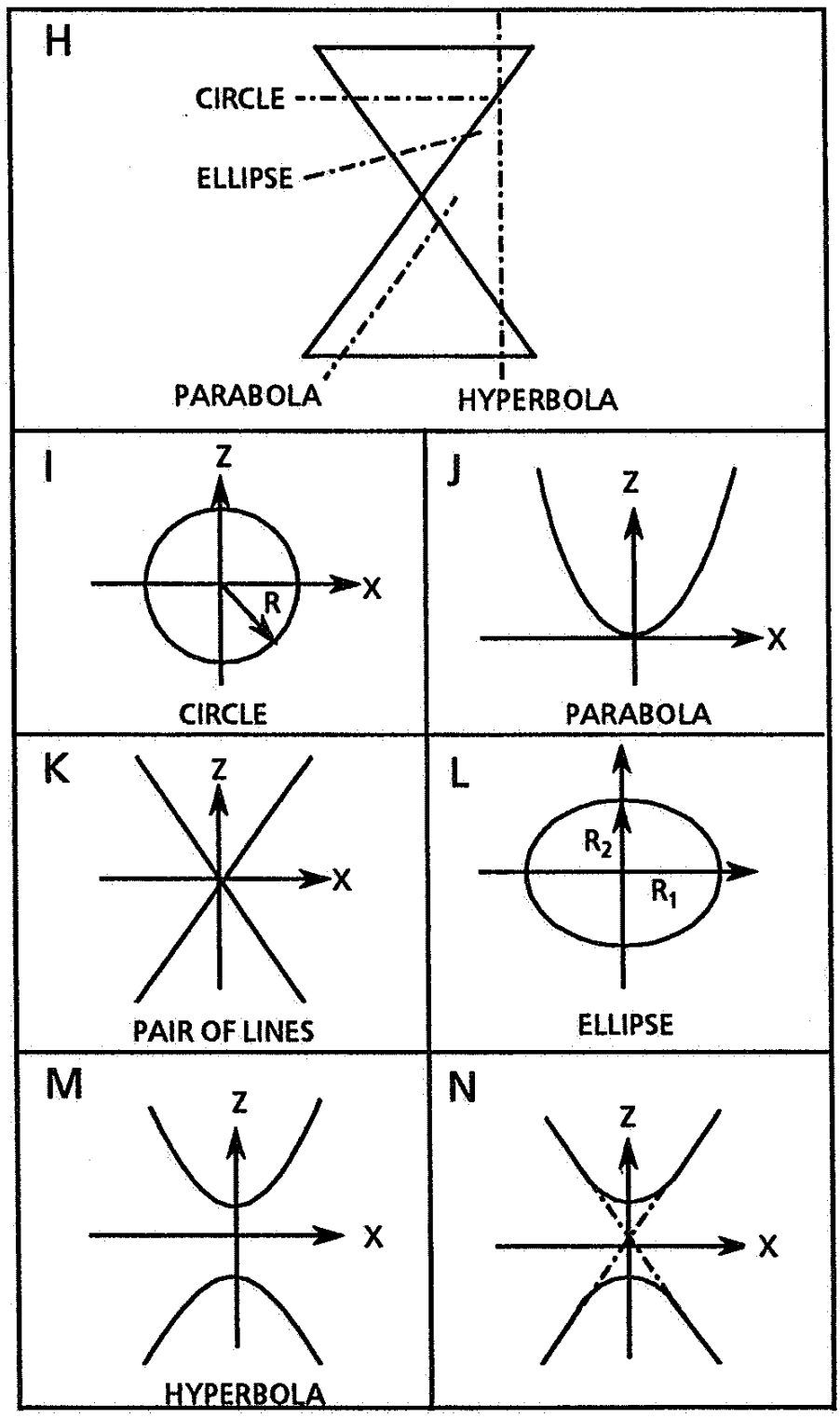
$$z^2 = (Ax)^2 \quad \text{where: } A = {}^{R_1}/_{R_2}$$

Note: Only the elliptical and hyperbolic forms are fitted to the measured data since the conic form fitted cannot be circular, parabolic or a line pair, due to finite measurement and computational errors.

Residuals The residuals are calculated perpendicular to the local tangential slope of the fitted conic section, hence the residual "x" axis is the developed profile length (not the chord length).

Limitations If a circular profile is measured, the stated form will be elliptical with the values of R_1 and R_2 nominally the same. Whereas with a line pair profile, the stated form will be hyperbolic.

Similarly, if a parabolic profile is measured, the stated form will be either elliptical or hyperbolic due to the fall of the residual error.



BANDWIDTH, FILTERING AND DATA POINTS

BANDWIDTH

In addition to filter cut-off selection, the Form Talysurf Series has the extra feature of instrument bandwidth selection. Used correctly, this allows the measurement conditions to be standardised and to be independent of the particular instrument system. It can eliminate the anomalies that have arisen when a particular surface was assessed using different types of measuring instrument.

WHAT IS BANDWIDTH?

Traditionally, the way in which stylus instruments respond in relation to different spacing of surface features has been described by referring to a 'cut-off wavelength', or by describing the measurement as 'unfiltered'. The term 'cut-off wavelength' refers to the longest spacing of surface features (surface wavelength) to which the instrument will respond, and for surface texture measurement will normally be in the range of 0.08 mm to 8 mm. This means that, with the instrument set for a cut-off of 0.8 mm, any surface effects which have a much greater spacing will not show in the recorded profile, or affect the surface texture parameters calculated by the instrument.

In practice, this is achieved by electrical filtering of the profile signal from the transducer, or by software filtering during data processing of the profile signal. When the measurement is described as being 'unfiltered', this refers only to the electronic or software processing of the profile signal.

There will always be an upper limit to the surface wavelengths which can affect the measurement, set by the length of the measurement traverse itself. This description of filtering in terms of cut-off is something of an over-simplification, since it

suggests that there is no lower limit to the surface wavelengths that can be detected. The design of any instrument will always impose some short wavelength (or high frequency) limit, through the finite dimensions of the stylus tip, the electrical or mechanical response of the measuring system, and the sampling rate where the profile data is digitised before being processed by a computer. One or more of these factors will always set a short wavelength limit, and the instrument will not respond to surface features with a closer spacing than this wavelength.

Although it may sound unfamiliar, it is more accurate to describe the response of an instrument as being within a band of wavelengths, between the cut-off wavelength and the shortest wavelength which can be detected. This is the instrument bandwidth, and is normally expressed as the ratio of the two limiting wavelengths. For most purposes a bandwidth ratio of 100:1 has been found to be suitable.

BANDWIDTH AND FILTERING

The cut-off wavelength is set by a filter which removes the longer wavelength components of the profile signal. Such a filter is referred to as a 'low pass' filter.

NOTE although this is an accurate description in terms of wavelength, it conflicts with the convention used in electronic engineering where such a filter would be described as 'high pass' since it removes the low frequency components of the signal. The latter, more usual convention, is used in descriptions for this instrument, i.e. a "High Pass" filter removes the longer wavelength components of the profile signal.

Unless provision is deliberately made to limit the short wavelength (high frequency) response of an instrument, it will be determined by the stylus geometry, the electrical amplifier characteristics, or the sampling interval.

These 3 factors give rise to quite different filtering characteristics, and can result in different parameter results when the same surface is measured on different types of instrument.

IMPORTANCE OF BANDWIDTHS

Outlined below is a summary of the reasons why constant bandwidth is of importance on multi-processed components:

- Slope or Curvature related parameters are very sensitive to small wavelengths, and can be dominated by them. The use of a constant bandwidth ensures that measurements made are 'Like for Like'.
- Conventional systems allow the stylus geometry to define the lower limit of the bandwidth. Since the geometry is not easily defined or controlled the use of a definable bandwidth is preferred.
- The use of selectable bandwidths allows a sensible correlation of measurements made over long assessment lengths.

DATA POINTS AND BANDWIDTHS

The maximum number of data points, for the PC system is 120, 000. Dataloging is carried out at intervals of 0.25µm for traverses of up to 30mm, and at 1µm intervals for traverse in excess of and equal to 30mm.

If the option to use all available data points is used, then the computation times can be long. A typical value of 2000-4000 data points is normally more than adequate for most surfaces. In determining the available bandwidths, the following criteria are used:

1. At least 5 points must be used for the Low-pass cut-off. This need not be a whole number.
2. The data reduction ratio must be a whole number.
3. The maximum bandwidth ratio is 1000:1.
4. With the exception of the High-pass cut-offs 0.08mm at 0.25µm spacing and 0.25mm at 1µm spacing , the band widths can only be

formed from a ratio of the standard cut-off lengths. This gives bandwidth ratios of 100:1, approx. 300:1 and 1000:1.

The data reduction which takes place is made in order to reduce the number of data points used in calculations. This is performed using a smoothing filter which requires a whole number reduction ratio. The following tables give the combinations of bandwidths available.

BANDWIDTHS AVAILABLE AT 0.25µm RAW DATA SPACING

High-pass cutoff (mm) (points)	Low-pass cutoff (mm) points)	Bandwidth ratio	Reduction ratio	High-pass points/ Low-pass points/
0.08 (320)	0.00125 (5)	64:1	1	320 / 5
0.25 (1000)	0.0025 (10)	100:1	2	500 / 5
0.8 (3200)	0.008 (32)	100:1	5	640 / 6.4
0.8 (3200)	0.0025 (10)	320:1	2	1600 / 5
2.5 (10000)	0.025 (100)	100:1	20	500 / 5
2.5 (10000)	0.008 (32)	312.5:1	5	2000 / 6.4
2.5 (10000)	0.0025 (10)	1000:1	2	5000 / 5
8.0 (32000)	0.08 (320)	100:1	64	500 / 5
8.0 (32000)	0.025 (100)	320:1	20	1600 / 5
8.0 (32000)	0.008 (32)	1000:1	5	6400 / 6.4

BANDWIDTHS AVAILABLE AT 1µm RAW DATA SPACING

High-pass cutoff (mm) (points)	Low-pass cutoff (mm) (points)	Bandwidth ratio	Reduction ratio	High-pass points/ Low-pass points/
0.25 (250)	0.005 (5)	50:1	1	250 / 5
0.8 (800)	0.008 (8)	100:1	1	800 / 8
2.5 (2500)	0.025 (25)	100:1	5	500 / 5
2.5 (2500)	0.008 (8)	312.5:1	1	2500 / 8
8.0 (8000)	0.08 (80)	100:1	16	500 / 5
8.0 (8000)	0.025 (25)	320:1	5	1600 / 5
8.0 (8000)	0.008 (8)	1000:1	1	8000 / 8
25.0 (25000)	0.25 (250)	100:1	50	500 / 5
25.0 (25000)	0.08 (80)	312.5:1	10	2500 / 8
25.0 (25000)	0.025 (25)	1000:1	5	5000 / 5

Example: If 7 0.25mm cutoffs and 0.25µm spacing are selected, then 7 x 500 = 3500 points will be used in the analysis.

FILTERS The program simulates the characteristics of the ISO 2CR, 2CR PC (phase corrected) and Gaussian filters. These do not give a sharp cut in response to irregularities of widths greater than the cut-off length. Instead there is a gradual fall-off in response, as shown in the graphs on the following pages.

The 2CR filters (including 2CR PC) have been standardised to have a transmission of 75% at the selected cut-off. This means that the amplitudes of the irregularities having a spacing equal to the cut-off length are reduced to 75% of their true value. The amplitudes of shorter wavelength irregularities will be almost unchanged. The amplitudes of longer wavelength irregularities are progressively reduced.

Gaussian filters, however, have a transmission of 50%. This means that the addition of the roughness filtered profile to the waviness filtered profile equals the original unfiltered profile. Coupled with the data discarding arrangement described later, this filter tends to provide a less distorted profile analysis.

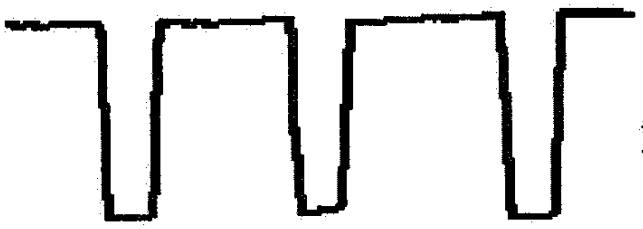
The extreme ends of any data collection are subjected to distortion. This is mainly because the traverse unit requires a finite amount of time to accelerate from rest up to its measuring speed. There is also a requirement to allow for filter settling. To minimise this problem, after filtering has taken place, some of the data collected from the ends of the traverse (particularly the start) is discarded. The amount of data discarded and its location, is dependent on the filter used, as follows:

ISO 2CR - The first two cut-offs are discarded.

2CR PC - The first and last cut-off are discarded.

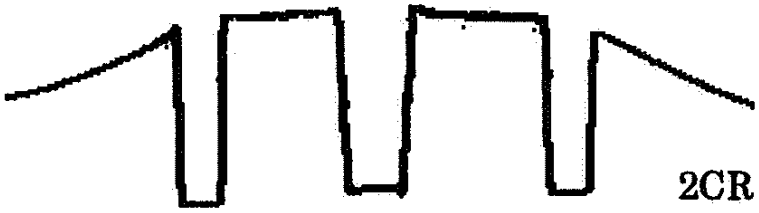
Gaussian - Half of the first cut-off and half of the last cut-off are discarded.

The following profile graphs show the effect, in the extreme case on a vertical profile slope. of using no filter, the 2CR filter (which has a phase shift effect), the 2CR PC filter and the Gaussian filter (which is also phase corrected).

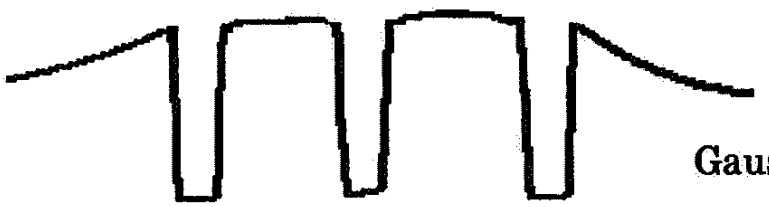


No Filter

2CR



2CR PC



Gaussian

2CR FILTERS

Filter details for ISO 2CR filter are as follows:

Amplitude transmission ratio for a sinusoidal waveform:

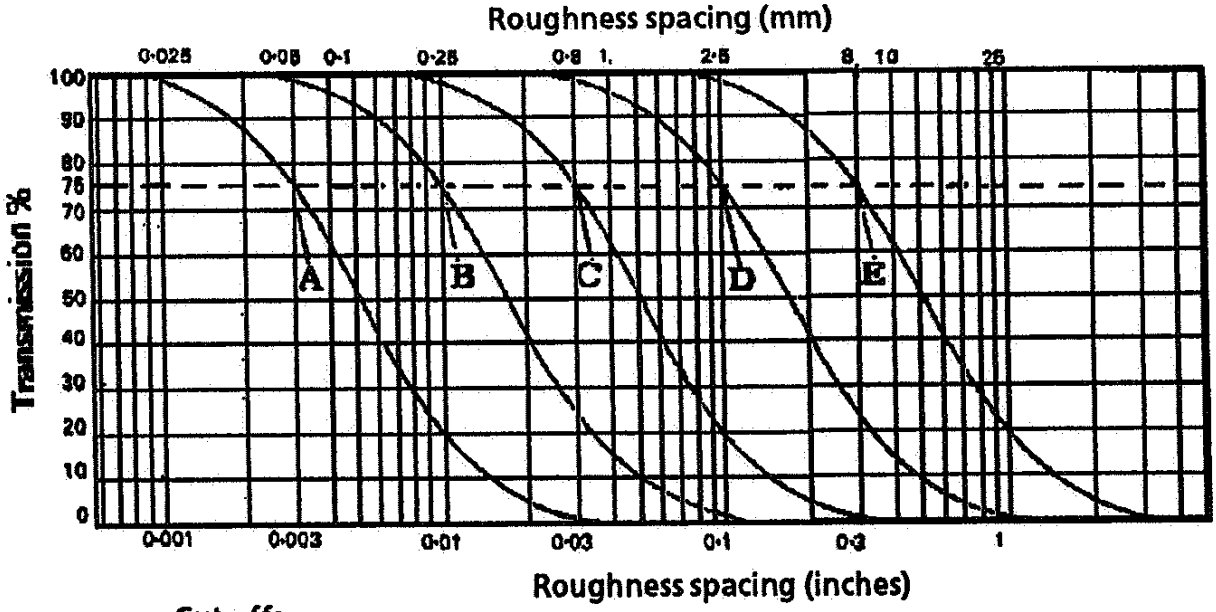
Amplitude transmission: $\text{ratio} = \dfrac{\text{output}}{\text{input}} = \dfrac{3}{3 + \alpha^2}$

$$\text{where } \alpha = \frac{\lambda \text{ input}}{\lambda \text{ cut-off}}$$

There is a phase distortion effect (ϕ) dependent on α such that:

$$(\phi) = 2\left(\text{Tan}^{-1}\ \frac{\alpha}{\sqrt{3}}\right)$$

FILTER TRANSMISSION CHARACTERISTICS (Roughness Profile)



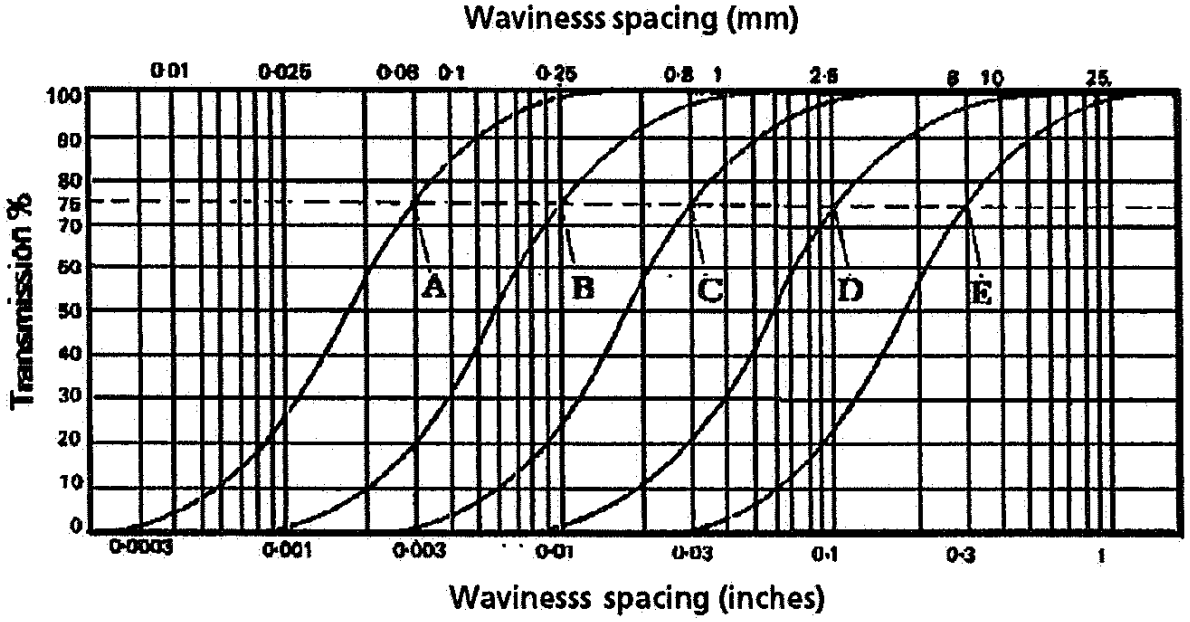
	Cut offs mm.	in.		mm.	in.
A	0.08	0.003	D	2.5	0.10
B	0.25	0.010	E	8.0	0.30
C	0.80	0.030			

WAVINESS ANALYSIS Waviness parameters are defined in the same manner as their roughness counterparts, but assessments are made using the surface data which has wavelengths greater than the cut-off selected. as shown below.

Amplitude transmission: $$\text{ratio} = \frac{\text{input}}{\text{output}} = \frac{3}{3 + \beta^2}$$

$$\text{where } \beta = \frac{\lambda \text{ cut-off}}{\lambda \text{ input}}$$

FILTER TRANSMISSION CHARACTERISTICS (Waviness Profile)



	Cut offs				
	mm.	in.		mm.	in.
A	0.08	0.003	D	2.5	0.10
B	0.25	0.010	E	8.0	0.30
C	0.80	0.030			

NOTE If a waviness analysis is attempted when an appropriate dongle is not fitted, then the analysis is made with reference to the Least Squares Line only.

GAUSSIAN FILTERS

Gaussian filtering does not simulate a specific electronic filter, but is a mathematical function that is applied to the profile data. The filter is a weighted mean of the profile, where the weights have a gaussian (bell) shape. Since this shape is symmetrical, the resulting filter is phase corrected.

A property of a Gaussian filter is the ability to take account of data before and after the effective stylus position. The response at the cut-off value is 50% of the maximum transmission within the band.

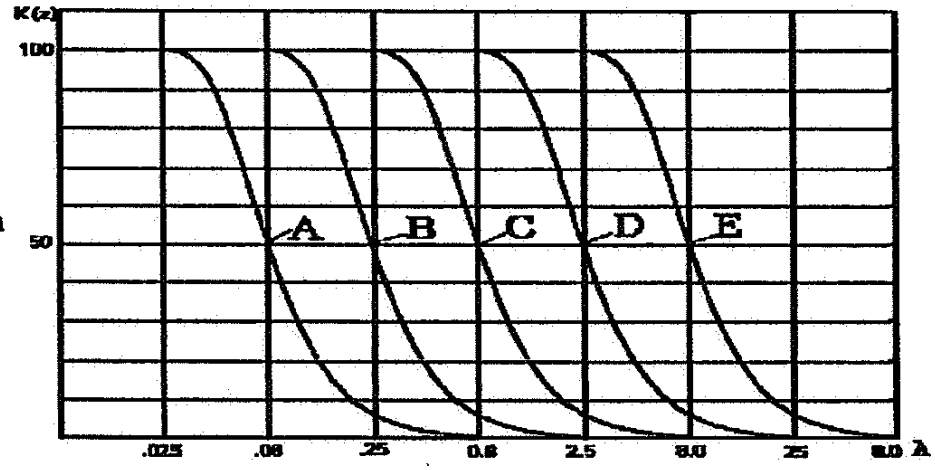
The weighting function for the Gaussian filter has the equation of the Gaussian density function.

The transmission characteristics are made up of two components, these are: (a) the transmission characteristics of the mean line and (b) the wavelength characteristics of the roughness profile.

a. The filter characteristic is determined from the weighting function, by means of the Fourier transformation.

b. The roughness profile is the difference between the actual profile and the mean line. The filter characteristic is, therefore, the difference between the wavelength characterisation of the roughness profile.

FILTER TRANSMISSION CHARACTERISTICS (Roughness Profile)

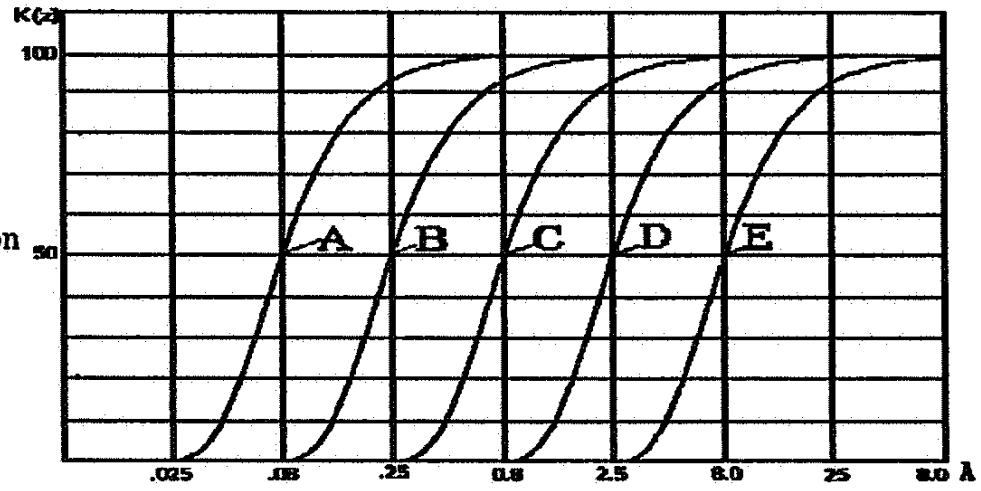


Transmission Coefficient

Wavelength Spacing (mm)

	Cut offs mm.	in.
A	0.08	0.003
B	0.25	0.010
C	0.80	0.030
D	2.5	0.10
E	8.0	0.30

FILTER TRANSMISSION CHARACTERISTICS (Waviness Profile)



Transmission Coefficient

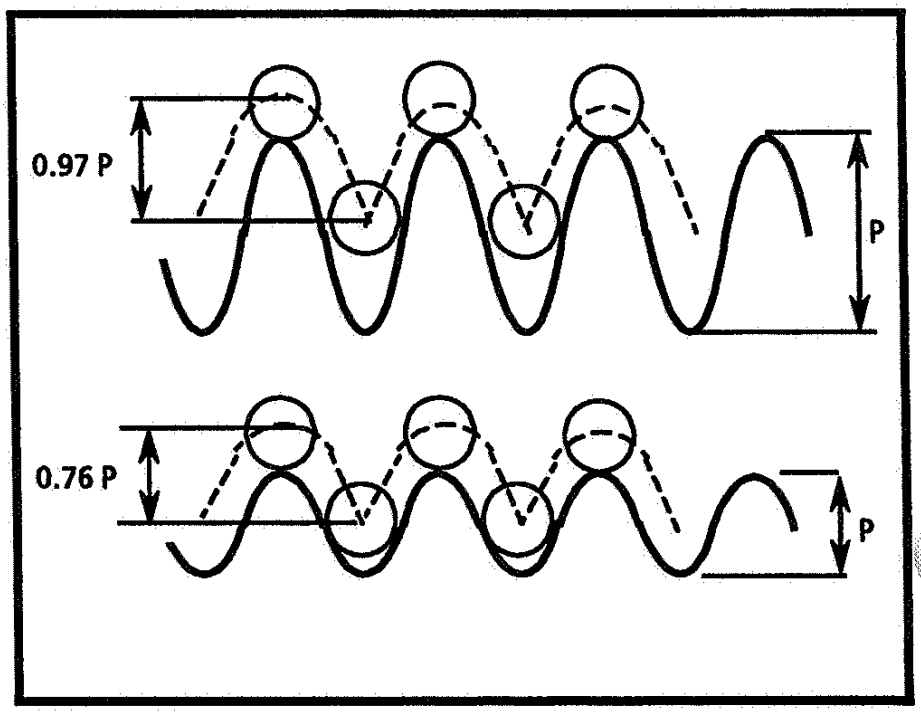
Wavelength Spacing (mm)

	Cut offs mm.	in.
A	0.08	0.003
B	0.25	0.010
C	0.80	0.030
D	2.5	0.10
E	8.0	0.30

EFFECT OF STYLUS GEOMETRY

DESCRIPTION When the stylus tip radius is small compared with the curvature of the surface, the movement of the stylus will accurately follow the contours of the surface. As the curvature of the surface increases, there is a tendency for the stylus to bridge over any depressions with a small radius - reducing its sensitivity to short wavelength components. However this reduction is not simply dependent on wavelength, as with an electrical filter. The curvature of the surface is affected by both the height and the spacing of the surface features, and the filtering effect of the stylus tip radius can become less significant as the roughness of the surface is reduced. Although it must be noted that the above is true for surfaces of a constant wavelength, smoother surfaces usually also have a shorter wavelength and hence can often be more susceptible than rougher surfaces.

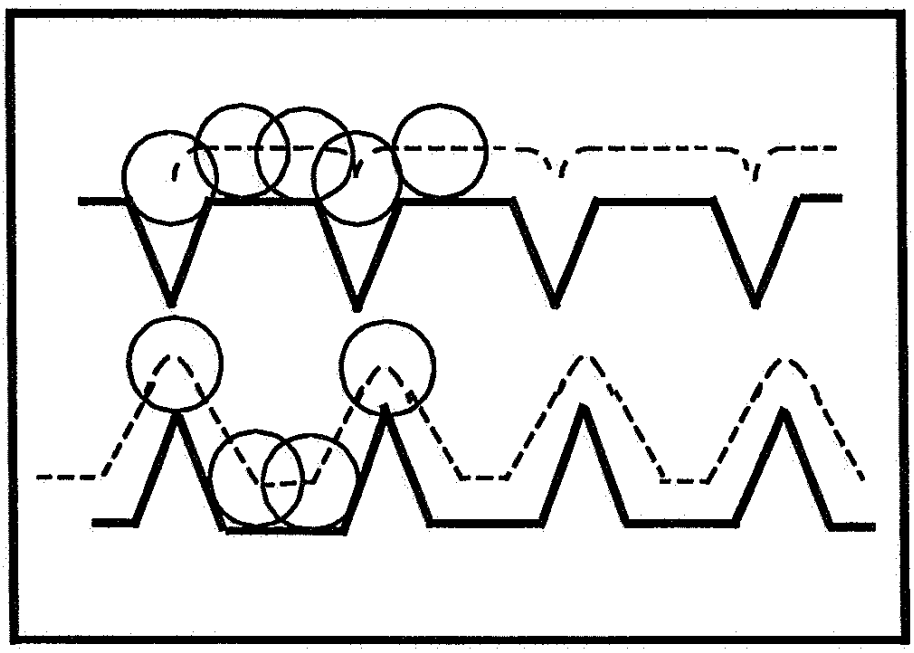
EFFECT OF MECHANICAL FILTERING ON ROUGHNESS



Each of the above profiles have the same wavelength but due to the amount of penetration of the stylus (or skid nosepiece) each would yield a different roughness value.

Although a stylus is not capable of fully entering a depression in the surface with a smaller radius of curvature than the stylus tip, it will be fully deflected by a similar shaped mound on the surface. The filtering effect of a stylus tip will therefore depend on the symmetry, or skew, of the surface profile, as shown in the following diagram.

EFFECT OF SKEW ON STYLUS PATH



AMPLIFIER CHARACTERISTICS

All electronic amplifier systems have a finite upper limit to their frequency range. Although it is possible to design amplifiers with very high upper frequency limits, and very large bandwidths, the frequency range is normally restricted in order to improve the noise performance. Both the transducer and the amplifier generate some electrical noise, and this noise which is superimposed on the profile signal effectively limits the resolution of the instrument. The amount of noise introduced is directly related to the bandwidth of the system, and for high resolution it is usual to design the

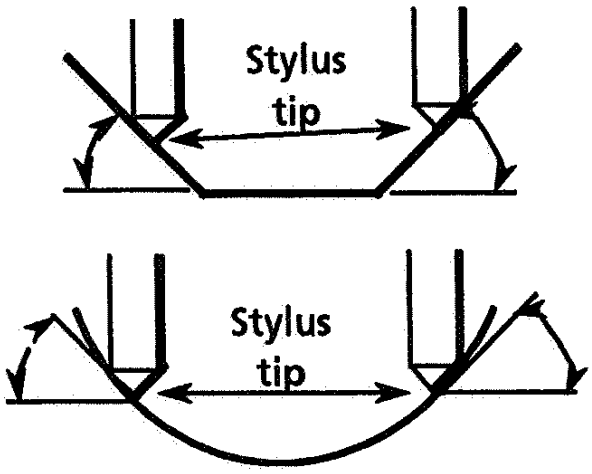
amplifier with only the minimum bandwidth required. Amplifier bandwidth is normally limited by the inclusion of electrical filtering networks. Although such filters may have a variety of different characteristics, their filtering effect is dependent only on frequency, and is not affected by the amplitude of the signal or by the skew of the profile.

When the measuring instrument uses a chart recorder to provide a profile graph, the mechanical response of the recorder system introduces a further limitation at high frequencies.

STYLUS FLANKING There are certain conditions of stylus/component profile contact which can affect the validity of measurement results.

1. The effect of interference between the sides of the stylus tip and sloping or curved profile sections (stylus flanking) should be considered.

   This will occur when the stylus is traversed over a component profile which includes either a slope or a radiused section, any part of which presents a tangential angle greater than 35° for a diamond tipped stylus or 55° for a ball tipped stylus.



The maximum traverse obtainable in a radiused section without stylus flanking occurring is given by:

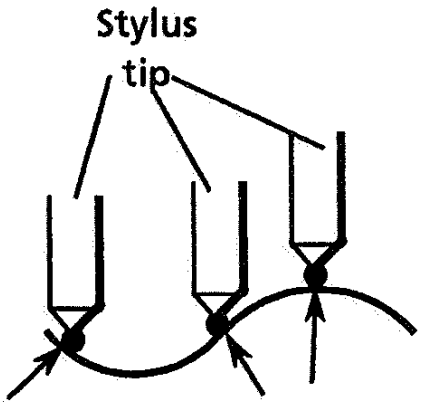
T = 1.15 x R for a diamond tipped stylus,

and,

T = 1.6 x R for a ball tipped stylus

Where T = Traverse length and R = the profile radius.

2. When using a ball tipped stylus, the contact point of the ball with the profile being measured changes as the slopes of the profile contour changes.



The measured profile data is computed and results output with compensation for the stylus radius. However, dimensional data obtainable from the X and Z axis co-ordinates of the Data Selection displays is not compensated. Therefore, this effect should be taken into account when using these displays.

ACCURACY OF RADIUS MEASUREMENT

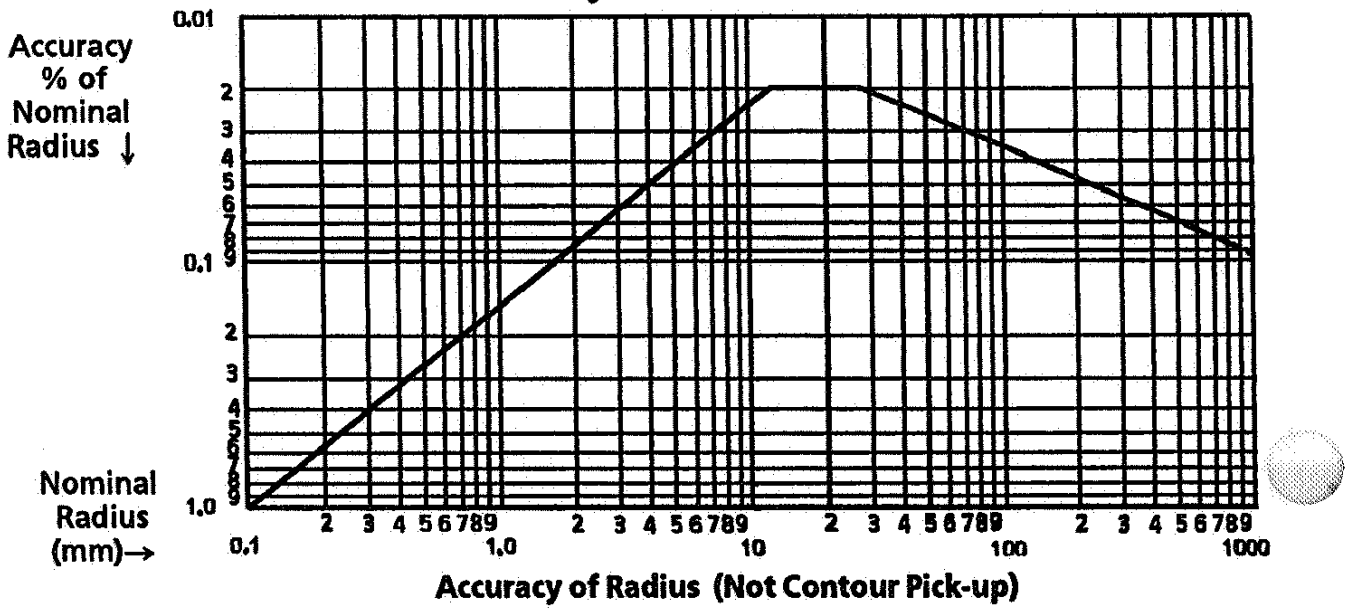
When measuring small radii, the surface roughness of the component and the value of the included angle have a major influence on the accuracy. For larger radii the accuracy depends more on the accuracy of calibration and traverse.

The best accuracy will normally occur in the 12.7mm to 25mm range (nominally around the calibration value), with an included angle of approx. 60°. For small values of radius with the requisite surface quality, an accuracy of 1% can be obtained with an included angle near to 60°. The accuracy for values of radii larger than 25mm is such that at the largest radius of 1000mm, an accuracy of 0.1% can be achieved with a minimum included angle of 5°.

Accuracy is always influenced by the following :

1) Accuracy of calibration
2) Condition of stylus
3) Component surface finish
4) Component form error
5) Included angle and its symmetry with respect to the vertical.
6) Accuracy of traverse

Any abnormal effects of these factors will degrade the accuracy further.

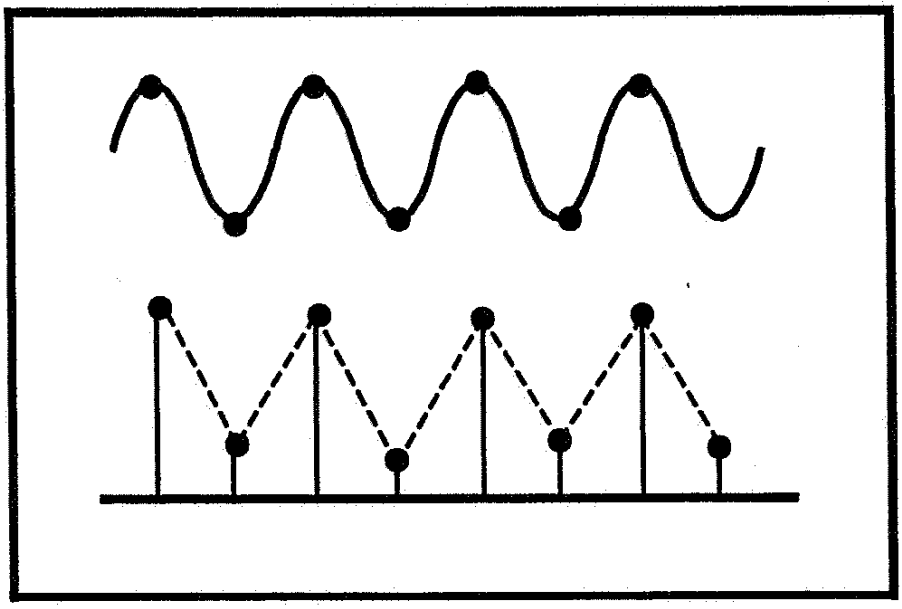


SAMPLING INTERVAL THEORY

DESCRIPTION The use of digital computers to process profile data introduces another limitation to the high frequency response of the measuring system. Because the computer can only perform calculations with discrete numbers rather than a continuously changing electrical signal, the profile signal has to be sampled at regular intervals to provide a series of data values, each of which represents the surface height at one point on the surface. The spacing of these points along the surface determines the shortest surface wavelength which can be resolved.

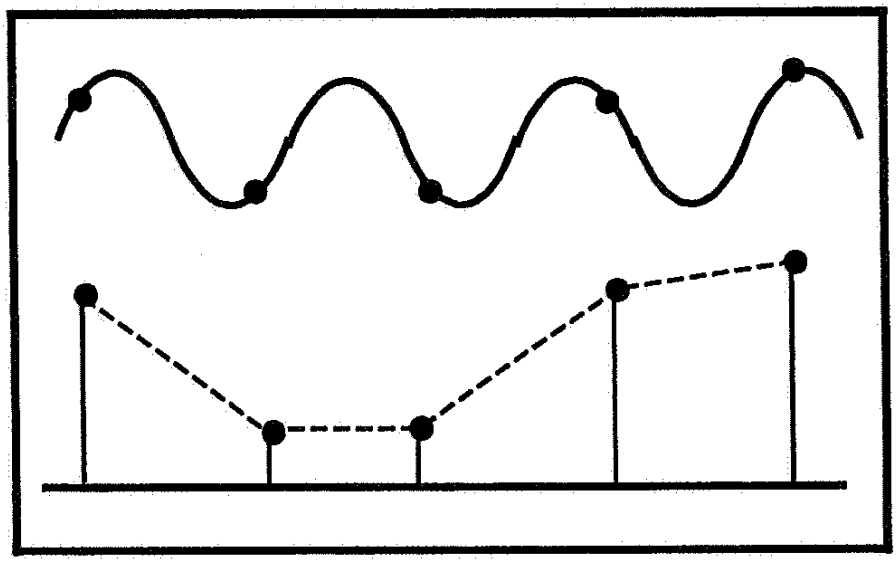
Conventional sampling theory requires that the sampling frequency should be at least twice the highest frequency to be resolved. In terms of wavelength, this means that there should be at least two data points within the shortest surface wavelength to be detected. The speed and data capacity of the computer system impose a limit to the maximum sampling rate that can be used, and therefore to the shortest wavelength the system is capable of measuring.

MINIMUM SAMPLING INTERVAL IS HALF THE WAVELENGTH



ALIASING A further complication arises due to the phenomenon known as aliasing. When the profile contains a frequency which is greater than half of the sampling frequency, the sampling process can result in a much lower frequency being detected (as shown below).

EFFECT OF ALIASING



The detected frequency is the difference between the sampling and actual profile frequencies. If the sampled data were used to create a profile graph, the effect of aliasing would be to introduce long wavelength components into the profile, which were not present on the actual surface. To prevent this happening, it is usual to provide an electrical filter which removes any unwanted high frequencies from the profile data before it is sampled. Such a filter is commonly described as an anti-aliasing filter.

EFFECT ON RESULTS With most manufactured surfaces, the longer wavelength components of the surface texture tend to have the greatest amplitudes. This is a natural consequence of most manufacturing processes. When the surface texture parameters of this type of surface are assessed, the short wavelength limi and bandwidth become much less significant than the long wavelength limit (cut-off), because it is mainly the long wavelengths which are contributing to the parameter values.

Very high precision surfaces, which have been subjected to a succession of machining operations, do not always show this same increase in amplitude with wavelength. The effect of the multiple machining is to remove the long wavelength components leaving only the short wavelengths. For these surfaces, the parameter values obtained after a measurement will be very sensitive to bandwidth and short wavelength limits. Not surprisingly, it is with this type of surface that most anomalies are found when measurements are made using different types of instrument.

SECTION 7
TROUBLESHOOTING & TIPS

SYSTEM DOES NOT POWER UP CORRECTLY.

- Check all cable connection and fuses.

COMPUTER DOES NOT AUTOLOAD THE PROGRAM.

- Check the computer using the enclosed diagnostics.
- Check that the system 'DONGLE' is correctly installed.
- If diagnostic tests pass then re-install the Form Talysurf Series software.

SELECTING 'RETURN TO PREVIOUS MENU' KEEPS SWITCHING FROM THE RESULTS PAGE TO THE DATA SELECTION PAGE

- This is a function of the software, Press the F1 key to return to the main menu.

SELECTING 'RETURN TO PREVIOUS MENU' DOES NOT RETURN TO THE MAIN MENU

- This option returns operation to the previous menu selected, in some instances this can switch between 2 menus without returning to the 'MAIN MENU'. Pressing F1 will return operation to the MAIN MENU.

SYSTEM DOES NOT RESPOND TO A MENU SELECTION

- This often happens when the system is expecting an operator input from the Keyboard (a menu box should be displayed which either has the current value entered or is blank) as in the case of entering the required traverse length. The correct value or input should be entered by the operator followed by the 'ENTER' key.

- The above may also occur when the value or input from the operator is not a valid option. e.g. 0.002mm as a traverse length.

EVEN THOUGH 5 CUT-OFFS ARE SELECTED IN THE FILTER & PARAMETER OPTIONS MENU, ONLY 3 ARE INCLUDED IN THE ANALYSIS

- To allow for Filter settling, it is conventional that for a 2CR filter 2 cut-offs are ignored from any assessment and for a Gaussian filter 1 cut-off is ignored. See FILTERS under BANDWIDTH, FILTERING AND DATA POINTS in the PARAMETERS, DEFINITIONS AND THEORY section.
- Select 2 cut-offs more than are required to be analysed for a 2CR filter or 1 cut-off more for the Gaussian filter.
- Sometimes less cut-offs than selected will be analysed (3 less cut-offs for 2CR filter - 2 less cut-offs Gaussian filter). This is due to the arcuate calibration shortening the measured data. Increase the measurement length to obtain more cut-offs.

SELECTING THE PRINT OPTION F7 DOES NOT WORK

- Check on the results presentation menu that some or all of the data is selected for output.
- Press the F6 key to initialise the printer and this will clear any data which may be causing the printer not to function.

SELECTING THE SCREEN DUMP OPTION F8 DOES NOT WORK

- Check that the selection of menu & graph colours are suitable for Black on White printing. (e.g.CYAN on WHITE would appear as white on white on the printer).
- Press the F6 key to initialise the printer and this will clear any data which may be causing the printer not to function.

DISPLAYED TRAVERSE LENGTH IS NOT AS SELECTED IN THE FILTER & PARAMETER OPTIONS MENU.

- The Traverse Length set in the source box of the main menu may be less than the selected number of cut-offs or traverse length in the Filter & Parameter options menu. Change the

traverse length in the Source Box to at least the length required.

- If the result is displayed in the Data Selection-Raw Data menu (i.e. after a Data Collection measurement), check that the **REGION** selected is the complete profile. Selecting **CLEAR REGION** should restore the display to the full measured traverse length.

EVEN THOUGH THE TRAVERSE LENGTH OR CUT-OFF SELECTION IS CORRECT THE ANALYSED DATA IS OVER A SHORTER LENGTH

- This is due to a shorter traverse length setting on the SOURCE option of the MAIN MENU.
- Enter a new length at the SOURCE option of the MAIN MENU.

ON INITIATING A MEASUREMENT THE TRAVERSE UNIT MOVES TO THE LEFT BEFORE MEASURING

- The data logging position set in the DATA SOURCE is set to a value lower than the current traverse unit position.
- Either correct the data logging start position or move the traverse unit (and/or component).

ON INITIATING A MEASUREMENT THE TRAVERSE UNIT DOES NOT MOVE

- The data source is set to either MEMORY OR FILE
- The Traverse Unit is not selected as the Measurement Axis in the CONFIGURATION-EQUIPMENT MENU

TRAVERSE TABLE (Y AXIS STAGE) IS NOT OPERABLE

If the traverse table is the type that requires an IEEE interface card to be fitted, then ensure that the card has been properly fitted to the computer and that its software has been installed. Check that the computer CONFIG.SYS file includes the line DEVICE=C:\IEEE\GPIB.COM.

MOVE INTO CONTACT ON THE COLUMN DOES NOT CORRECTLY CENTRE THE GAUGE IN THE MIDDLE OF ITS RANGE

This is often a sign the gauge matching is out of

adjustment. It should be reset, as necessary (see MATCHING THE GAUGE section 5).

AFTER A 'DATA COLLECTION', THE DATA SELECTION RAW PROFILE MENU IS NOT DISPLAYED.

Ensure that the 'DISPLAY DATA COLLECTION' option is selected in the FURTHER SETTINGS-PRESENTATION MENU.

DATA SELECTION MENU, MARKER MOVEMENT AND DATA SELECTION MODE CHANGE IS NOT POSSIBLE.

This may occur when a region has already been setup and the current profile does not occupy the whole of the region.

If a new region is required, then use the CLEAR REGION option to reset the region definition.

JOYSTICK OR HANDHELD CONTROLLER DISABLED.

Press key F9 to re-enable the joystick.

DUAL PROFILE PRINTING ON DP 7000 PRINTER - NO PRINT GIVEN

The test profile (transformed test or difference) will only be printed if it is entirely increasing in X. Reduce that amount of rotation before printing.

SECTION 8
GLOSSARY OF TERMS

AUTOEXEC.BAT The file which the computer looks for immediately on switch on and which is used to make programs automatically execute.

BANDWIDTH Bandwidth is the frequency or wavelength used to describe the upper and lower limit of a systems measurement or analysis capability. An example of which is the common transistor radio which for any given wave band (e.g. FM,VHF etc) has an upper and lower limit of frequency at which it can receive data.

BAUD RATE The rate at which data is transferred, usually via the RS232 communications port. e.g. 2400 Baud is 2400 bits of data per second.

CURSOR Crossed lines which are displayed on the screen of Pc systems. The operator moves the crossed lines by moving the mouse.

DATA COLLECTION Raw data is obtained by measuring the surface of a component or by accessing previously measured data that is stored in the computers memory or in a disc file. The collected data can then be displayed or analysed.

DATA LOGGING POSITION The position to which the stylus will move before any data is taken.

DONGLE An electronic device which contains a coding pattern which, when matched with the appropriate software, allows the operation of the program.

DOS Disk Operating System:- Provides the computer with the ability to interpret the commands

contained in the executable files of software packages e.g. Form Talysurf Series

EGA Enhanced Graphics Adaptor:- The display method used on the majority of graphics display computers and that used in the Form Talysurf Series software. It gives a resolution of 600 x 350 pixels.

EIM Electronic Interface Module: necessary for communications between computer and instrument.

FILTER CUT-OFF The wavelength at which data will be ignored or analysed depending on whether Roughness or Waviness Filter is selected. The Cut-Off length is also equivalent to the sample length in conventional surface texture assessments.

GAUSSIAN A statistical distribution which is least susceptible to errors in population, when applied to surface texture it helps prevent a phenomenon known as *ringing*.

HARD DISC Usually contained within the computer the Hard disc is a series of coated and sealed aluminium discs which are used to store programs and other forms of data. They are similar in appearance to Floppy discs but can hold considerably more data.

ICON A graphic representation of a computer or hardware function.

LANDSCAPE A page printed so that as you read it, the width of the page is greater than its height.

PIXEL A unique point which can be individually controlled on a computer screen (picture element).

PORTRAIT A page printed so that as you read it, the width of the page is less than its height.

RINGING Ringing is a phenomenon often found in digital systems, the effect is to generate a false representation of measured data which in surface texture measurement appears as a sinusoidal beat frequency on the surface.

RS232 A standardised protocol for serial data exchange between computers and peripheral devices (e.g. a printer).

VGA Virtual Graphics Array:- This is a standard used for displaying high resolution images on computer screens. It gives a resolution of 640 x 480 pixels.

ZONEWIDTH Zonewidth is usually the term applied to the area into which a profile must pass through in a Peak Count Analysis. It is normally equispaced about the Mean Line.

9 - WARNING AND ERROR MESSAGES

Messages which are displayed when a system status error is detected, have the form [1234/1234] followed by a message relevant to the cause of the error. The message can be cleared by selecting the window in which it is contained. The following pages give a list of these messages and the action to be taken by the operator. Only the digits preceding the / are listed below; the remaining digits relate to the area within the system in which the fault has occurred and are for use by the staff of Taylor Hobson only. In the case of a persistent fault contact Taylor Hobson

Error Message and *Operator action*

2/ Insufficient DOS memory

This fault will only occur on PC systems when the computer is excessively loaded with software in addition to that required for the Form Talysurf system - remove the third party software.

3/ Error reading file

File does not exist or has invalid content.

4/ Error writing to a file

Probably no space on the disc for the file. Try a new disc.

5/ Corruption of file data

Delete file.

6/ Corruption of file data

Delete file.

7/ Unable to open file

File probably does not exist. If using drive A or B, check if the floppy disc is present.

8/ Unable to open file

File probably does not exist.

9/ Unable to open internal file

Contact Taylor Hobson.

10/ Unable to open file

File probably does not exist.

11/ Unable to open file

File probably does not exist.

12/ Unable to open stylus or pickup information

Possibly one of the following files is missing: \TS\ PICKUP. CAL, \TSS\STYLUS. CAL, \TSS\STY_TP.CAL. Copy the missing file from the master disc.

13/ Unable to delete internal file

Contact Taylor Hobson.

14/ Maths error

Contact Taylor Hobson.

15/ Invalid data for an aspheric form fit

Possibly aspheric axis not found or polynomial constant is incorrect. Check polynomial constants (try changing the signs - ve to + ve). Check location of traverse over the component and remeasure.

16/ Invalid data for a conic form fit

Surface not suitable for conic fit . Change the form reference.

17/ Invalid data for a conic form fit

Surface not suitable for conic fit . Change the form reference.

18/ Aspheric axis not found

Measured data dose not include a valid axis. Check that the traverse is made over the component axis and remeasure. Check also the polynomial constants (try changing the signs - ve to + ve).

19/ Insufficient data length

Insufficient data for the number of cutoffs selected. Make sure that a valid data collection has been made. Increase measurement length, increase analysis length or reduce cutoff wavelength. Can be caused when surface has not been levelled, or by arcuate calibration correction.

20/ Insufficient data for a form fit

Increase data length for analysis.

21/ Invalid data for minimum zone form fit

Data too smooth for MZ fit, select LS.

22/ Insufficient data length

Increase data length for analysis. Check that a valid data collection has been made.

23/ Insufficient data length

Increase data length for analysis. Check that a valid data collection has been made.

24/ Insufficient data for an analysis.

Increase data length for analysis. Check that a valid data collection has been made.

26/ Invalid measurement spacing

Data spacing in input file must be 0.25μm or 1μm.

28/ Invalid bandwidth

Bandwidth too large. Decrease bandwidth selected.

30/ Invalid ball calibration data

Ensure that the calibration data is continuous through the measurement and over a relevant ball standard.

31/ Invalid 3 line calibration data.

One of the following conditions has occurred:
The stylus traverse was started in a groove.
Three clearly defined grooves were not found.
Stylus damaged.
Incorrect gauge range selected

32/ Invalid 3 line calibration data.

One of the following conditions has occurred:
The stylus traverse was started in a groove.
Three clearly defined grooves were not found.
Stylus damaged.
Incorrect gauge range selected.

33/ Invalid 3 line calibration data.

One of the following conditions has occurred:
The stylus traverse was started in a groove.
Three clearly defined grooves were not found.
Stylus damaged.
Incorrect gauge range selected.

34/ Invalid 3 line calibration data.

One of the following conditions has occurred:
The stylus traverse was started in a groove.
Three clearly defined grooves were not found.
Stylus damaged.
Incorrect gauge range selected.

35/ Magnification too high

Reduce gauge range to the correct setting for calibration. Alternatively, use a three line standard for calibration measurement.

36/ Calibration limit exceeded

As for 31/. Also check pick-up phase and balance (not laser traverse unit).

37/ Invalid calibration conditions

The data source is not a valid component or check the pick-up signal is not off-line

39/ Invalid move

Contour gauge has already passed the 'move to position' or lift off height causes the stylus to move into the component. Move gauge off of the surface and restart or use a value for lift off height that causes the stylus to move away from the component after measurement completion.

40/ Invalid calibration - gauge inverted

Ensure that the gauge is correctly orientated during calibration.

41/ Stylus tip position is too low

Crown ball correctly before calibration and ensure gauge reading is suitable if using a manual column.

43/ Unable to open file

File probably does not exist.

44/ Disc full - program step limit reached

Maximum program size reached. Revise the program.

45/ Disc full - program step limit reached

As 44/.

46/ Invalid program name

Program name is not in an acceptable form.

47/ Program not saved

Indicates that an attempt is being made to create a new program when the program being prepared is still in progress and has not yet been saved or abandoned.

48/ Invalid program name

Enter valid filename.

49/ Invalid program name

Program name is not in an acceptable form.

50/ Insufficient data length

Increase data length for analysis. Check that a valid data collection has been made.

51/ MZ form fit invalid

Data too smooth for MZ fit, select LS.

52/ Invalid data for an Rk parameters calculation

Increase assessment length, decrease max. number of data points. This error may be generated by attempting calculation of the Rk, Rpk, Rvk parameters on a non-platau honed surface. The surface is, therefore unsuitable for this type of analysis.

53/ Rk assessment length too small

Increase assessment length, decrease max. number of data points.

54/ Too many data points for the Rk filter

Decrease assessment length or decrease maximum number of data points.

55/ Incompatible calibration file

Delete file \TSS\CALIB/CALIB.CAL

56/ Invalid date format

Enter date in format DD/MM/YY e.g.07/05/90 for the 7th May 1990.

57/ Printer off-line

If the printer is switched on when this message is displayed, check that the printer leads are connected correctly. Prints are not possible when running off-line with no EIM.

58/ Communications error

Check all cable connections and then retry. If fault persists contact Taylor Hobson.

59/ Unable to remove internal file

Contact Taylor Hobson.

60/ Invalid data for an LS arc form fit

Insufficient curvature detected, increase traverse length.

61/ Invalid language file

Language file corrupted. *Copy language files from the master disc, i.e. *.LNG *.ERR *.HLP*

62/ DOS drive is write protected

See DOS Handbook.

63/ DOS drive is unknown

See DOS Handbook.

64/ DOS drive not ready

Check that a disk is in the selected drive and is correctly inserted. See DOS Handbook.

65/ DOS unknown command

See DOS Handbook.

66/ DOS data error, bad checksum

See DOS Handbook.

67/ DOS bad request structure length
See DOS Handbook.

68/ DOS drive seek error
See DOS Handbook.

69/ DOS unknown drive media type
See DOS Handbook.

70/ DOS drive sector not found
See DOS Handbook.

71/ DOS check paper in printer
See DOS Handbook.

72/ DOS write fault
See DOS Handbook.

73/ DOS read fault
See DOS Handbook.

74/ DOS general fault
See DOS Handbook.

75/ - 86/ Software errors
Retry. If fault persists contact Taylor Hobson.

87/ Extended Memory Fatal error
Refer to DOS manual for extended memory problems.

88/ - 92/ Software errors
Retry. If fault persists contact Taylor Hobson.

93/ Invalid tilt position
Adjust component to bring within range of ±9° datum line.

94/ Comms. protocol error
Retry. If fault persists contact Taylor Hobson.

95/ Comms. file creation error
Retry. If fault persists contact Taylor Hobson.

96/ Comms. file read error
Retry. If fault persists contact Taylor Hobson.

97/ Invalid comms. format
Retry. If fault persists contact Taylor Hobson.

98/ Timeout error for comms.
Retry. If fault persists contact Taylor Hobson

99/ Directory creation error
Directory already exists. Use a different directory. If fault persists contact Taylor Hobson.

100/ Illegal destination for comms.
Retry. If fault persists contact Taylor Hobson.

101/ *Current environment file is corrupted. A new environment file will be created.*

102/ Error reading directory
Directory specified does not exist.

103/ Error copying file
Check file name is valid and that file exists in the current directory.

104/ Error deleting file
Check file name is valid and that file exists and is not write protected.

105/ Invalid surface for crowning
Surface too flat for crowning.

106/ Move stylus tip closer to turning point
The slope of the component is too great at the current stylus position, this is creating problems in computing the turning point. Move the traverse start closer to the component crown.

107/ Fatal software error - switch off system
Switch off the system, then switch back on again to restart.

110/ Invalid rotation point - move marker
Marker must be positioned on the test profile, move marker to correct position and retry.

113/ Insufficient DOS memory

This fault will only occur on PC systems when the computer is excessively loaded with software in addition to that required for the Form Talysurf system - remove any third party software.

115/ Invalid operation - use filing menu

Attempting to save raw measurement data when the data source is a disc file. Use the filing menu and the copy function.

116/ No raw data - data collection required

Make a data collection from the Component (measurement) or use previous data stored in memory or disc file.

117/ Maximum areas reached

The maximum number of areas has been reached. Merge two areas into one.

118/ Insufficient DOS memory

This fault will only occur on PC systems when the computer is excessively loaded with software in addition to that required for the Form Talysurf system - remove any third party software.

119/ Insufficient data for power spectrum

At least 2000 data points are required for a Power Spectrum analysis. Increase number of data points or assessment length.

120/ Analysis not valid with current dongle.

The dongle will not allow the current analysis to be performed.

121/ The dongle has been removed.

The dongle must be replaced in the system, or the system switched off.

122/ Gauge out of range before data collection.

Position stylus to accommodate profile data collection.

123/ Gauge out of range during data collection.
Position stylus at start of traverse to accommodate the profile during data collection.

124/ Data unsuitable for R&W analysis.
Profile too smooth, so too many peaks and valleys are present.

125/ No dual profile datum exists.
A dual profile datum has not been created.

126/ Invalid dual profile datum.
Dual profile datum has been corrupted.

127/ Insufficient dual test profile length.
Too few data points in the dual test profile for a graphical display.

128/ Unable to complete measurement.
Measurement failed due to gauge out of range or communications error.

129/ Unable to delete directory.
Directory could not be deleted as it contains files. If no files are visible from the File Manipulation Menu, then the directory must contain non Taylor Hobson files. These must be deleted from MS-DOS.

The RTH directory will always be present and cannot be deleted.

130/ Unable to create RTH directory.
Directory could not be created because it already exists

131/ Maximum further parameters defined.
Maximum number of further parameters have been defined.

132/ Warning : Nothing will be printed.
No data is selected for printing in the printer configuration menu or no data for printing is available.

133/ Directory not clear.
PART000.RTH file already exists in RTHSPC.

134/ No SPC results to transmit.
SPC temporary file does not exist.

135/ Serial port transmission failure.
Error has occurred during transmission to SPC.

136/ SPC option not available
Program with SPC steps included has been run, but SPC dongle is not present.

137/ Logging of selected parameters
Present logging would lead to too many parameters in SPC temp file causing overflow.

138/ Error opening SPC file.
139/ Error writing to SPC file.
140/ Error reading from SPC file.
141/ Error accessing 3D output file.
142/ 3D file not found
File probably does not exist.

143/ Extend end stop hit.
Recalibrate table position.

144/ Retract end stop hit.
Recalibrate table position.

145/ Table moving.
Wait until table has stopped moving.

146/ No U100 Controller.
147/ U100 Control fault.
148/ Write handshake error.
149/ GPIB not addressed properly.
150/ Invalid argument.
151/ GPIB not system controller.
152/ I/O operation aborted.
153/ GPIB board non existent.
154/ Previous operation not complete.
155/ No capability for operation.
156/ File system error.
157/ Command error during call.
158/ Serial poll status byte lost.
159/ SRQ stuck in ON position.

160/ Table has become disconnected
Check leads and power supply.

161/ Not enough points for 3D analysis.
Increase measurement length.

162/ 3D option not available.
3D Dongle required.

163/ Software Forward end stop hit

164/ Software Retract end stop hit

165/ No traverse table present.
Automatic movement is not possible without a table.

166/ No stop command available.

167/ No step movement allowed.

168/ 3D measurement currently suspended.
Cannot store 3D program in suspended state.

169/ Not enough measurements in 3D file.
3D file corrupted. Repeat measurements from beginning.

170/ Printed profile is shorter than one division.
Use a higher resolution for horizontal print out scaling. In dual profile mode, the test profile may have been rotated so that it is not entirely increasing in X.

171/ Current gauge reading too high for required range.
Move gauge closer to zero position before changing range.

172/ Insufficient data for LS refinement.
Not enough overlapping points or profile X start greater than X end.

173/ Insufficient overlapping points were found.
Operation needs a bigger overlap between the full datum and test modified profiles.

174/ Dual profile not available.
The dongle does not allow dual profile access.

175/ Incompatible profile types.
The test and datum profiles are different types.

176/ Invalid profile for replacement
The profile has been rotated too far and is no longer increasing in X. Reduce rotation.

177/ Too many interruptions in the data
Maximum number of interruptions exceeded.

178/ Analysis not valid with filter mode

179/ Invalid gothic arch contact points
Left contact point is to the right of the bottom position or the right contact point was not found.

180/ Invalid gothic arch centres

181/ Gothic test ball radius too large
Use smaller test ball.

182/ Invalid axis position
Axis is not on the profile.

183/ Invalid surface for gothic form fit
Test ball centre position is invalid.

184/ Invalid parameters for gothic analysis
Bottom X is not on the profile or test ball radius is not within range.

185/ Gothic option not available
Gothic dongle is not present.

186/ Gothic analysis invalid on convex surface
Surface is not concave.

187/ Batch directory and current directory are the same
See SAVING DATA, in section 5, for correct selection of Batch file directories.

188/ This is not a Batch directory
189/ Batch directory does not exist
190/ Invalid Batch directory name
191/ No Data

500/ Warning : Selected region too small for a valid assessment.
The peak to valley is too large compared with the assessment length. Increase the assessment length. Check that a valid calibration has been made. Use a different form type.

501/ Warning : System not calibrated.
Calibrate the system before valid results can be obtained.

502/ Warning : Larger number of data points used.
The system has increased the number of data points used for the analysis, the operator selection was too small.

503/ Warning : Invalid data for R and W parameter calculation.
Select a gauge range with a higher resolution. Check that the Modified Profile is suitable for R&W parameter calculation.

504/ Warning : Remove printer lead from Sekonic plotter.
505/ Rotation limit reached.

506/ Warning : Add print results step if required.
The automatic print after an analysis option is selected but a print after an analysis must be added as a separate step when editing a program.

509/ Swap file already exists. Program swap abandoned.
This is caused by attempting to execute a shell from within FTSS when the program is already currently running a shell under FTSS.

510/ Disk drive full.

511/ Program image not found.
The image of the FTSS program, which was previously saved, cannot be located.

512/ Disk I/O error whilst accessing program image.

513/ Change directory error whilst swapping program environment.
514/ File error whilst restoring program.
515/ Error encountered whilst changing drive.
515/ Error encountered whilst changing drive.
516/ Unexpected error whilst accessing XMS memory.
517/ Unexpected error whilst accessing EMS memory.
518/ Unable to execute DOS command processor.
519/ Too many file handles in use.

520/ Top of memory address changed..
This can be caused by using a utility which alters the top of memory address.

521/ Memory allocation error.
521/ Memory allocation error.
522/ Memory allocation error.
523/ Memory allocation error.
524/ Memory allocation error.

525/ Unable to locate DOS command interpreter.
COMMAND.COM could not be located - check the PATH settings.

526/ Program swap internal error.

527/ Child process error code out of range.
Exit code ≥16

528/ Child process error number 1.
529/ Child process error number 2.
530/ Child process error number 3.
531/ Child process error number 4.
532/ Child process error number 5.
533/ Child process error number 6.
534/ Child process error number 7.
535/ Child process error number 8.
536/ Child process error number 9.
537/ Child process error number 10.
538/ Child process error number 11.
539/ Child process error number 12.
540/ Child process error number 13.
541/ Child process error number 14.
542/ Child process error number 15.
These messages are generated from program swap operations when the child process (DOS shell) returns an exit code.

543/ Unable to locate memory to save screen.
544/ Error whilst attempting to open screen image file.
545/ Error whilst writing to screen image file.
546/ Error whilst attempting to open screen image file.
547/ Error whilst attempting to read from screen image file.
548/ Error whilst attempting to read from screen image file.

549/ Unable to locate memory to restore screen.

These messages are generated from program swap operations and relate to saving and restoring the screen image. Error codes 543 to 545 are generated when it is not possible to save the screen image. Program swap is abandoned. Error codes 546 to 549 are generated when the program swap has been accomplished but it is not possible to restore the screen. In this case the program will attempt to construct the last screen.

550/ WARNING: Stylus selected does not match current pick-up.

551/ Warning: Pickup selected does not match curent system configuration.

These messages are generated when the data being input into the Gauge Information menu comprises a mismatch of inductive and PGI pickup and stylus details.

552/ Invalid prism calibration data

553/ Invalid prism calibration shape

554/ Not enough data to perform prism calibration

See section 5 of the handbook for correct prism calibration procedure.

555/ DEMONSTRATION MODE TIME OUT EXPIRED - TERMINATING PROGRAM.

For full operation of the Form Talysurf program the appropriate dongle must be obtained from Taylor Hobson.

1000/ Software error in MC

1001/ Software error in MC

1002/ Software error in MC

1003/ Software error in MC

These messages indicate that an error has occurred which may or may not be fatal. Clear the message and proceed. If the fault persists contact Taylor Hobson.

1004/ End stop detected

The axis has reached the end stop position.

1005/ Motor overload detected

The axis being driven has a motor over load.

1006/ Motor overload detected

The axis being driven has a motor over load.

1007/, 1008/ Software error in MC

These messages indicate that an error has occurred which may or may not be fatal. Clear the message and proceed. If the fault persists contact Taylor Hobson.

1009/ Emergency Stop Detected

The emergency stop button has been pressed. Operation can continue after the message has been cleared.

1010/ Software error in slave

If the symptoms persist, contact Taylor Hobson

1011/ Gauge over range detected

Reposition the gauge. If the system does not include a column, then having acknowledged the message, a further message "Manually bring gauge into range" is displayed. This will automatically clear when the gauge is in range.

1012/ Laser not switched on

Check that the *Laser covers are in place and that the pick-up lead is properly connected.*

1013/ Software error in slave
1014/ Software error in slave
1015/ Software error in slave
1016/ Software error in slave
1017/ Software error in slave
1018/ Software error in slave
1019/ Software error in slave
1020/ Software error in slave
1021/ Software error in slave
1022/ Software error in slave
1023/ Software error in slave
1024/ Software error in slave
1025/ Software error in slave
1026/ Software error in slave
1027/ Software error in data logger
1028/ Software error in data logger

1029/ Software error in data logger
1030/ Software error in data logger
1031/ Software error in data logger
1032/ Software error in MC
1033/ Software error in MC
1034/ Software error in MC
1035/ Software error in MC
1036/ Software error in MC
1037/ Software error in M
1038/ Software error in MC
1039/ Software error in MC
1040/ Software error in MC
1041/ Software error in slave
1042/ Previous axis movement not complete.
1043/ Software error in slave
1044/ Software error in slave
1045/ Software error in slave
1046/ Software error in slave
1047/ Software error in slave
1048/ Software error in slave

These messages indicate that an error has occurred which may or may not be fatal. Clear the message and proceed. If the fault persists contact Taylor Hobson Limited.

1049/ Absolute position not permitted until calibrated

Calibrate axes and continue.

1050/ Gauge status error
1051/ Software error in MC
1052/ Software error in MC
1053/ Software error in MC
1054/ Software error in Slave
1055/ Software error in Slave
1056/ Software error in MC
1057/ Software error in MC
1058/ Software error in MC
1059/ Software error in MC
1060/ Software error in MC
1061/ Software error in MC
1062/ Software error in MC
1063/ Software error in MC

1064/ Software error in MC

These messages indicate that an error has occurred which may or may not be fatal. Clear the message and proceed. If the fault persists contact Taylor Hobson.

1065/ Gauge over range detected

Reposition the gauge and retry.

1066/ Software error in MC
1067/ Software error in MC
1068/ Software error in MC
1069/ Software error in MC
1070/ Software error in MC
1071/ Software error in MC
1072/ Software error in MC

These messages indicate that an error has occurredwhich may or may not be fatal. Clear the message and proceed. If the fault persists contact Taylor Hobson

1073/ Software error in MC

Slave is not connected. This will normally be the traverse unit. Check all leads are correctly inserted.

1074/ Software error in MC
1075/ Software error in MC
1076/ Software error in MC

These messages indicate that an error has occurred which may or may not be fatal. Clear the message and proceed. If the fault persists contact Taylor Hobson.

1077/ Gauge out of range

Reposition the gauge to accommodate the profile being measured and retry.

1078/ Software error in MC
1079/ Software error in MC

These messages indicate that an error has occurred which may or may not be fatal. Clear the message and proceed. If the fault persists contact Taylor Hobson.

1080/ Software error in slave
1081/ Software error in slave
1082/ Software error in slave
1083/ Software error in slave
1084/ Software error in slave
1085/ Software error in slave
1086/ Software error in slave
1087/ Software error in slave
1088/ Software error in slave
1089/ Software error in slave
1090/ Software error in slave
1091/ Software error in slave
1092/ Software error in slave
1093/ Software error in slave

If the symptoms persist, contact Taylor Hobson which may or may not be fatal. Clear the message and proceed. If the fault persists contact Taylor Hobson.

1073/ Software error in MC

Slave is not connected. This will normally be the traverse unit. Check all leads are correctly inserted.

1074/ Software error in MC
1075/ Software error in MC
1076/ Software error in MC

These messages indicate that an error has occurred which may or may not be fatal. Clear the message and proceed. If the fault persists contact Taylor Hobson.

1077/ Gauge out of range

Reposition the gauge to accommodate the profile being measured and retry.

1078/ Software error in MC
1079/ Software error in MC

These messages indicate that an error has occurred which may or may not be fatal. Clear the message and proceed. If the fault persists contact Taylor Hobson.

1080/ Software error in slave
1081/ Software error in slave
1082/ Software error in slave
1083/ Software error in slave
1084/ Software error in slave
1085/ Software error in slave
1086/ Software error in slave
1087/ Software error in slave
1088/ Software error in slave
1089/ Software error in slave
1090/ Software error in slave
1091/ Software error in slave
1092/ Software error in slave
1093/ Software error in slave

If the symptoms persist, contact Taylor Hobson

1100/ Insufficient raw data

The gauge went out of range and measurement was aborted, but processing continued. Remeasure ensuring gauge remains within range.

1101/ Software error in MC
1102/ Software error in MC

With the above messages, clear the message and proceed.

1103/ No raw data - data collection required

Make a *data collection from the Component (measurement) or use previous data stored in memory or disc file.*

1110/ Gauge underrange for balance procedure.'; ERR_BALANCE_POS

Re-set the gauge position (see section 5 "MATCHING THE GAUGE" and re-try.

1111 'Gauge not connected - cannot be calibrated'; ERR_AUTO_BALANCE_GAUGE

Check gauge connections, then re-try.

1112 'Timeout occurred during resistive balance' ; ERR_AUTO_BAL_TIME_RES

Ensure that during the traverse, the gauge reading starts positive, passes through zero and becomes negative (see section 5 "MATCHING THE GAUGE").

1113 **'Timeout occurred during phase balance' ; ERR_AUTO_BAL_TIME_PHASE**
Ensure that during the traverse, the gauge reading starts positive, passes through zero and becomes negative (see section 5 "MATCHING THE GAUGE").

1114 **'Traverse unit stopped during auto-balance procedure' ; ERR_BALANCE_TU_STOPPED**
Ensure that traverse unit movement is not obstructed.

1115 **'Gauge out of range during auto-balance procedure';ERR_BALANCE_UNDERRANGE**
For correct setup procedure, see section 5 "MATCHING THE GAUGE".

1120 **'Gauge range incorrect for balance procedure.' ; ERR_BALANCE_RANGE_INCORRECT**
For correct setup procedure, see section 5 "MATCHING THE GAUGE".

1121 **Error - Set Balance procedure failed'; ERR_SET_BALANCE_FAILED**
For correct setup procedure, see section 5 "MATCHING THE GAUGE".

1122 **'Unable To Complete Measurement. Stylus Raised'**

5000/ Software error in comms.
5001/ Software error in comms.
5002/ Software error in comms.
5003/ Software error in comms.
5004/ Software error in comms.
5005/ Software error in comms.
5006/ Software error in comms.
5007/ Software error in comms.
5008/ Software error in comms.
5009/ Software error in comms.
5010/ Software error in comms.
5011/ Software error in comms.
5012/ Software error in comms.
5013/ Software error in comms.
5014/ Error_Out _Of_Range
5015/ Software error
If the symptoms persist, contact Taylor Hobson.

CHAPTER 10
ACCESSORIES

This chapter covers the principal hardware accessories which are available. Individual sections of this chapter may also, as appropriate, be included with the purchased item.

CONTENTS OF THIS CHAPTER

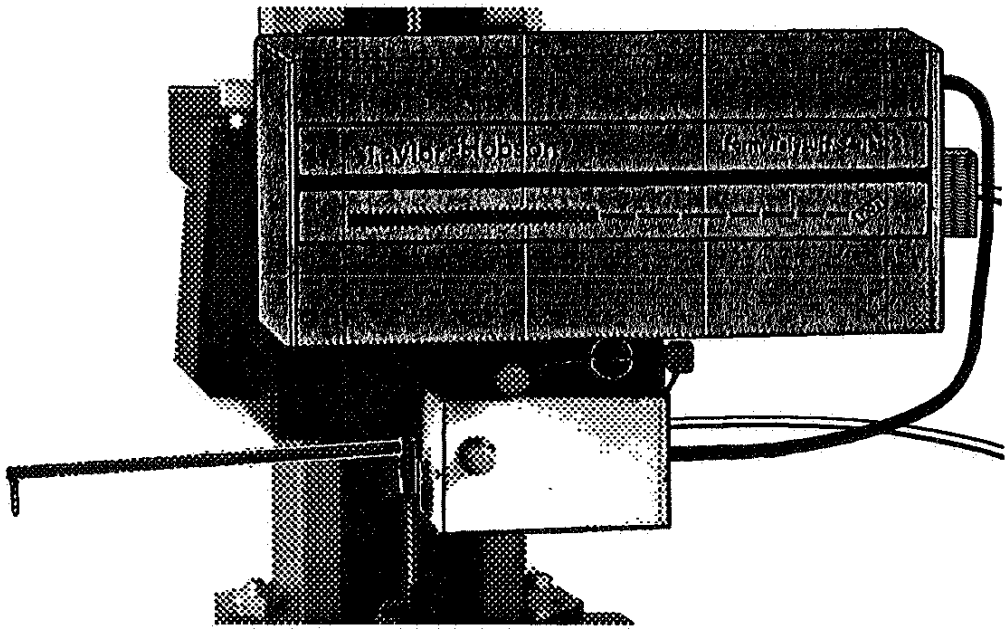
THE CONTOUR PICK-UP

DESCRIPTION This pick-up provides a wide dynamic range for component contour measurement. It is used only in conjunction with a 120mm Traverse Unit which is mounted on a motorised column. The pick-up can be mounted for measurements in the direction of traverse, or at right angles.

IMPORTANT Before fitting a pick-up, power to the instrument must be switched **off**.

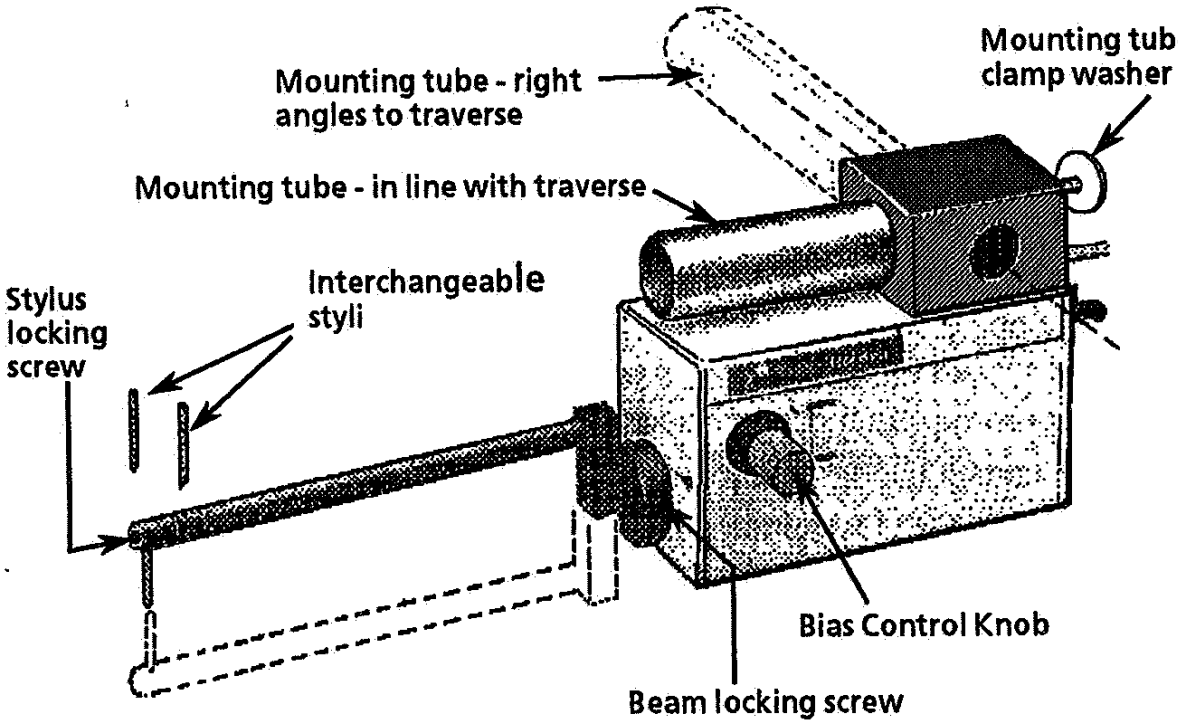
The stylus can be fitted and biased for measurements in either the upward or downward direction.

Full arcuate compensation is provided by the software and, when required, the stylus can be programmed to automatically lift clear of the workpiece, after making a measurement, before beginning the return stroke.

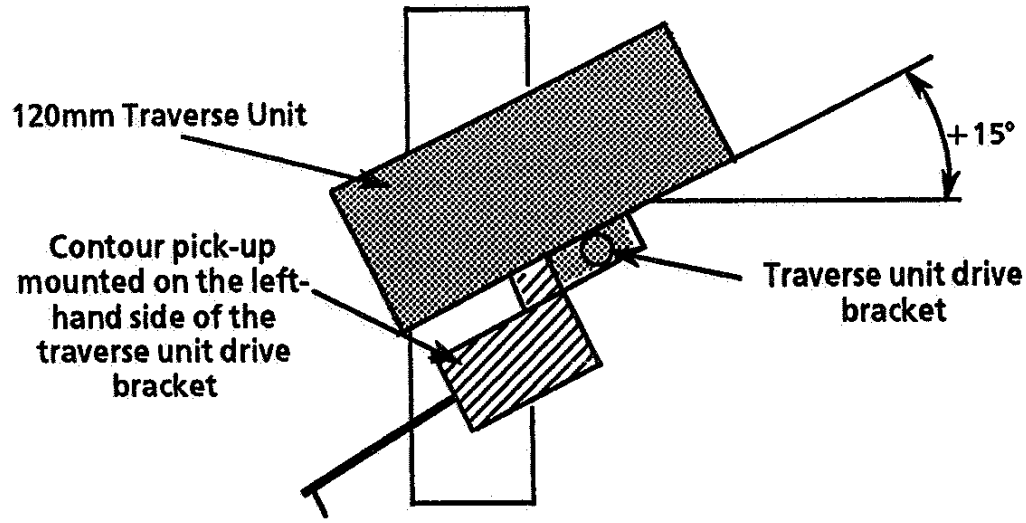


MOUNTING THE PICK-UP The mounting tube is used to mount the pick-up into the drive bracket of the 120mm traverse unit. Dependent on which hole in the pick-up mounting bracket the tube is assembled, the pick-up can be mounted either on axis or at right angles to the traverse movement. The tube is retained by a clamp washer, which has a captive screw.

Note Whenever the mounting attitude of the pick-up or the stylus is changed, the gauge should be recalibrated.



IMPORTANT The side of the traverse unit drive bracket on which wide range pick-up is mounted, is dependent on the angle at which the traverse unit is to be tilted during the measurement. If the traverse unit attitude is to be greater than 15°, then the pick-up **must** be mounted on the **left-hand** side of the traverse unit drive bracket.



The mounting tube should be inserted fully into the traverse unit drive bracket, to bring the mounting bracket of the pick-up close up to the drive bracket, and then securely locked in position.

THE STYLUS Two lengths of stylus beam are available: one beam gives a profile peak to valley range of 20mm (0.78in), and the other gives a profile peak to valley range of 15mm (0.59in).

The stylus beam is a push fit into the anvil of the pick-up. The beam can be fitted with the crank part downwards or upwards, as required and locked in position by a screw. The locking screw is accessed (using a small screwdriver) through a hole in the collar which surrounds the anvil socket, into which the stylus is plugged,

The pivot of the pick-up is a delicate mechanism. Therefore, care must be taken, when inserting and removing the stylus beam, not to force the beam into its socket or to impart a sideways or twisting movement.

STYLUS TIPS The stylus is interchangeable and conical, chisel or ball styli are available. The ball and conical styli are the most suitable for general purpose use, but when the profile has steep descent angles, the chisel stylus should be fitted. The chisel is sharper and more prone to wear and damage, it should not, therefore, be used when either the ball or conical tip is suitable.

The stylus can be fitted, to the beam, pointing either downwards or upwards and is retained by one small screw which must be loosened and partially extracted before a stylus can be fitted or removed. A flat on one side of the stylus provides a face against which the retaining screw should be locked. This ensures the correct orientation of the stylus to the beam. When inserting a stylus, ensure that the flat side faces the retaining screw. **It is important that the bias control is set appropriately for the attitude of the stylus.**

Note If the beam is fitted with both the crank and the stylus downwards, then there can be some deterioration in the accuracy specification

Note To prevent damage to stylus tip and/or component surface, it is recommended that the **auto-lift facility is selected on the CONFIGURATION EQUIPMENT MENU.**

When the auto-lift has been used, the gauge position icon is accurate to only ±0.5mm. Full positional accuracy is restored when the stylus has recontacted a surface.

THE BIAS CONTROL The bias control is used to set the stylus bias, either downwards or upwards, according to the attitude of the stylus.

Note In both settings the air /metal relationship will be correct. It is **NOT** necessary to use the INVERT PROFILE option.

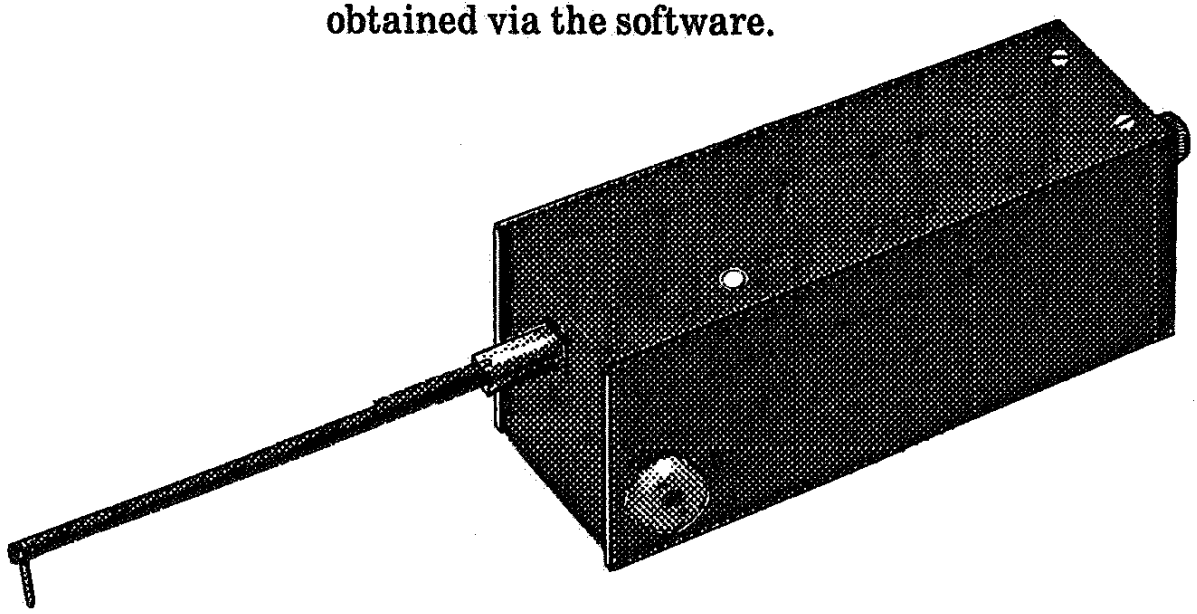
IMPORTANT Before valid measurements can be made, the gauge balances must be set and the system then calibrated. See **Matching the Gauge**, in Section 5.

SPECIFICATION

Transducer:	Linear Variable Differential Transformer (LVDT).
Range :	20mm (0.78in) or 15mm (0.59in) dependent on stylus arm length.
Resolution (using 250mm long stylus arm):	
At 20mm (0.78in) range:	305nm (12µin)
At 4mm (0.157in) range:	61nm (2.4µin)
Dimensions (W x D x H):	120mm, 50mm, 60mm (4.7 x 1.9 x 2.3in)
Weight:	350g (12.3 oz) approx.
Interchangeable Styli	
Tungsten carbide conical tip - 112/2024:	30° included angle x 0.02mm to 0.04mm (0.0008in to 0.0016in) wide.
Tungsten carbide chisel tip - 112/2025:	15° one side only x 0.02mm to 0.04mm (0.0008in to 0.0016in) wide.
Sapphire Ball - 112/2026:	0.5mm±0.125µm radius
Stylus Force:	2gf to 4gf (0.02N to 0.04N)
Max. Recess Depth:	20mm (0.78in)

THE WIDE RANGE PICK-UP

DESCRIPTION This unit is a wide range inductive pick-up for profile measurement. It can be used with either a 120mm or 50mm Traverse Unit (not with the laser traverse unit). Full arcuate compensation is obtained via the software.

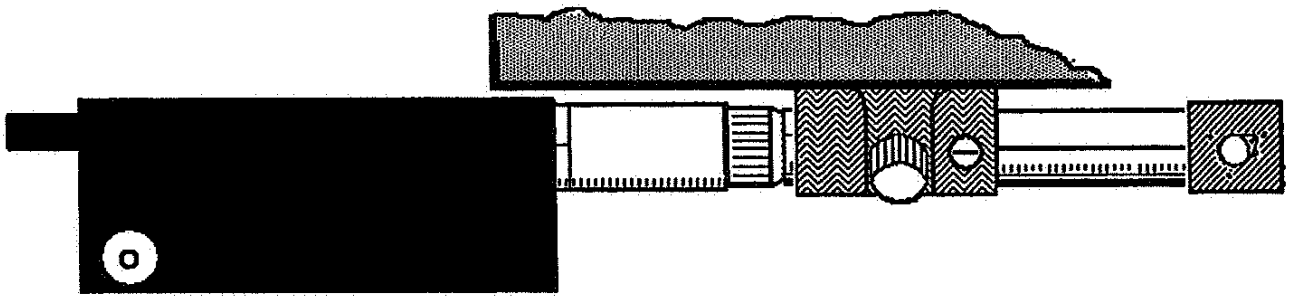


IMPORTANT Before fitting a pick-up, power to the instrument must be switched **off**.

MOUNTING The wide range pick-up is plugged into either the hinge unit, or a hinged or solid pick-up stem and clamped to the traverse unit drive bracket. The pick-up must be mounted with the stylus in the downward direction only. As this pick-up is used skidless, if the hinged pick-up stem is to be used, this must be locked solid..

When plugged into a stem, the projection of the pick-up beyond the traverse unit can be set as required. However, for maximum accuracy, the stem should be inserted into the traverse unit drive bracket to bring the pick-up as close to the drive bracket as is practical. The solid stem can be inserted into the bracket up to the rotatable end into which the pick-up is plugged. The Hinged

stem can be inserted into the bracket up to the hinge locking sleeve.



THE STYLUS The length of stylus beam (160mm) gives a profile peak to valley range of 28mm (1.1in).

The stylus beam is a push fit into the anvil of the pick-up. A stop pin is fitted through the beam and this must fully engage with the recess in the anvil.

The pivot of the pick-up is a delicate mechanism. Therefore, care must be taken, when inserting and removing the stylus beam, not to force the beam into its socket or to impart a sideways or twisting movement.

STYLUS STOP When measuring workpieces which have interrupted surfaces, the stylus can drop into a hole or recess and cause the stylus to be damaged or the stylus arm to be disengaged from the pivot. To prevent this occurring, the movement of the stylus can be limited, by adjusting the stylus stop screw.

The stop screw is located by inserting an M3 hexagon key through the hole in the top plate of the pick-up. The screw should be adjusted so that the stylus is free to fully contact the surface to be measured but have only a limited drop into the interruption.

When non-interrupted surfaces are to be measured, the stop screw should not limit the movement of the stylus arm. This condition can be checked by allowing the stylus to hang freely and ensuring that the displayed stylus position indicates an out-of-range condition.

IMPORTANT Before valid measurements can be made, the gauge balances must be set and the system then calibrated. See **Matching the Gauge,** in Section 5.

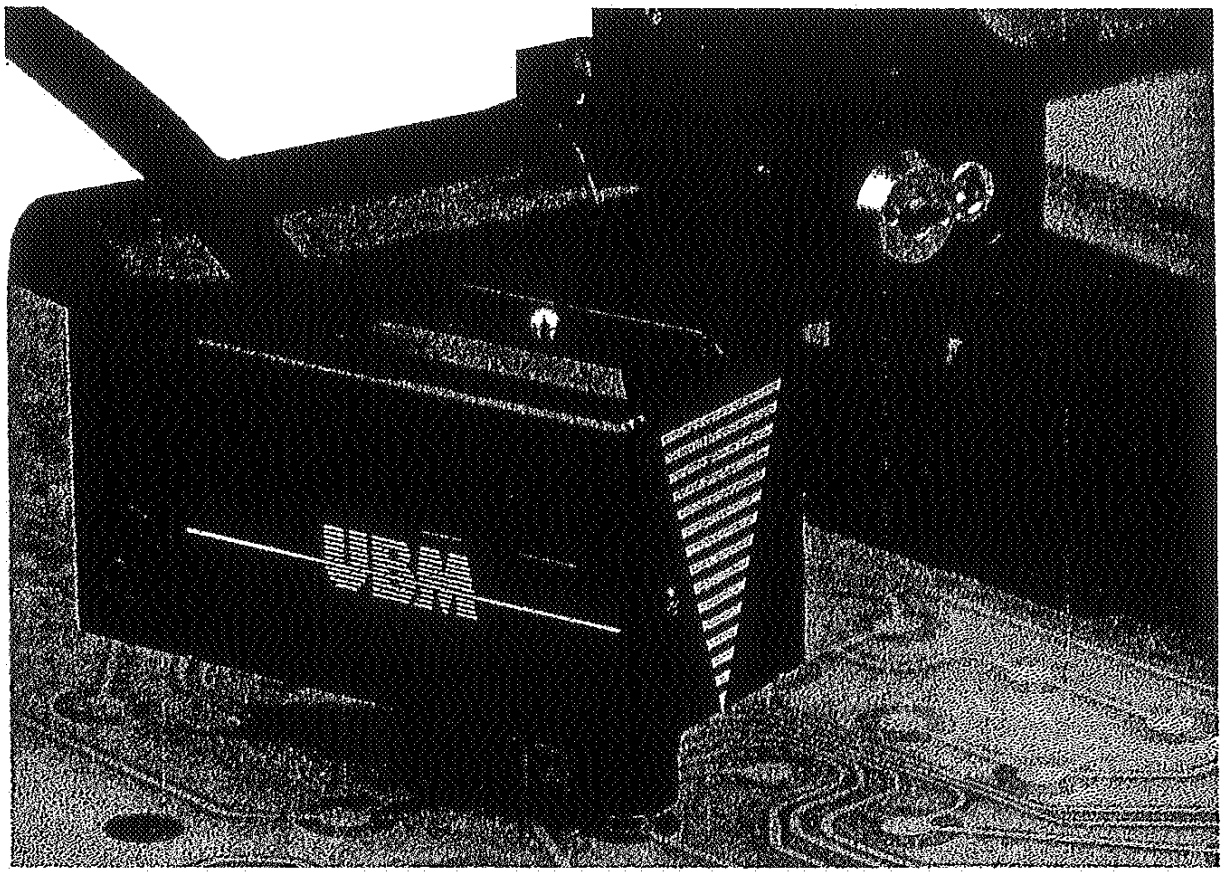
SPECIFICATION

Transducer:	Variable inductance
Range :	28mm (1.1in)
Dimensions (W x D x H):	97mm, 30mm, 40mm (3.8 x 1.18 x1.57in)
Interchangeable Styli	
Tungsten carbide 15° chisel tip- K501/1684:	20µm tip radius
Tungsten carbide 30° conical tip-K501/1685:	20µm tip radius
Sapphire Ball-K501/1686:	500µm tip radius
Resolution	426nm (17µin)
Stylus Force:	3gf (0.03N) nominal
Radius accuracy:	<0.5% *
Linearity:	<0.1% *

* Figures quoted are for measurements made within the calibrated range of the pick-up.

NON-CONTACT GAUGING

DESCRIPTION Non contact gauging for Form Talysurf Series (inductive systems only) comprises a UBM focus follower measuring head with programmable controller. The non-contact gauge replaces the standard inductive pick-up and can be retrofitted to existing systems.



The data provided from the non-contact gauge is totally compatible with existing Form Talysurf Series software, including the 3D analysis package.

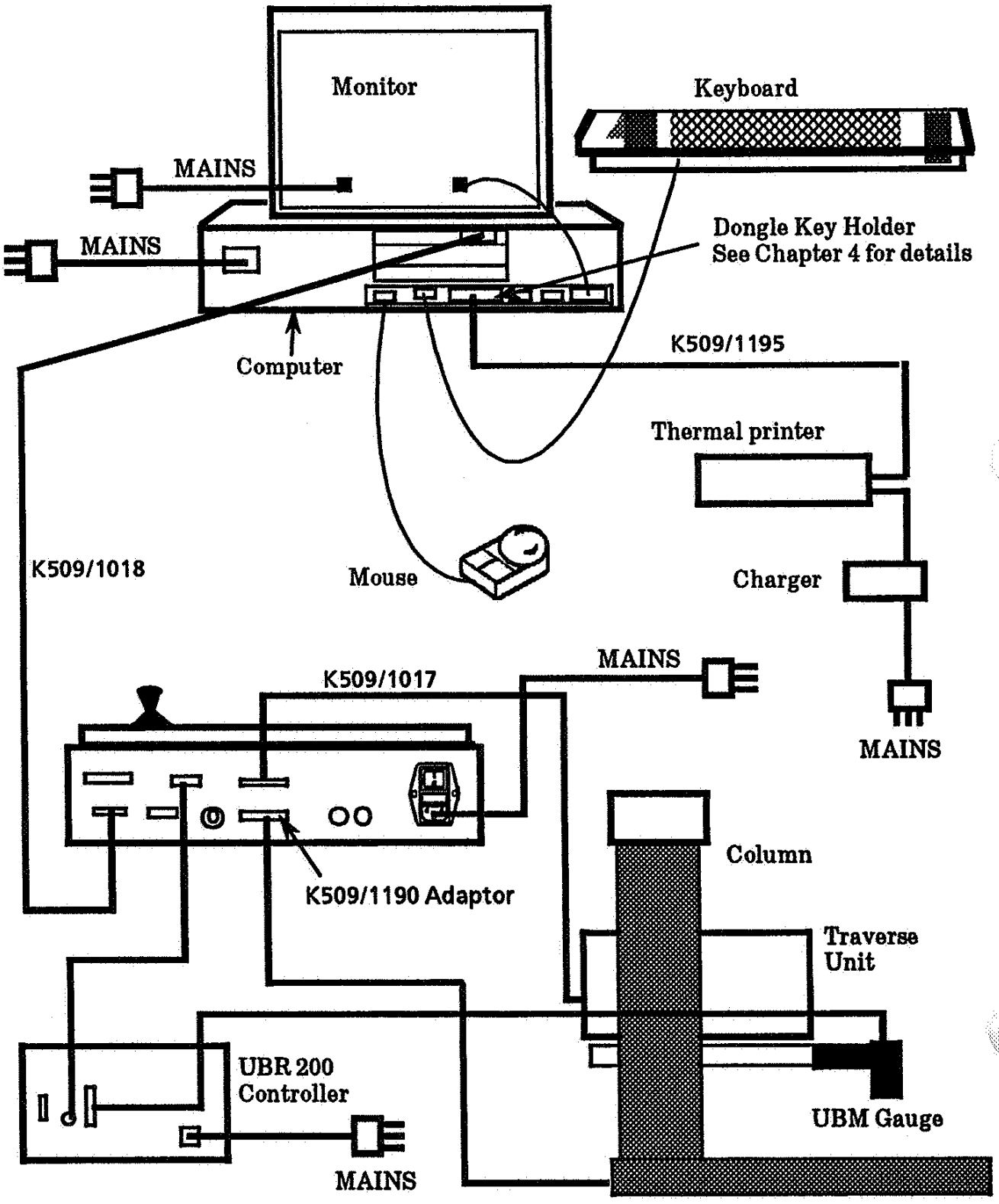
SETUP For correct operation, the details entered into the GAUGE INFORMATION MENU are as for the standard inductive gauge i.e.

Pick-up: 112/2564,	Stylus; 112/2009
Range: 1.0mm,	Resolution 16nm,
Arm length: 60mm,	Tip Radius 2.00um

CALIBRATION The gauge is calibrated over a ball, using the routine (described in section 5) of ***Calibration from memory for special stylus arms.***

The interconnections are as follows:

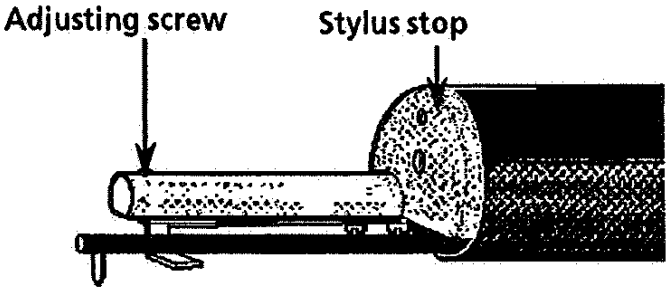
WARNING: ALL CONNECTIONS AND DISCONNECTIONS MUST BE MADE WITH THE POWER SWITCHED OFF.



STYLUS STOP FOR INDUCTIVE PICK-UP

DESCRIPTION When measuring workpieces which have interrupted surfaces, the stylus can drop into a hole or a recess. This action can disturb the position of the stylus in its socket or even cause damage to the stylus. A stylus stop attachment can be used to overcome this problem.

This accessory is attached to the end of the gauge (with the stylus removed) in the same manner as a nosepiece. The stylus is then fitted such that it is supported by the projection on the spring leaf that runs along the bottom face of the stop attachment. The the lower part of the stylus movement is, therefore, restricted. The amount of restriction is controlled by an adjusting the screw, that bears on the leaf spring.



FITTING THE STYLUS STOP In order to fit the stylus stop, the pick-up nosepiece (if fitted) must first be removed.

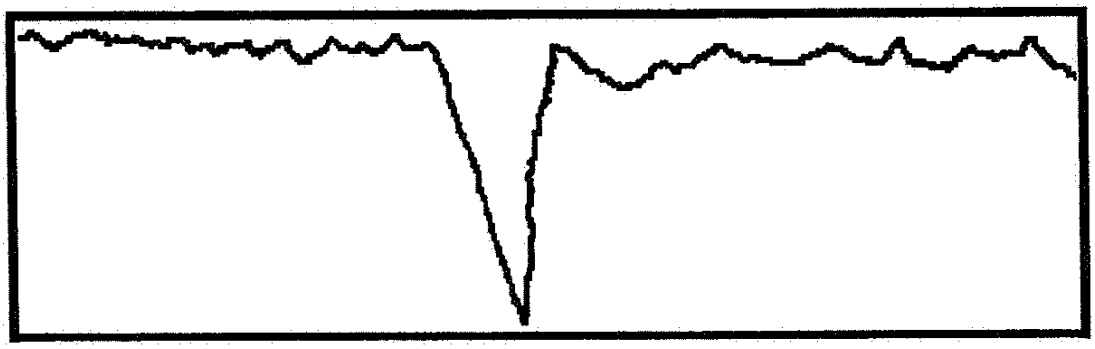
Remove the stylus.

Fit the stylus stop to the gauge, in the same manner as a standard nosepiece.

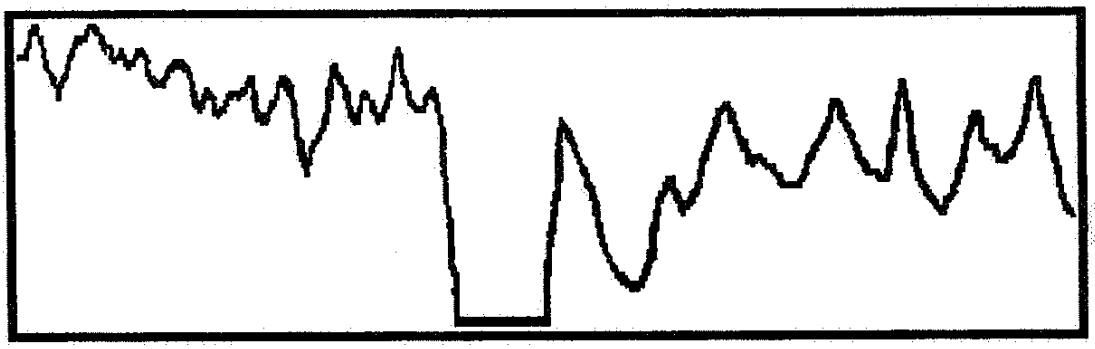
Re-fit the stylus such that the arm is supported by the projection from the leaf spring that runs along the bottom face of the stop attachment.

Turn the adjusting screw to achieve the required setting.

In addition to preventing the stylus engaging with surface interruptions, the stylus stop attachment can be used to restrict the displacement of the stylus in order to achieve screen displays of the measured profile at the highest magnification.



PROFILE DETAIL INHIBITED BY SPIKE

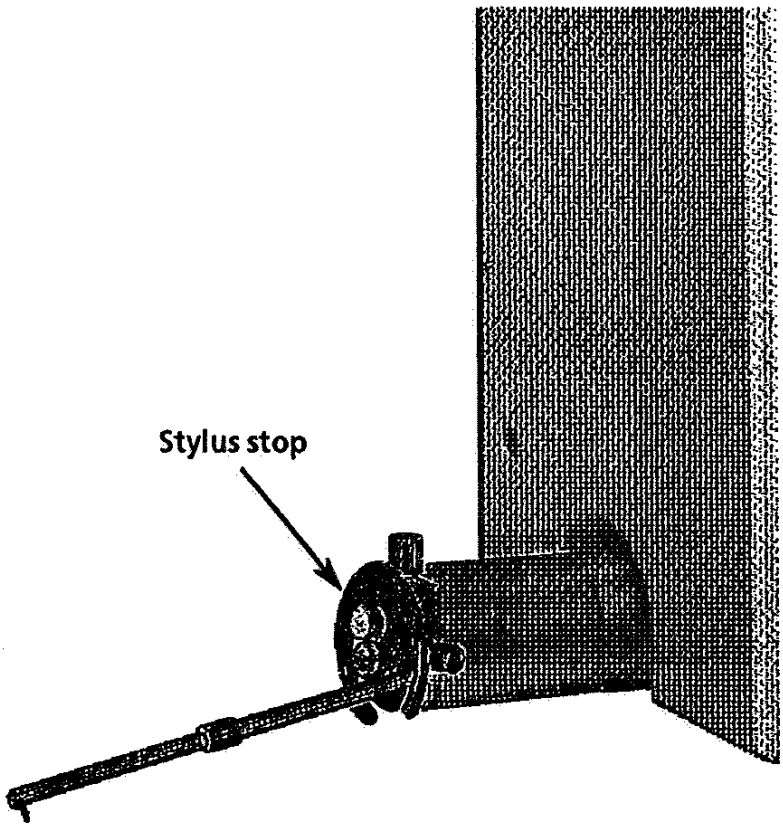


PROFILE DETAIL REVEALED BY RESTRICTING STYLUS MOVEMENT INTO SURFACE INTERRUPTION (I.E. DEEP SCRATCH).

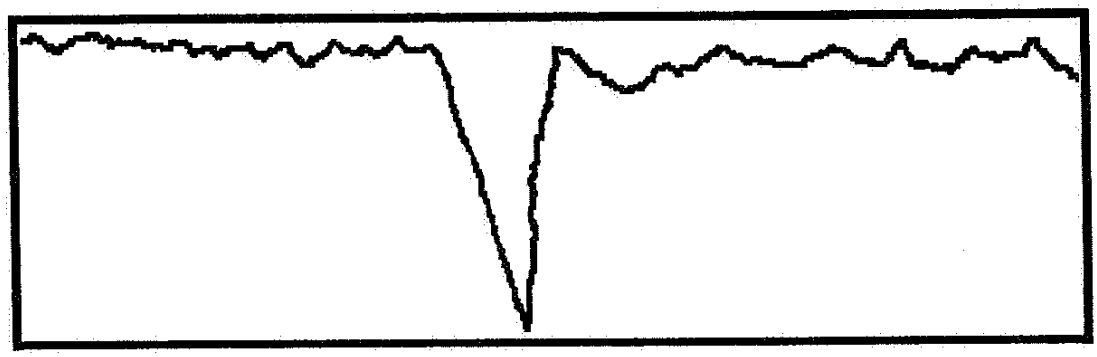
STYLUS STOP FOR LASER TRAVERSE UNIT

DESCRIPTION When measuring workpieces which have interrupted surfaces, the stylus can drop into a hole or a recess. This action can disturb the position of the stylus in its socket or even cause damage to the stylus. A stylus stop attachment can be used to overcome this problem.

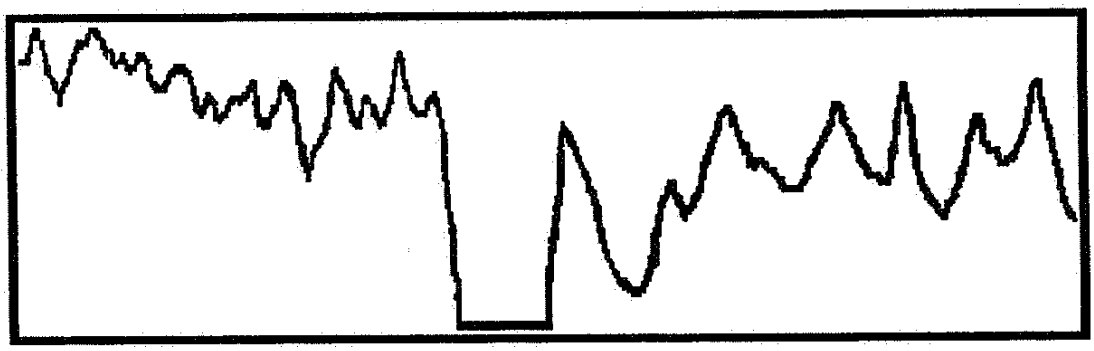
This accessory is attached to the end of the pick-up cartridge and primarily consists of a rotatable disc which is cut-away to accommodate stylus arms of two different diameters. When the stylus arm is engaged in the appropriate cut-away section, the lower part of its movement is restricted. The amount of restriction is controlled by rotating the disc.



In addition to preventing the stylus engaging with surface interruptions, the stylus stop attachment can be used to restrict the displacement of the stylus in order to achieve screen displays of the measured profile at the highest magnification.



PROFILE DETAIL INHIBITED BY SPIKE



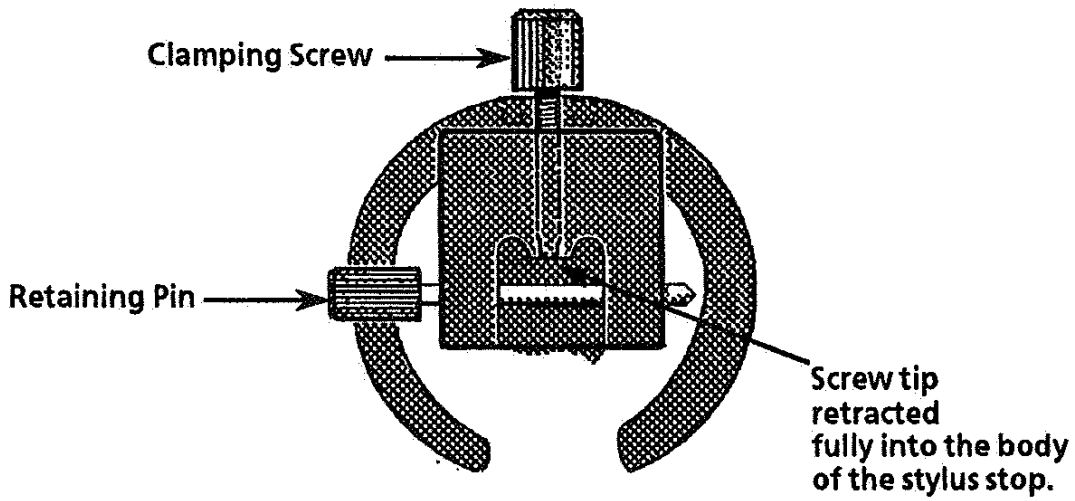
PROFILE DETAIL REVEALED BY RESTRICTING STYLUS MOVEMENT INTO SURFACE INTERRUPTION (I.E. DEEP SCRATCH).

FITTING THE STYLUS STOP

In order to fit the stylus stop, the pick-up nosepiece must first be removed.

Ensure that the stylus stop is set to its central position To check this, hold the body of the stop and rotate the disc until the central stop is encountered.

Unscrew the stylus stop clamping screw until the screw tip has retracted fully into the body of the stylus stop (seen from the back of the stylus stop).

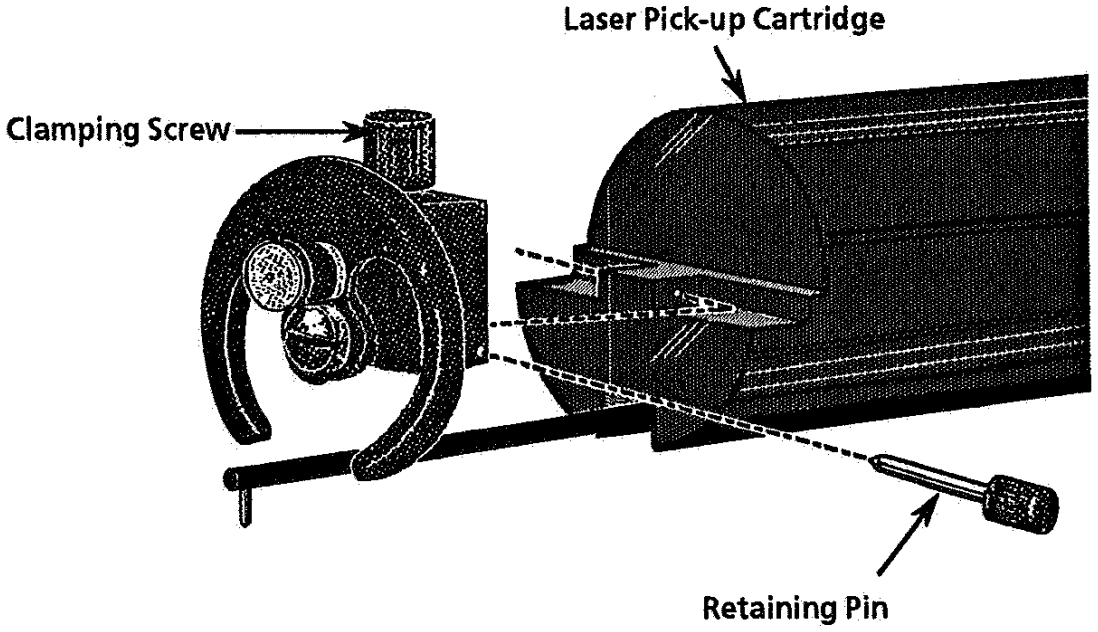


Withdraw the retaining pin.

Hold the stylus stop, with the clamp screw to the top. Place the stylus stop on the end face of the pick-up cartridge and engage the cut-out in the back of the stylus stop body with the tenon of the pick-up cartridge.

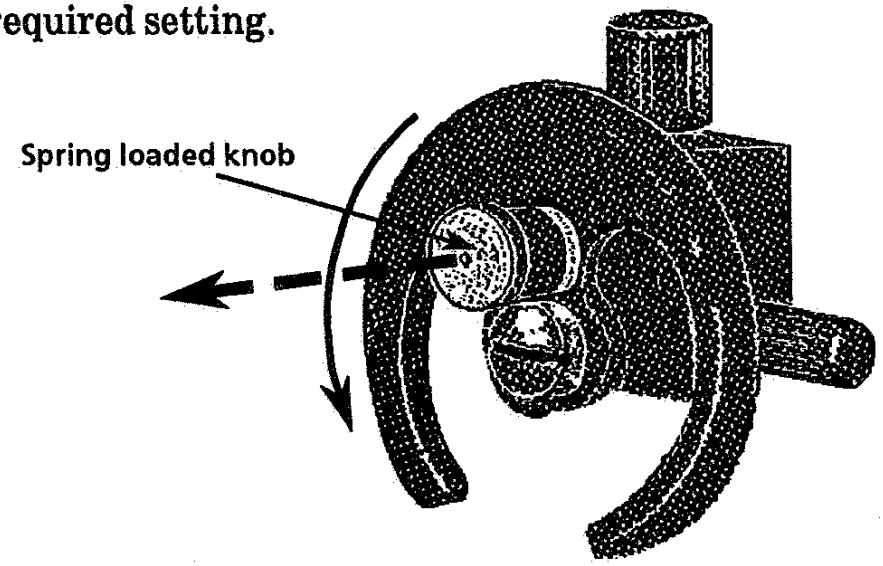
Push the stylus stop retaining pin through the hole in one side of the stylus stop body (engaging the pin with the hole in the cartridge tenon) and on through to emerge from the hole in the far side of the stylus stop body.

Screw down the clamping screw to lock the stylus stop in position.



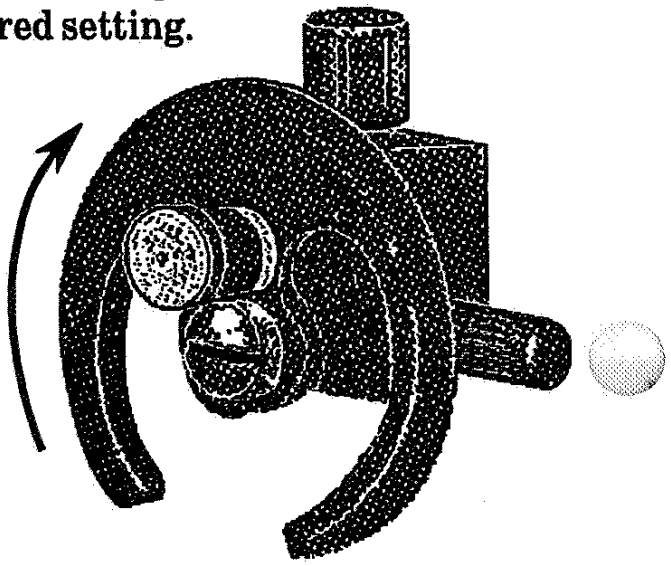
METHOD OF USE WITH 6mm RANGE STYLUS ARMS

To engage the stylus arm with the stop, pull the spring loaded knob outwards, approximately 1mm, against its spring and rotate the cut-away disc in an anti-clockwise direction engaging the stylus arm into the left-hand side cut-away section of the disc. As the disc is rotated, the lower part of the stylus movement is progressively restricted. Adjust the position of the disc to achieve the required setting.



METHOD OF USE WITH 12mm OR 15mm RANGE STYLUS ARMS

To engage the stylus arm with the stop, rotate the cut-away disc in a clockwise direction engaging the stylus arm into the right-hand side cut-away section of the disc. As the disc is rotated, the lower part of the stylus movement is progressively restricted. Adjust the position of the disc to achieve the required setting.



IMPORTANT

1. The stylus stop must always be set to its central position when fitting the stop to the pick-up and when fitting or removing a stylus arm.

2. The left-hand side cut-away section of the disc can only be accessed by pulling the spring loaded knob outwards by approx 1mm and rotating the disc (in the anti-clockwise direction) passed the central position.

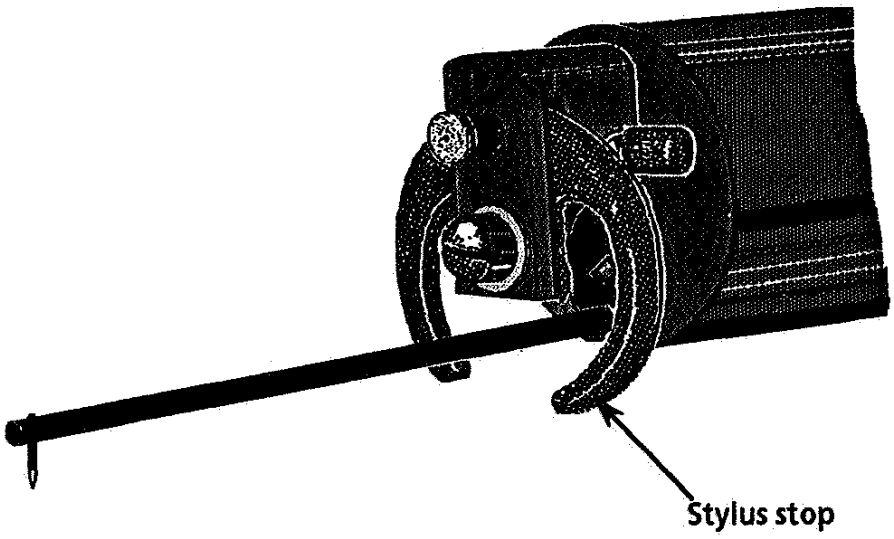
   This position is for use with the 6mm range stylus arms only and NO attempt should be made to engage a 12mm or a 15mm range stylus arm in this part of the disc.

   Failure to observe this advice may result in damage to the larger diameter stylus arms or to the pick-up.

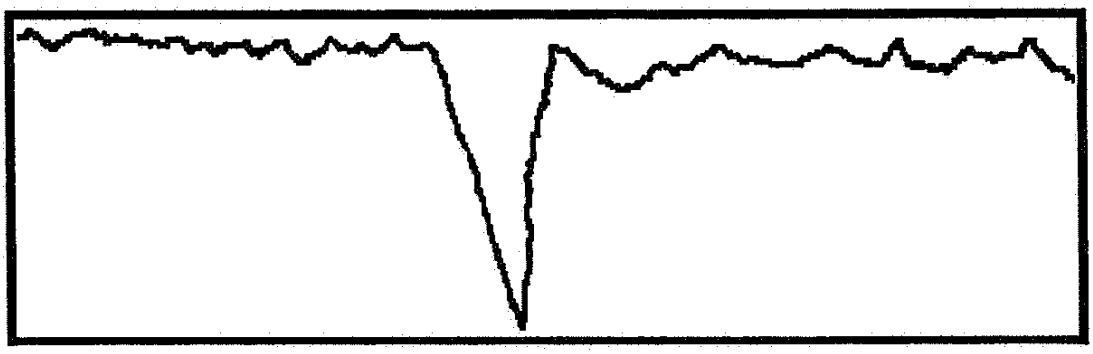
STYLUS STOP FOR PGI TRAVERSE UNIT

DESCRIPTION When measuring workpieces which have interrupted surfaces, the stylus can drop into a hole or a recess. This action can disturb the position of the stylus in its socket or even cause damage to the stylus. A stylus stop attachment can be used to overcome this problem.

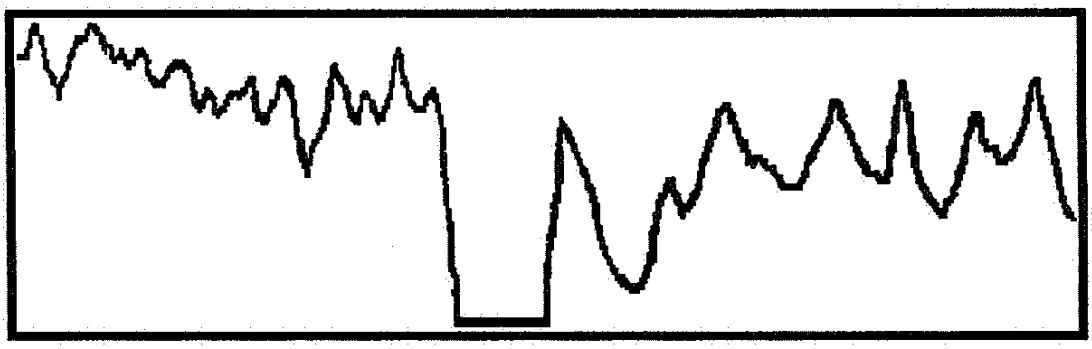
This accessory is attached to the end of the pick-up cartridge and primarily consists of a rotatable disc which is cut-away to accommodate stylus arms of two different diameters. When the stylus arm is engaged in the appropriate cut-away section, the lower part of its movement is restricted. The amount of restriction is controlled by rotating the disc.



In addition to preventing the stylus engaging with surface interruptions, the stylus stop attachment can be used to restrict the displacement of the stylus in order to achieve screen displays of the measured profile at the highest magnification.



PROFILE DETAIL INHIBITED BY SPIKE



PROFILE DETAIL REVEALED BY RESTRICTING STYLUS MOVEMENT INTO SURFACE INTERRUPTION (I.E. DEEP SCRATCH).

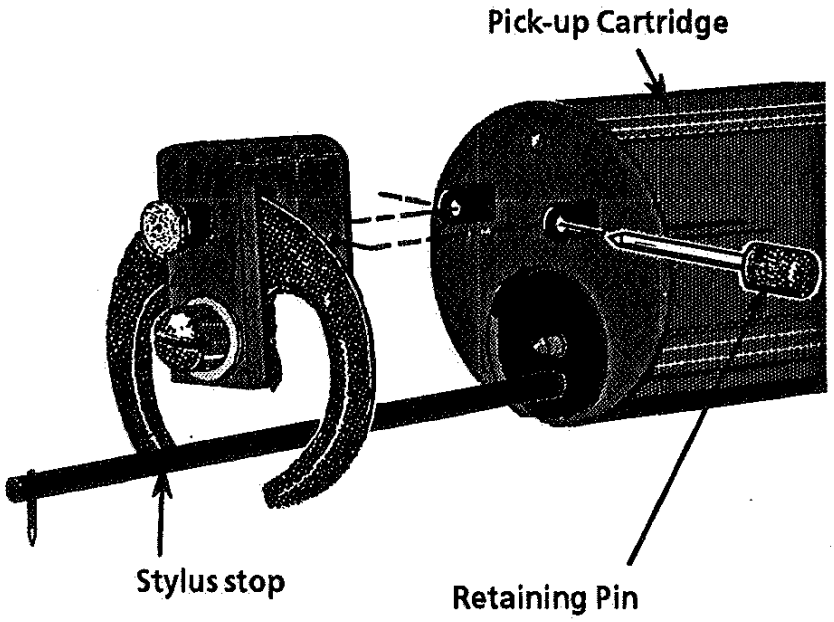
FITTING THE STYLUS STOP

In order to fit the stylus stop, the pick-up nosepiece must first be removed and the stylus required for the measurements must be fitted.

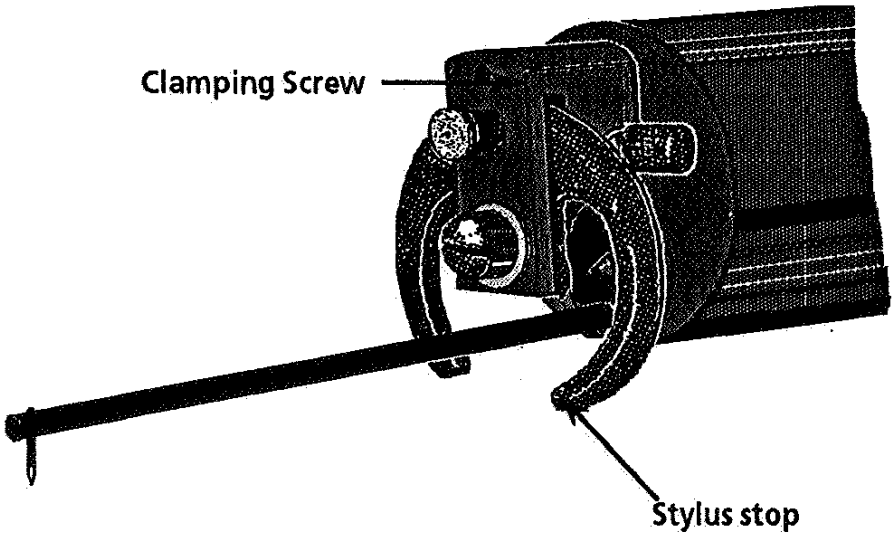
Ensure that the stylus stop is set to its central position To check this, hold the body of the stop and rotate the disc until the central stop is encountered.

Withdraw the retaining pin and place the stylus stop on the end face of the pick-up cartridge, engaging the stylus stop body between the lugs on the front face of the cartridge.

Push the retaining pin through the hole in the lug one side of the cartridge, through the hole in the stylus stop body and on to emerge from the hole in the lug on the far side of the cartridge.

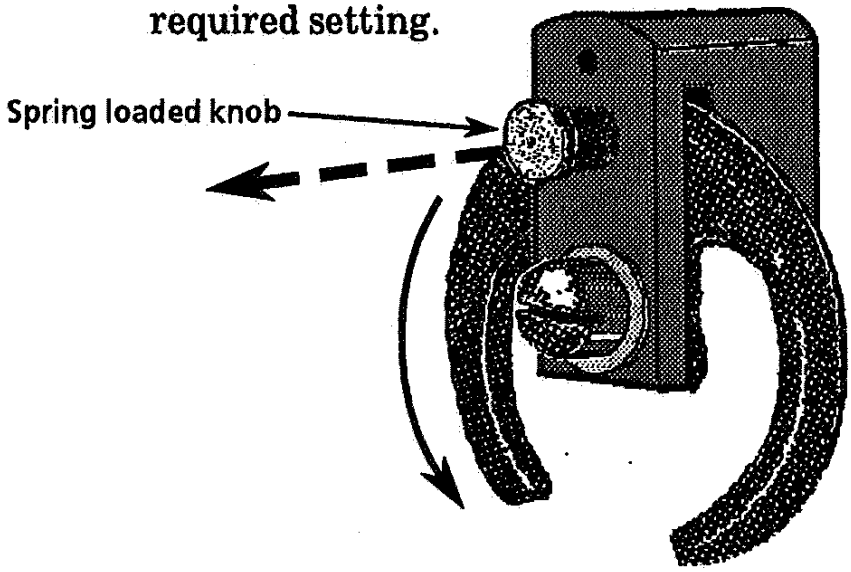


Gently screw in the clamping screw to just lock the stylus stop in to position.



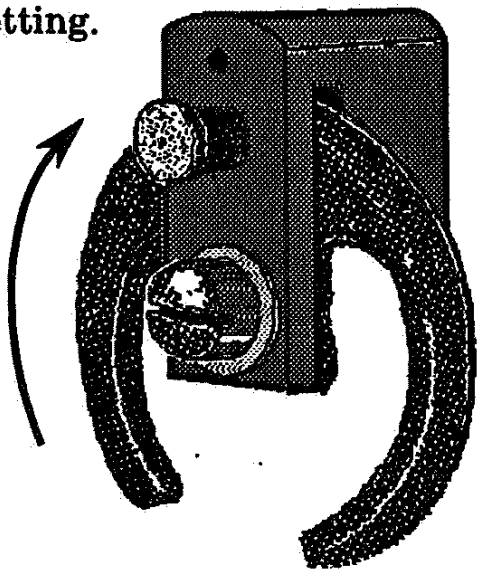
METHOD OF USE WITH 10mm RANGE STYLUS ARMS

To engage the stylus arm with the stop, pull the spring loaded knob outwards, approximately 1mm, against its spring and rotate the cut-away disc in an anti-clockwise direction engaging the stylus arm into the left-hand side cut-away section of the disc. As the disc is rotated, the lower part of the stylus movement is progressively restricted. Adjust the position of the disc to achieve the required setting.



METHOD OF USE WITH 20mm OR 25mm RANGE STYLUS ARMS

To engage the stylus arm with the stop, rotate the cut-away disc in a clockwise direction engaging the stylus arm into the right-hand side cut-away section of the disc. As the disc is rotated, the lower part of the stylus movement is progressively restricted. Adjust the position of the disc to achieve the required setting.



IMPORTANT

1. The stylus stop must always be set to its central position when fitting the stop to the pick-up cartridge.

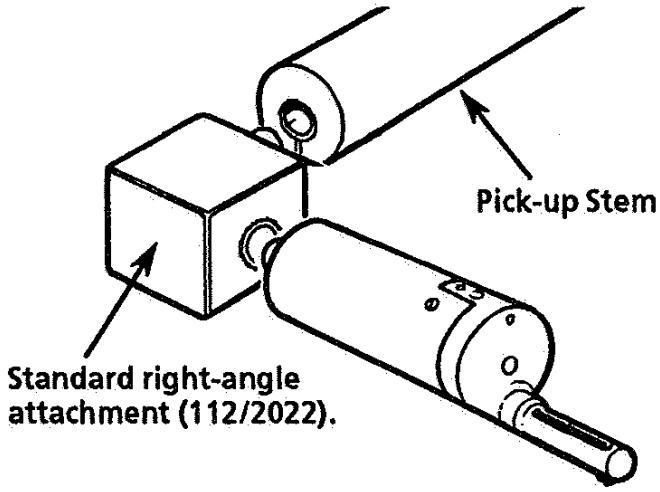
2. The left-hand side cut-away section of the disc can only be accessed by pulling the spring loaded knob outwards by approx 1mm and rotating the disc (in the anti-clockwise direction) passed the central position.

   This position is for use with the 10mm range stylus arms only and NO attempt should be made to engage a 20mm or a 25mm range stylus arm in this part of the disc.

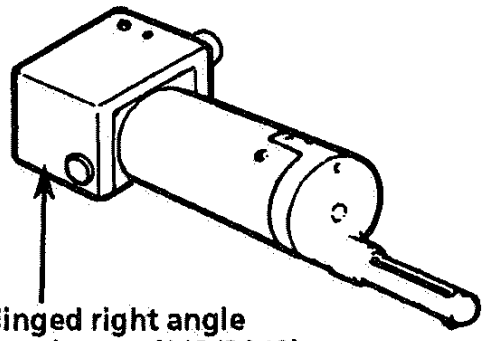
   Failure to observe this advice may result in damage to the larger diameter stylus arms or to the pick-up.

RIGHT-ANGLE ATTACHMENT

DESCRIPTION The configuration of certain components makes it necessary to traverse the inductive pick-up at right-angles to the direction of traverse and there are two attachments available which enable the pick-up to be used in this attitude. The standard unit (112/2022) is a direct right-angled connector, the other (112/2040) has a built-in hinge. These attachments have their own special right-angle nosepieces that have skids positioned transversely (parallel to the direction of the traverse). It is essential that the correct nosepiece is fitted when using the pick-up in this attitude.



Standard right-angle attachment (112/2022).



Hinged right angle attachment (112/2040).

To choose the appropriate attachment, the following must be considered:

1. **The Standard right-angle attachment (112/2022) can be assembled to a locked hinged stem, to a solid pick-up stem or to a locked Hinge unit and used for skidless measurements. It can also be assembled to an unlocked hinged stem and used with a skid nosepiece.**

   However, the standard right-angle attachment with a skid nosepiece must not be used in conjunction with a **Hinge Unit**. The Hinge Unit

movement is on a smaller radius than that of the hinged stem and is not suitable for direct right angled operation.

Measurements made with a skid nosepiece require a suitably hinged pick-up. Therefore, the standard right-angle attachment with a **skid nosepiece must not** be used in conjunction with a **a solid pick-up stem.**

2. The **hinged right angle attachment (112/2040) is for use in conjunction with a locked Hinge Unit only and should not be attached to either a hinged or a solid pick-up stem (as this arrangement can foul the underside of the traverse unit when it is retracted).**

   Measurements made without a skid nosepiece require a rigid pick-up mounting. Therefore, as the hinged right angle attachment cannot be locked, **skidless** measurements **must not** be attempted with this attachment.

The choice of right-angle attachment required for a particular measurement is determined by the method used for clamping the pick-up to the traverse unit (either via a hinged pick-up stem, a solid pick-up stem or a Hinge Unit) and the measurement mode to be used (with skid or skidless). The combinations are as follows:

WITH SKID NOSEPIECE:

Instruments fitted with a hinged pick-up stem (120mm traverse unit).

Standard right angle attachment (112/2022) the stem hinge must be **unlocked.**

Instruments fitted with a solid pick-up stem (120mm traverse unit).

Standard right angle attachment (112/2022) **must not be used in this mode.**

Instruments fitted with a Hinge Unit (120mm and 50mm traverse units).

Standard right angle attachment (112/2022) **must not be used in this mode.**

Hinged Right angle attachment (112/2040) the Hinge Unit must be **locked.**

SKIDLESS:

Instruments fitted with a hinged stem (120mm traverse unit).

Standard right angle attachment (112/2022) the stem hinge must be **locked.**

Hinged Right angle attachment (112/2040) **must not be used in this mode.**

Instruments fitted with a solid pick-up stem (120mm traverse unit).

Standard right angle attachment (112/2022).

Hinged Right angle attachment (112/2040) **must not be used in this mode.**

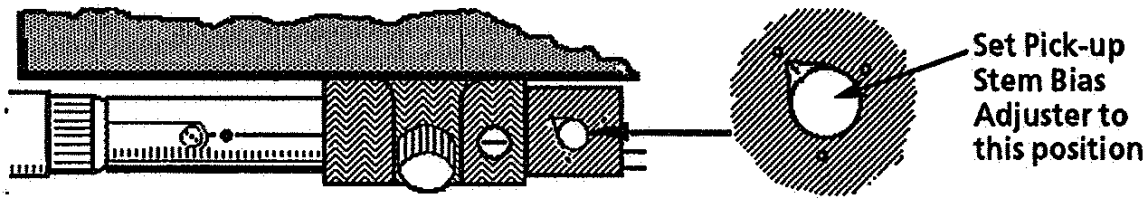
Instruments fitted with a Hinge Unit (120mm and 50mm traverse units).

Standard right angle attachment (112/2022) the Hinge Unit must be **locked.**

Hinged Right angle attachment (112/2040) **must not be used in this mode.**

ASSEMBLY

Hinged Stem If a right-angle attachment is to be used with a hinged stem, set the stem Bias Adjuster to the middle position, as shown below.



Assemble a standard right-angle attachment (112/2022) to the pick-up stem in the same manner as the pick-up is normally assembled to the stem. The pick-up is then similarly assembled to the right-angle attachment. Attach the correct nose piece to the pick-up. Alternatively, the stem hinge can be locked and the pick-up used in the skidless manner.

Hinge Unit If a right-angle attachment is to be used with a Hinge Unit, then the hinge must be locked.

Assemble the right-angle attachment to the Hinge unit in the same manner as the pick-up is normally assembled. The pick-up is then similarly assembled with the right-angle attachment. Ensure that when measuring with a skid, that the correct nose piece is fitted to the pick-up.

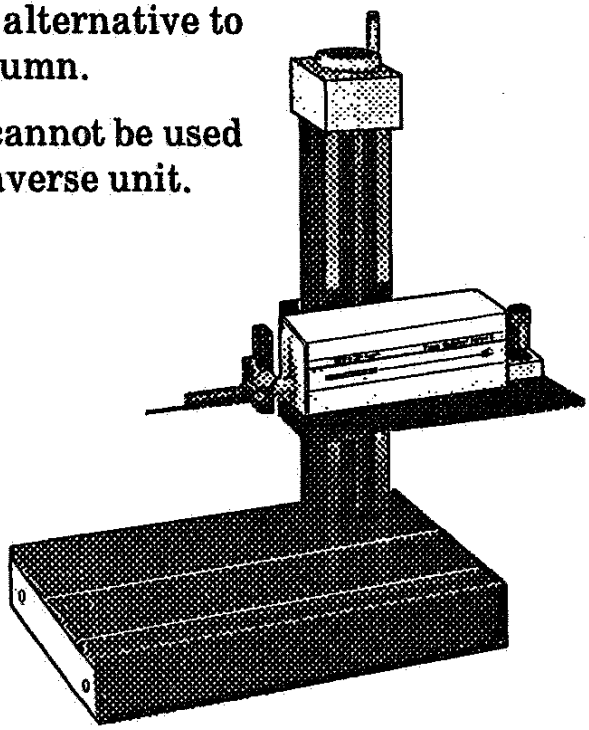
IMPORTANT When using a right angle attachment, the pick-up must first be calibrated in the normal in-line condition then, without disturbing the stylus, the pick-up should be removed from the pick-up stem or hinge unit and carefully assembled into the attachment. The attachment is then assembled in the stem or hinge unit.

NOTE When a right angle attachment is fitted, the Right Angled Gauge option must be selected on the CONFIGURATION EQUIPMENT MENU.

MANUAL COLUMN AND BASE AND COLUMN ADAPTOR BRACKET

DESCRIPTION The manual column and base (112/2093) with column adapter bracket (112/2094), provide a manually operated height adjustment stage and are for use with free standing 50mm and 120mm traverse units with inductive pick-ups. These items provide an alternative to the motorised column.

This equipment cannot be used with the laser traverse unit.



WARNING Care must be taken when moving the column and stand assembly, which is top heavy and unstable when carried. Therefore, before moving, remove the traverse unit and set the height adjustment stage to its lowest position.

Four screw-in carrying handles are supplied and these should be fully screwed into the stand and used whenever it is required to lift the column and stand assembly. It is recommended that four persons (one at each handle) are required to safely lift this assembly.

SPECIFICATION

Base:

Material:	Epoxy granite
Height:	113mm
Width:	630mm
Depth:	400mm

Column:

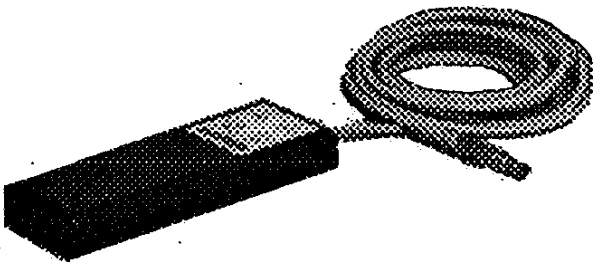
Material:	Epoxy granite
Height (including handwheel):	776mm
Traverse length:	480mm

Total Weight 100 kg (220 lbs) approx.

THE HAND HELD CONTROLLER

DESCRIPTION The hand held controller is used with free-standing systems only.

When connected to the Electronic Interface Module, the four switches on this unit give remote control of the forward and reverse/fast and slow operation of the traverse unit (in the X direction).

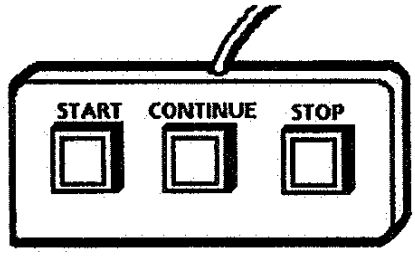


W x D x H:	140 x 55 x 25mm
Controls:	Four membrane switches
Speeds	
Fast:	5.0mm/sec Forward and Reverse
Slow:	0.5mm/sec Forward and Reverse

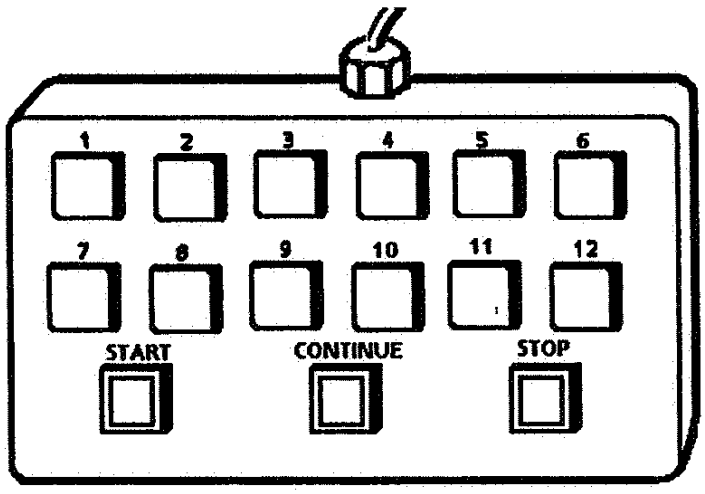
INDUSTRIAL KEYPAD

DESCRIPTION The optional accessory industrial keypad is used for the simplified operation of measurement programs. Two versions are available, one with three buttons and one with fifteen buttons.

The three button unit enables a program, selected via the keypad menu, to be run using only the START, CONTINUE and STOP buttons on the keypad.



The fifteen button unit operates as the three button unit but has twelve additional keys, each of which can be allocated a program. Pressing a key which has a program allocated, causes the program to be loaded. This can then be run using only the START, CONTINUE and STOP buttons on the keypad.



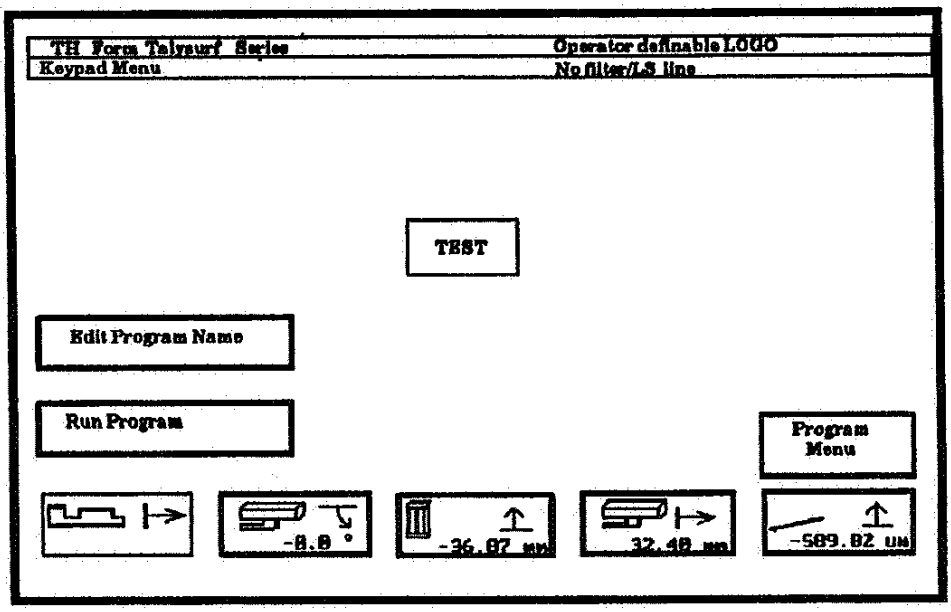
START Pressing this button causes the program to start,

CONTINUE Pressing this button causes the program to re-start after an interruption.

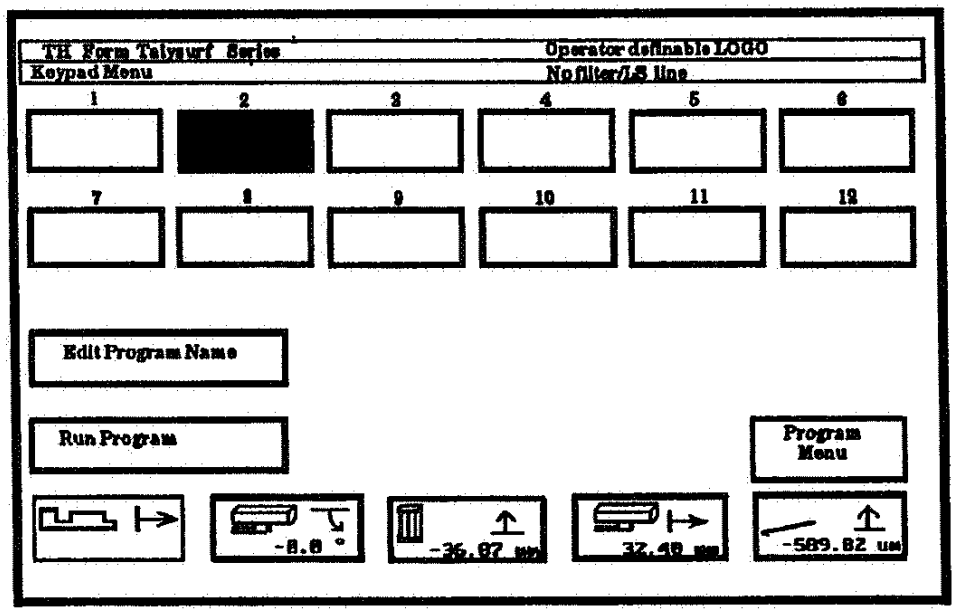
STOP Pressing this button will cause the program to stop (normally on completion of the current action).

When the industrial keypad is connected to the system, the program which was last in use (and properly exited) is automatically loaded on startup and one of the following menus is displayed.

Three button keypad Menu



Fifteen button keypad Menu



The PROGRAM option, of the **MAIN MENU** is renamed KEYPAD (the functions of this option remain the same). Without the keypad, the computer runs the standard Form Talysurf Series program.

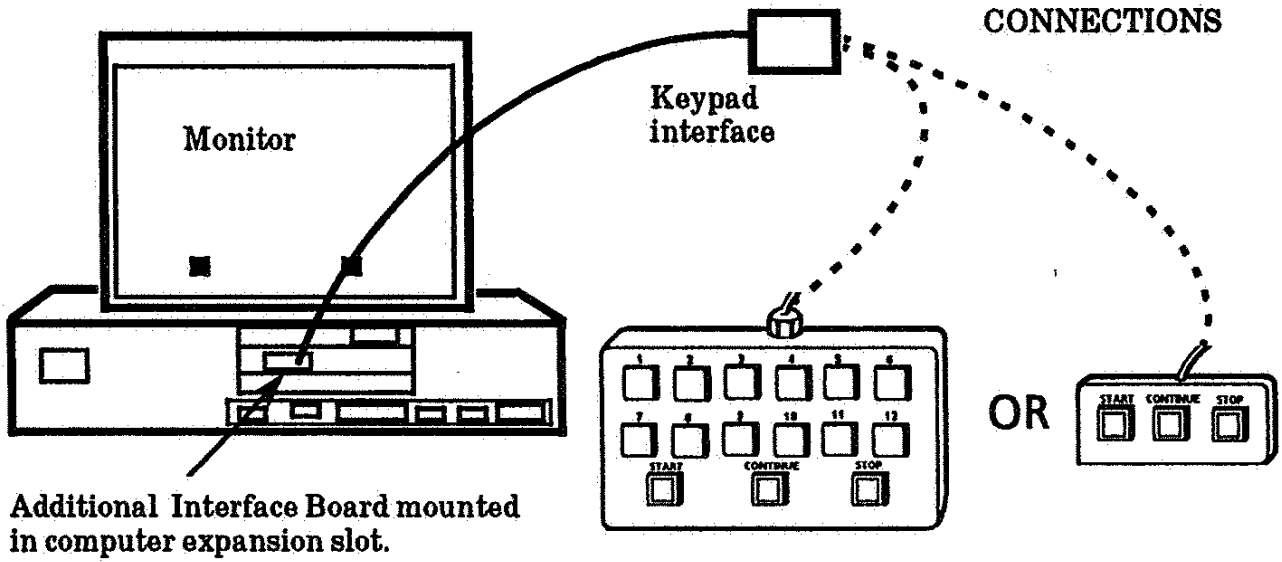
The options on the **KEYPAD MENU** are as follows:

EDIT PROGRAM NAME When the three button unit is fitted and this option is selected, the operator is prompted to enter the name of the next program to be run. This can be any program stored in the current directory. After selection, the name of the current program is displayed in the box in the centre of the menu.

When the fifteen button unit is fitted and this option is selected, then a numbered box on the menu must be selected (either by using the mouse to select the box on the screen or by pressing the related button on the keypad).

The operator is prompted to enter the name of the program to be allocated to this keypad button. This can be any program stored in the current directory.

RUN PROGRAM Selecting this option causes the current program to be run (as pressing the START button on the keypad).



Additional Interface Board mounted in computer expansion slot.

HP LASERJET PRINTER

DESCRIPTION The Hewlett Packard Laserjet 5P can be supplied as an optional accessory and provides an alternative or addition to the DP7000. Results printouts are output to fit on *A4* or *Letter* size paper.
Details of operation and specification are provided in the manufacturer's handbooks.

Versions are supplied appropriate to the country in which it is to be operated:

112/2696 E	for use in the U.K.
112/2696 F	for use in France
112/2696 G	for use in Germany
112/2696 I	for use in Italy
112/2696 S	for use in Spain
112/2696 U	for use in the U.S.A. and Canada.

IMPORTANT

1. Do **not** load the printer driver software supplied with the Laserjet 5P laser printer. The printer drivers required for use with Taylor Hobson equipment, are included and loaded with the instrument software.

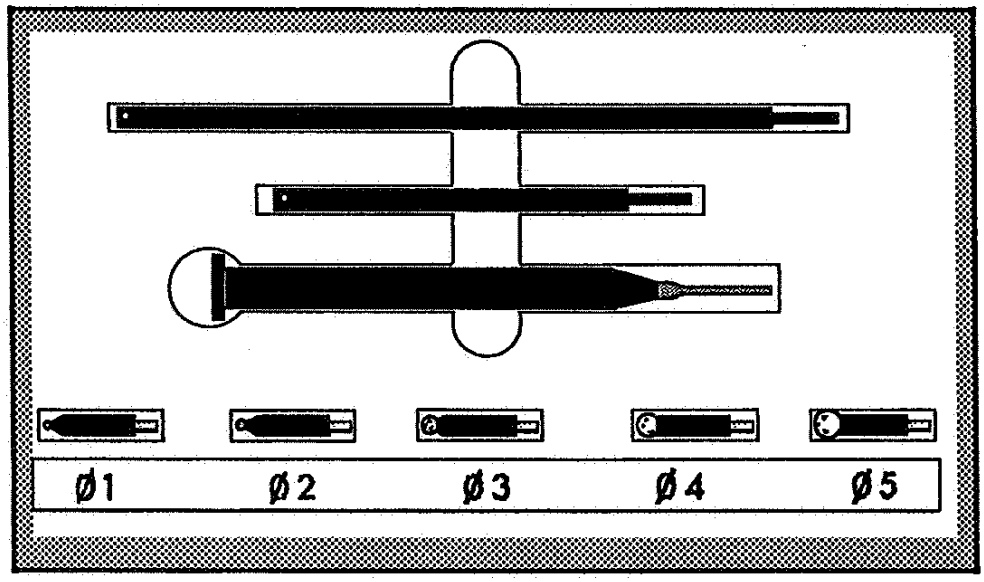
2. Use only the lead supplied with the Taylor Hobson equipment to connect the printer to the parallel port of the computer. Do not use the lead supplied with the printer

For further details on the laser printer, refer to the manufacturer's handbook supplied.

THE BALL STYLUS KIT
(NOT FOR USE WITH P.G.I. GAUGE)

DESCRIPTION The stylus kit comprises one 120mm beam, one 60mm beam, five interchangeable ball styli (from 1 to 5mm diameter) and a small screwdriver.

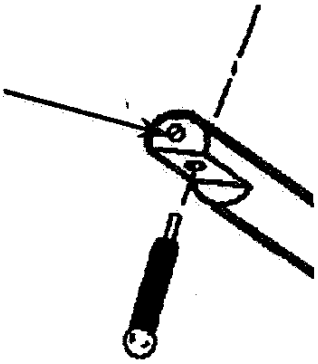
A stylus produced with the kit can be used with the laser pick-up or an inductive pick-up without skid nosepiece.



FITTING A STYLUS Select the beam required and, using the screwdriver supplied, withdraw the locking screw in the end of the beam until the hole for the stylus pin is clear.

Insert the pin of the selected stylus fully into the hole in the beam, from the flat side of the beam.

Lightly tighten the locking screw to just clamp the stylus.



ENTERING STYLUS DETAILS

The details of the stylus and beam must be entered into the GAUGE INFORMATION MENU. This is done as follows:

From the GAUGE INFORMATION MENU, select the **CHANGE GAUGE** option. From the options then offered, select ENTER STYLUS. Type SPECIAL and press the return key. The message:

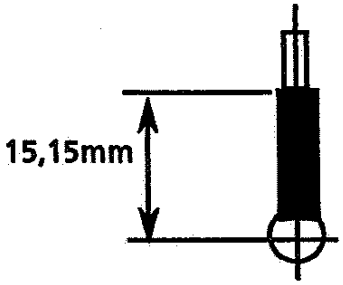
Couldn't find that stylus
Enter customer parameters (y/n) ?

Enter Y. The option to enter the stylus length is then displayed. Enter either 60 or 120 as appropriate to the stylus beam selected. The option to enter the stylus tip radius is then displayed. Enter the **radius** (not the diameter) of the selected stylus.

CALIBRATION

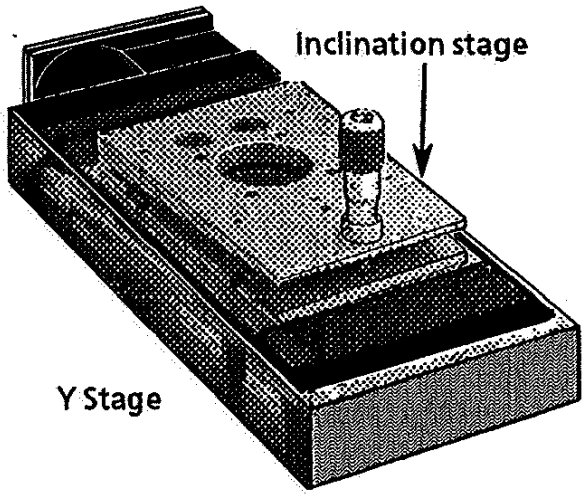
Gauge calibration is is carried out as described in section 5 of this handbook and requires an 80mm radius standard. The acceptable form error being $\lessdot 0.5\mu m$.

SPECIFICATION

Nominal active length of beams:	60mm and 120mm
Radii of Sapphire balls:	0.5mm, 1mm, 1.5mm, 2mm and 2.5mm.
Stylus force:	Does not exceed 3.0 gf with any combination of beam and stylus.
Depth from beam to ball centre:	

THE Y AXIS STAGE

DESCRIPTION This optional accessory provides computer controlled, Y axis traversing of the component. It is particularly useful when combined with the optional 3D analysis software, for the analysis of mapped surfaces. An optional inclination stage is available to provide a tilt facility.



A stepper motor, ensures accurate trace length and sample spacing when data logging parallel profiles for surface mapping. The positional displacement of the stage is controlled through computer software.

The stage can be located in tee slots of the base unit. Alternatively, it can be free standing, at any angle to the normal direction of traverse.

The unit is supplied with a motor controller/driver unit.

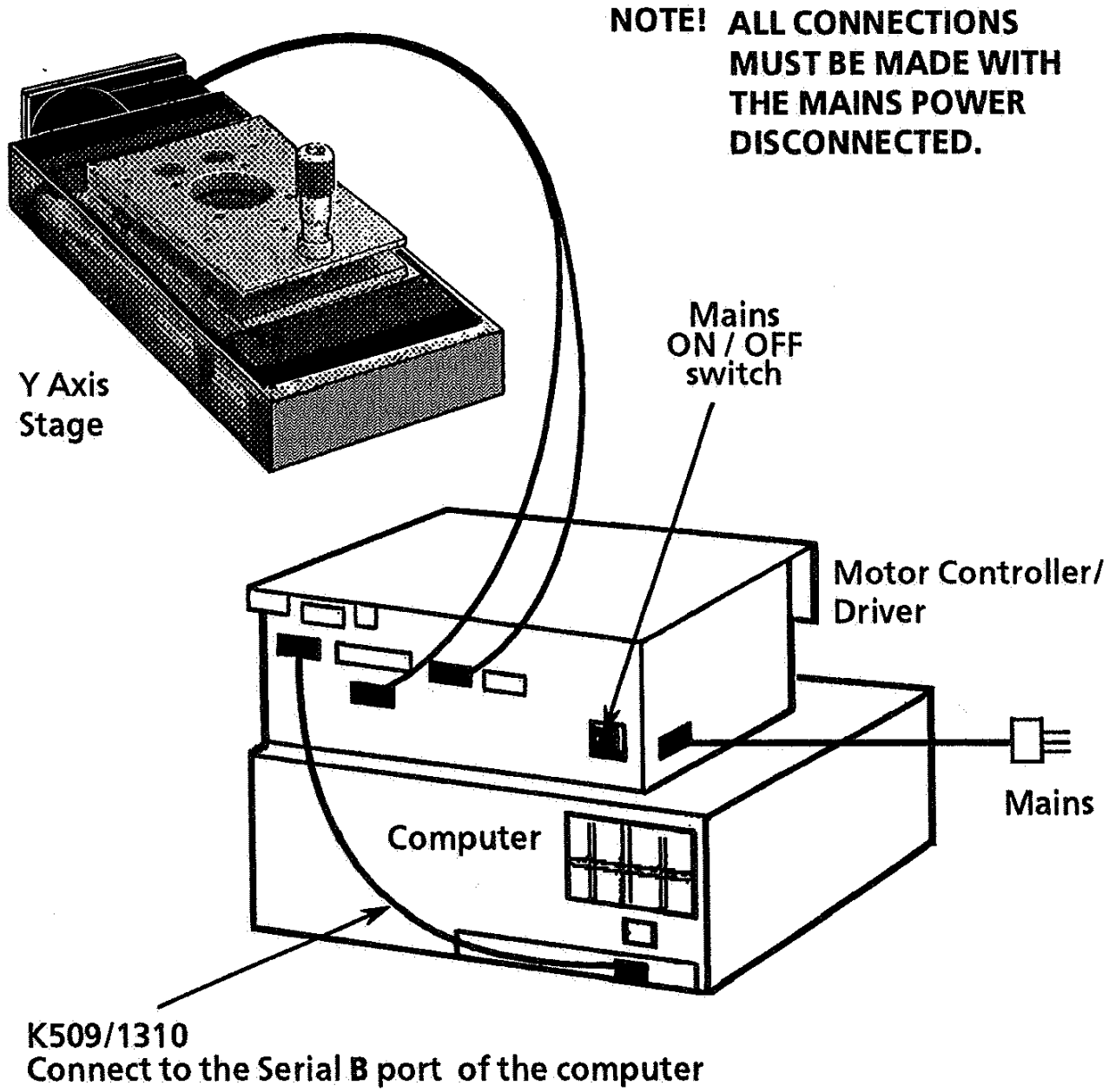
WARNING The stage is normally operated under the control of a computer program and, when in operation, can move without warning. Therefore, **Keep fingers clear of the table when it is in operation.**

CAUTION The operation of the Y axis table is **NOT** affected by pressing the **stop button** on the Electronic Interface Module or by the occurrence of a ***Gauge Out of Range*** condition. Once commenced, a table move operation will continue until it is completed.

SPECIFICATION

Y Axis Stage	Stroke length:	50mm (1.97 in)
	Minimum Step:	1µm (39.4 µin)
	Straightness:	±2µm (±78.8 µin) over 50mm
	Pitch:	<12 arc secs
	Yaw:	<6 arc secs
Optional inclination stage	Tilt	± 2.3°

INTERCONNECTION DIAGRAM

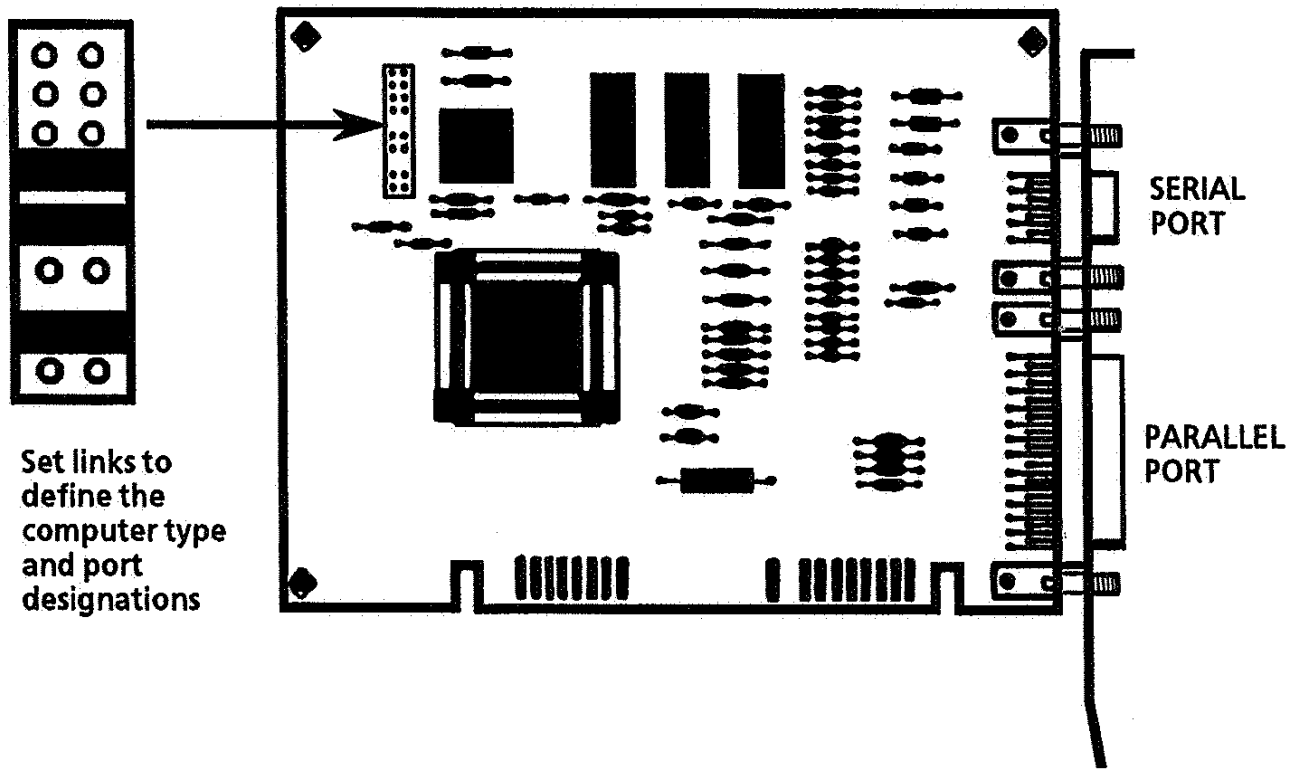


ADDITIONAL SERIAL / PARALLEL PORTS

DESCRIPTION To accommodate the range of printers supported by the Form Talysurf software, additional serial and parallel ports can be added to the computer of PC based systems. These are mounted on an interface card which carries one serial port and one parallel port.

INSTALLATION The interface card must be fitted into an available expansion slot of the computer system unit, in accordance with the computer manufacturer's instructions.

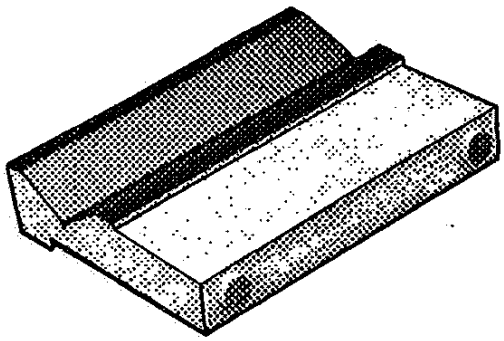
Prior to installing a card into the computer, link settings which define the computer type and port designations (normally LPT2) must be made. These are made by positioning jumper links on the pins located at the top left-hand side of the card. These must be set in accordance with the manufacturer's instructions.



WORK HOLDING ACCESSORIES

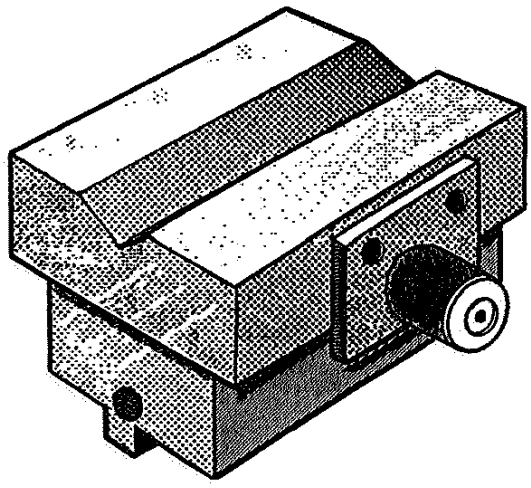
Plain Vee block 112/1283

This is a simple aid for rigidly supporting cylindrical components.



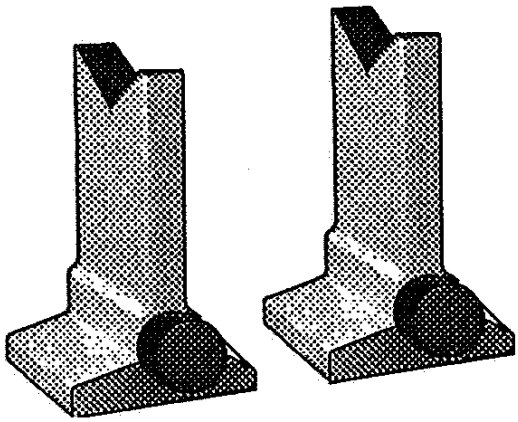
Adjustable vee block 112/1326

This accessory has 40mm (1.5in) of lateral adjustment and is particularly useful for bringing the crest of a cylindrical workpiece directly under the stylus and into line with the axis of the pick-up traverse



150mm (5.9in) Vee block (pairs) 112/1645

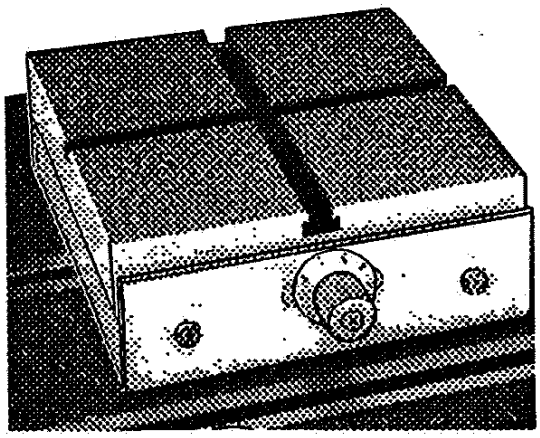
This vee block is supplied in pairs for supporting components such as crankshafts, which cannot be easily supported on other types of vee block. A tee slot lock is provided to enable the vee block separation distance to be maintained.



Y Axis table 112/1826

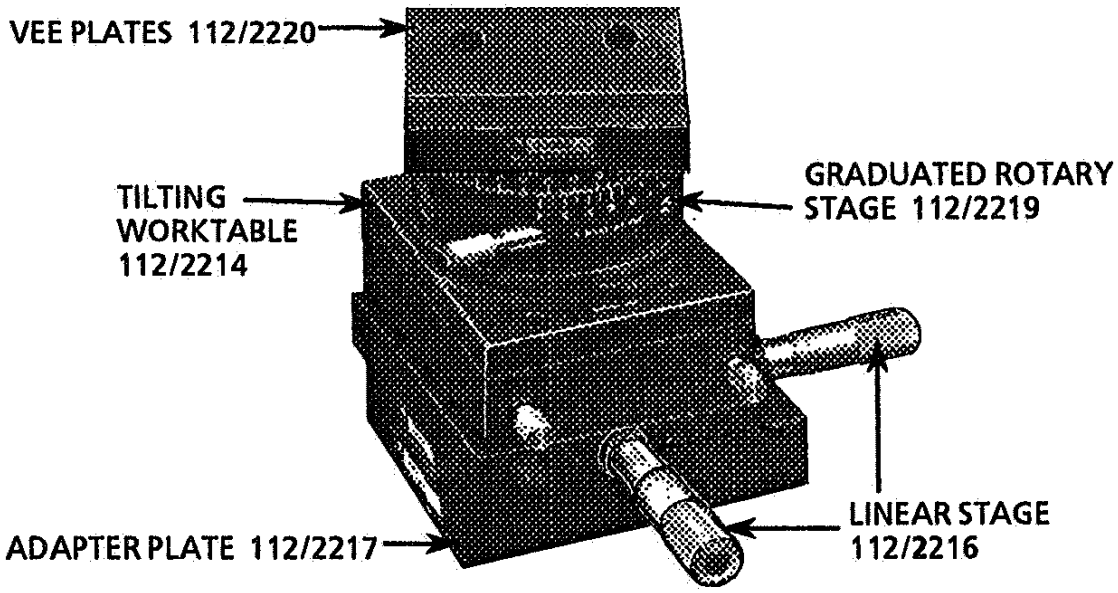
This accessory comprises a 200mm (7.87in) square table which can be manually traversed, by rotating a small knob, to provide 10mm (0.39in) lateral adjustment of a workpiece weighing up to 20kg (44lb).

The Y axis table can also be used with the adjustable vee block 112/1326 to position a cylindrical workpiece at right angles to the direction of pick-up traverse



Work mounting accessories

The work mounting accessories can be used individually or together, in various combinations, to provide the movement required.



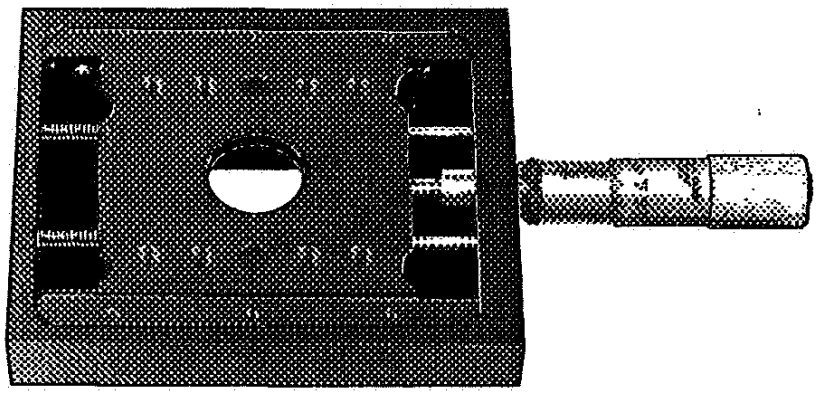
25mm (1in) LINEAR STAGE. 112/2216

This micrometer stage provides 25mm (1in) of linear movement in one axis. Two of these stages can be combined to provide movement in both X and Y axes (as shown above).

Overall dimensions: 20mm high, 100mm wide, 120mm long, (205mm over micrometer).

Weight: 0.9kg(0.75 lbs)

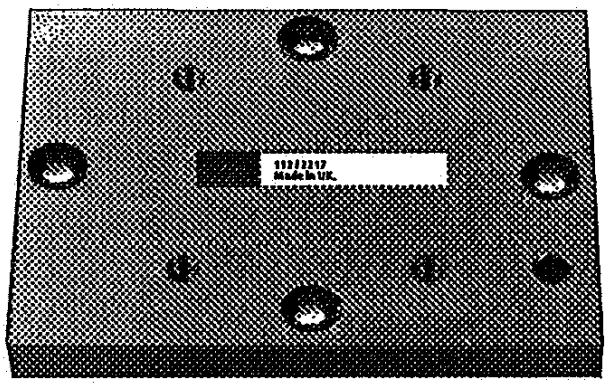
Maximum load capacity: 2kg (26lbs).



ADAPTER PLATE FOR 25mm (1in) LINEAR STAGE. 112/2217

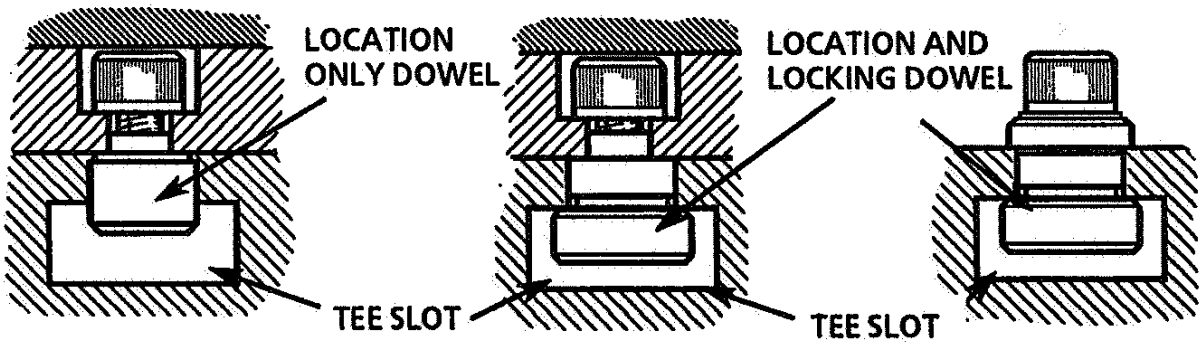
The adapter plate can be attached to the 25mm (1in) linear stage to provide tee slot locations for use with the location dowels 112/2215 (see below). This provides the stage with either just positive location in the tee slots of a base plate or with location and locking into position in a tee slot.

Overall dimensions: 10mm high, 100mm wide, 120mm long, (0.39in x 3.94in x 4.72).



LOCATION DOWELS 112/2215

Supplied under this code number are two types of dowels. These can be attached, as appropriate, to various workholding accessories to provide either tee slot location only or tee slot location and locking. Locking dowels can also be used as tee slot stops, to provide locations, on a base plate, for free standing workholders or components.



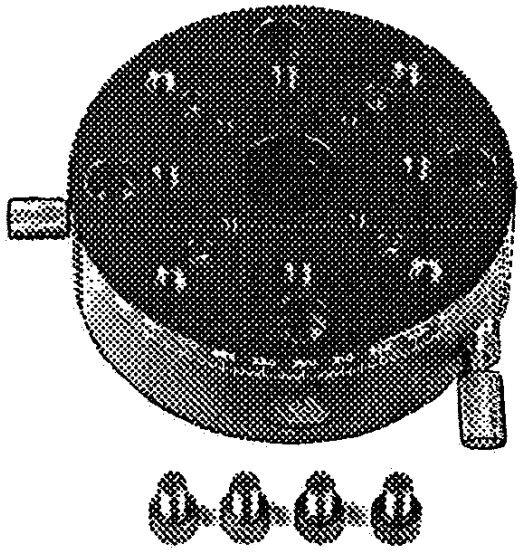
ARRANGEMENT FOR LOCATION ONLY OF WORKHOLDER

ARRANGEMENT FOR LOCATION AND LOCKING A WORKHOLDER

ARRANGEMENT FOR USE AS A TEE SLOT STOP

GRADUATED ROTARY STAGE 112/2218

This stage can be rotated, by hand, through 360 degrees and is lockable in at any position: 5 degrees of fine adjustment, graduated to 0° 5′ are then available.

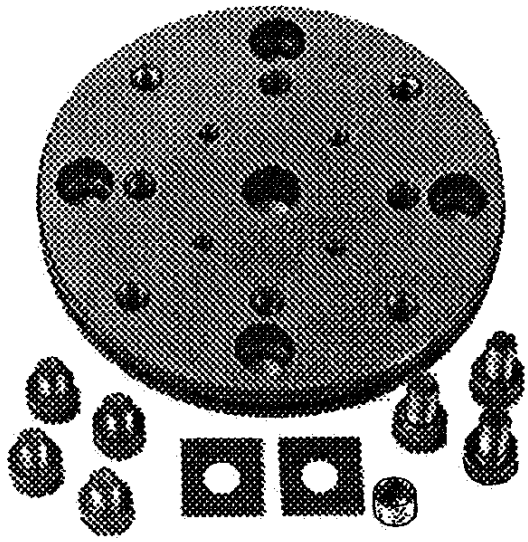


Work mounting area: 89mm diameter (3.5in) with 8 M6 mounting holes on 25mm (1 in) centres and 4 M3 mounting holes on 35mm (1.38 in) centres about a central location hole.

Height: 37.5mm (1.48 in)

SIMPLE ROTARY STAGE 112/2219

This stage can be clamped on the graduated rotary stage or mounted on the tilting worktable..



Overall dimensions: 89mm diameter x 10mm high (3.5 in dia. x 0.39in high).

Weight: 0.5kg (1.1 lbs).

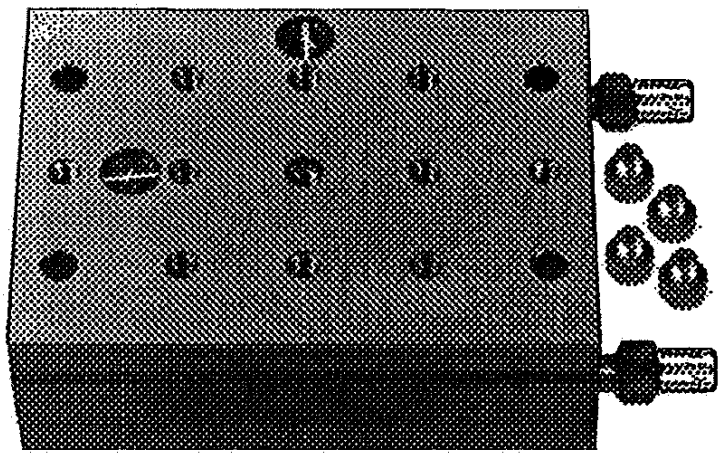
Range: 360° not graduated.

Height: 10mm (0.39 in).

TILTING WORKTABLE 112/2214

The surface plate of this worktable can be manually tilted in two planes, to provide component levelling.

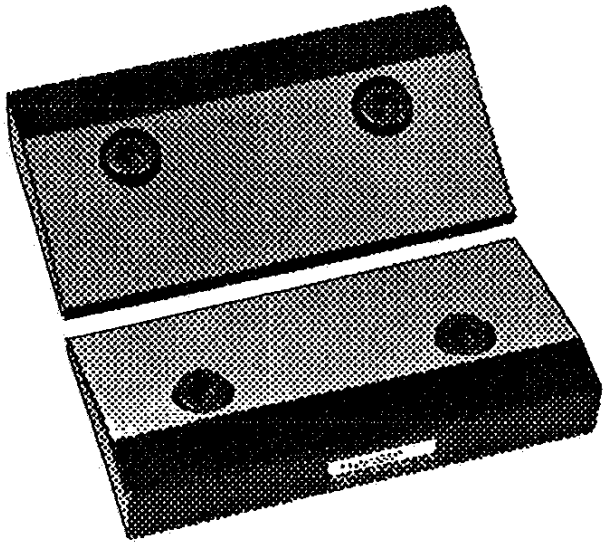
Work mounting area:	89mm x 120mm (3.5 in x 4.72 in) with 10 M6 mounting holes on 25mm (1 in) centres.
Height to work surface:	40mm (1.57 in) nominal.
Overall dimensions	40mm high x 89mm wide x 143mm long (to adjustable knob) (1.57 in x 3.5 in x 5.63 in).
Range:	2.5° (±1.25°) for both axes.
Load capacity:	2.3kg (5 lbs).
Weight:	1.6kg (3.4 lbs).



VEE PLATES 112/2220

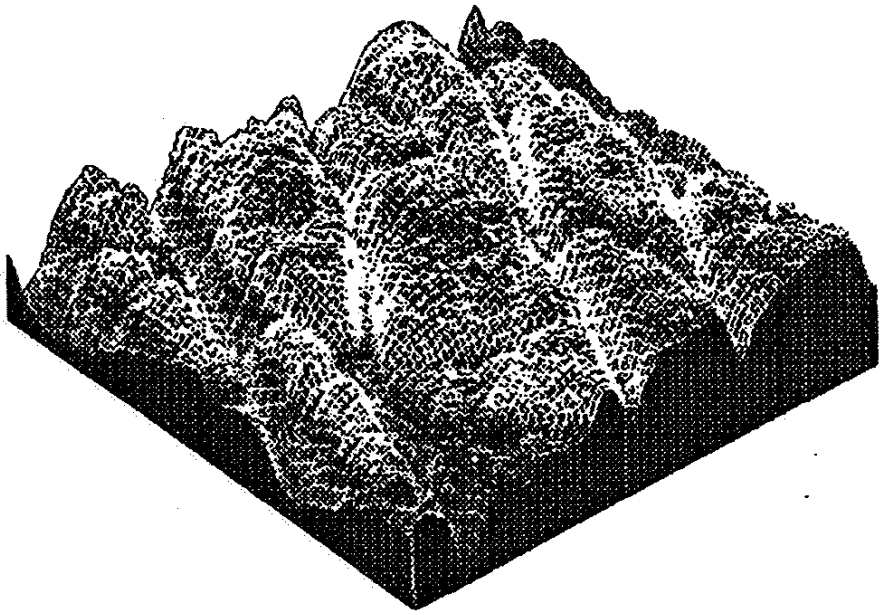
Two angled plates can mounted on either of the rotary stages to form a 140° vee block.

Overall dimensions	89mm (3.5 in) square x 16mm (0.63 in) high x 3.5mm (0.14 in) to the intersection of the angled surfaces from the seating face.
Weight:	0.7kg (1.6 lbs).



TALYMAP

DESCRIPTION TalyMap is a software package which accepts the results data from a selected number of sequential parallel conventional two dimensional measurements and generates a three dimensional image of the surface.



The displayed surface can then be manipulated in various ways enabling critical studies of individual features to be made. Visual display options include:

- Rotation and tilt of the angle of view.
- Slice level options.
- 3D wire or continuous images.
- Photographic simulation.
- Zoom for studying close detail.
- Contour colour/height discrimination levels.
- Pattern recognition defined with colours.
- Alignment of axes.
- Inversion of surface heights, for the the study of moulds or imprints.

Analysis functions include:

- Volumetric calculation, for quantifying the volumes of surface holes, grooves, user inverted peaks etc.

- A 2D slice through the 3D surface can be extracted. The slice can be of any shape and enables specific features to be extracted and viewed separately.
- Filtering, to allow the waviness and roughness components to be separated from the raw surface.
- Material distribution by depth definition.
- Separation of features/discreet points.
- Bearing area curve calculation.
- 3D parameter calculation.
- Distance measurement.
- Levelling to correct component set-up errors.

In addition to the 3D representations, calculations of a large number of statistical parameters, both on 2D profiles and on 3D surface areas (dependent on software package) are available.

COMPUTER TYPES TalyMap 3D software is available in two versions, providing different levels of performance. One version runs on suitable IBM compatible PCs, the other on suitable Apple Mackintosh computers.

The IBM compatible version (code number S112/2635-01) can be run on a separate PC or utilise the computer of the measuring system for both data gathering and analysis. This package provides a full surface topography analysis but does not include the enhanced software capabilities of the desk top publishing and macro facilities included with the Apple Mackintosh version.

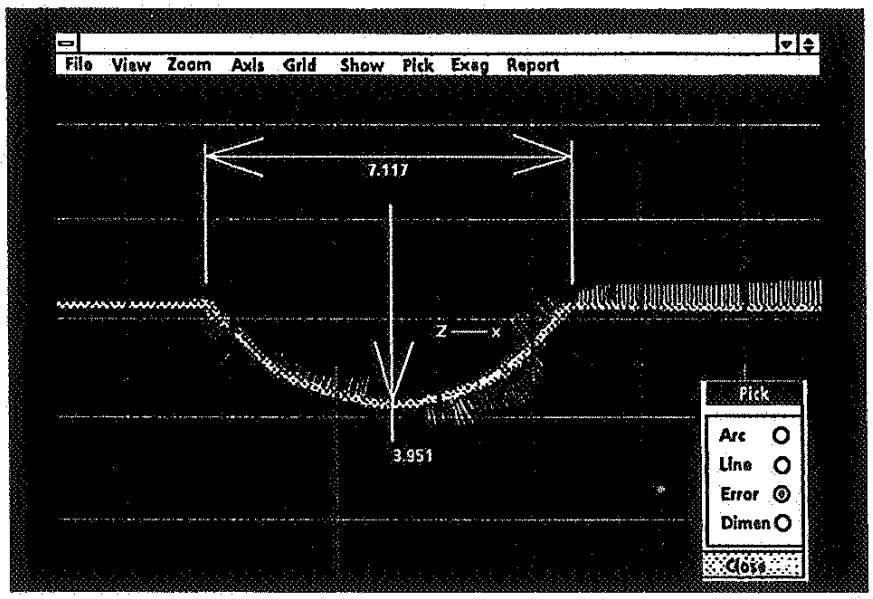
The Apple Mackintosh package (code number S112/2635-02) includes full desk top publishing facilities for the presentation of evaluation reports. This package also has a number of facilities not included in the package for IBM compatible PCs.

Full details of these packages and the minimum hardware requirements can be obtained from Taylor Hobson or its agents.

CONTOUR

DESCRIPTION Contour is a software package for the inspection of two dimensional profile data. The source data can be derived from measurement results obtained from the Form Talysurf instrument or from software generated profiles (such as from CAD or CAM systems). The data files can be in ASCII, DFX, Binary or Contour format.

The form data is inspected by collecting a number of data points from over the form and fitting lines and arcs through these points, to create the contour. This can then be dimensioned. The results are displayed on the screen, in colour coordinated forms which can be output to a colour printer or plotter (Hewlett Packard Graphics Language compatible).



When measuring components of an unknown contour, the Contour software has the ability to fit geometric elements to the profile and to determine the size, position and the relationship between various features. Using *best fit* techniques, the geometric elements of a known contour form can be related to a reference template. Comparisons can

then be made for each point of the contour against the nearest element of the template.

The Contour package is run on an IBM compatible PC as a Microsoft Windows™ application program.

The minimum hardware and software required to run this utility successfully is:

An IBM (or compatible) personal computer with Intel 80486DX processor running at 25Mhz with 4MB of memory, 3MB of free hard disc space and a 1.44MB floppy disc drive.

MS-DOS ® 3.1 or later

Microsoft Windows 3.1 or later.

MS-DOS ® and Microsoft Windows ™ should be installed on the personal computer, as detailed in the manufacturers instructions.

The methods of choosing and selecting items are as for any Windows application (Refer to the Microsoft Windows Users Guide).

POWER DENSITY

DESCRIPTION When included, the optional Power Density parameter provides an analysis which reduces the measured surface data to a series of sine waves (harmonics) and plots the squares of the amplitudes of the sine waves (Power Density) against their wavelengths. The results are displayed as a histogram which can also be printed-out. A print-out of this data in tabular form can also be obtained.

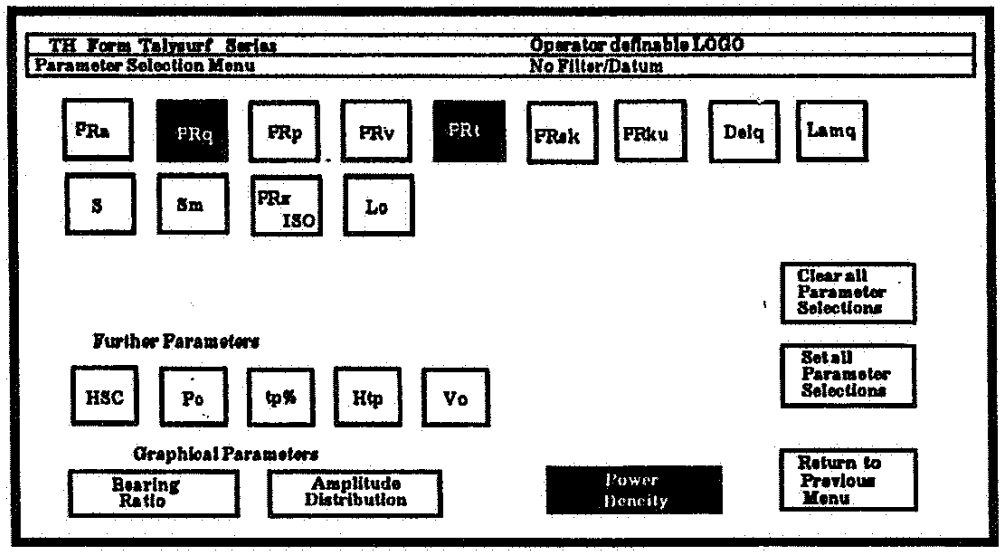
Up to 500 harmonics can be assessed, the smallest resolvable difference between the wavelengths of adjacent harmonics being 2µm. The assessment requires a minimum of 2000 data points.

This analysis is particularly useful in the measurement of repetitious surface characteristics (such as machine tool feed marks).

The procedure for making a Power Density analysis from a direct measurement or from stored data, is as for a standard analysis with the following differences:

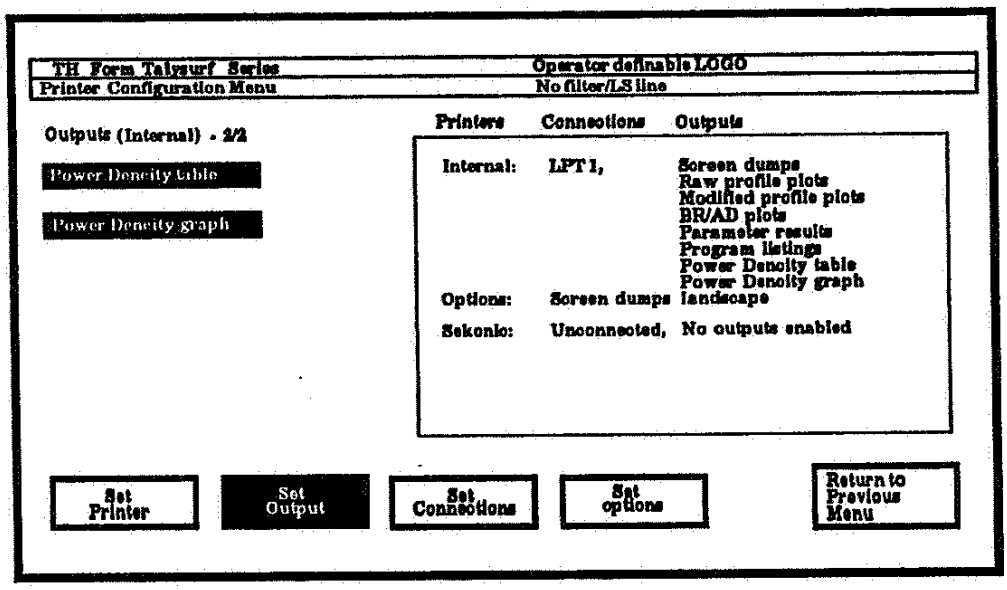
1. From the PARAMETER SELECTION MENU, select the **Power Density** option.

PARAMETER SELECTION MENU WITH POWER DENSITY OPTION



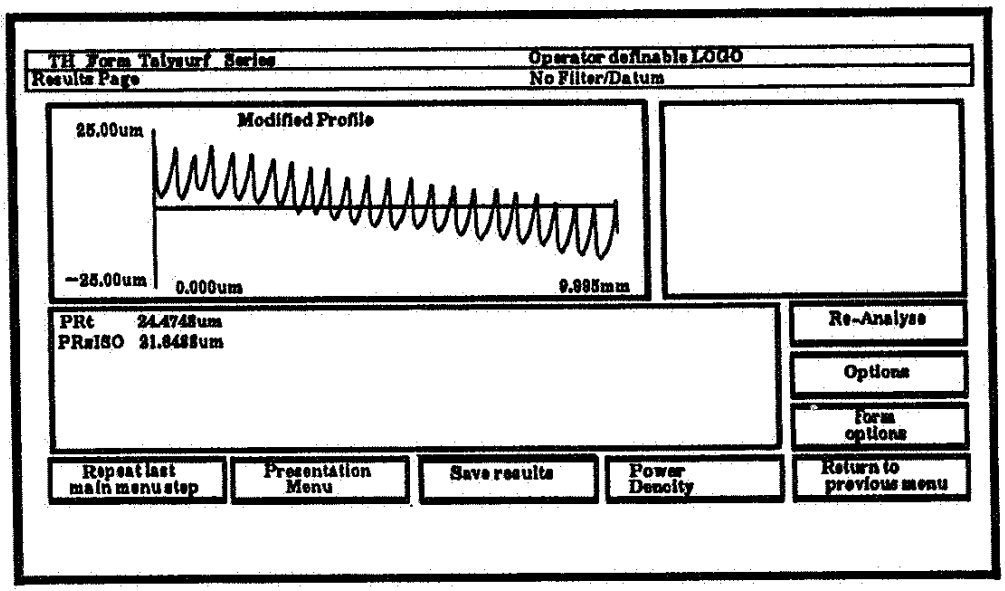
2. If printouts of the Power Density graph or results table are required, these must be selected from page 2 of the **SET OUTPUT** option of the PRINTER CONFIGURATION MENU.

PRESENTATION MENU WITH PRINTOUT OPTIONS FOR POWER DENSITY RESULTS



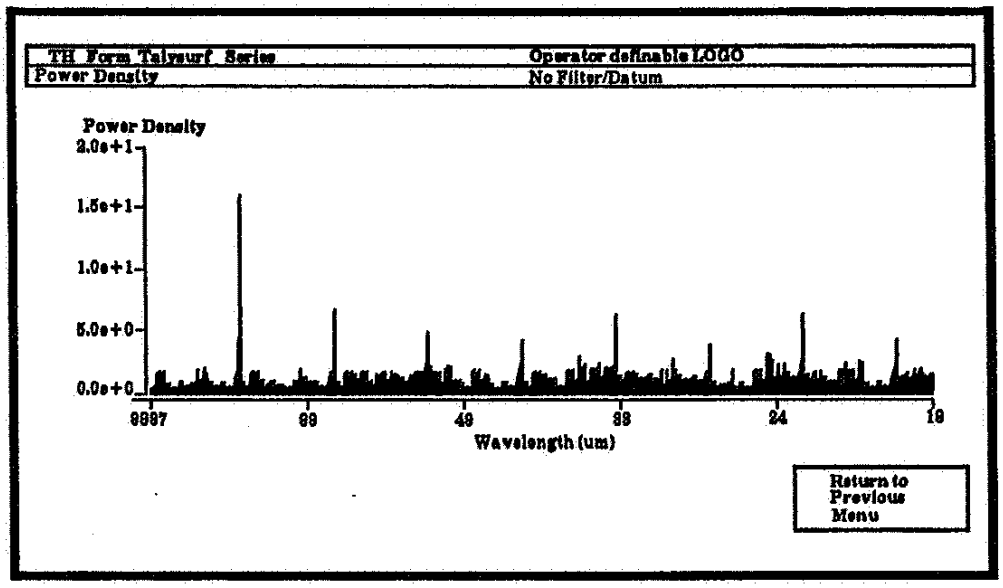
3. Select the **DATA COLLECTION ANALYSIS option of the MAIN MENU to make a measurement or analysis of stored data in the normal manner. The RESULTS PAGE is then displayed.**

RESULTS PAGE



4. Select in the POWER DENSITY box, to display the Power Density results.

POWER DENSITY



If key F7 is pressed, when this menu is displayed, the Power Density results (graph and table) are printed.

APPENDIX 1

DATA EXCHANGE PROTOCOL CONVERSION

DESCRIPTION The CONV_DEP program is a utility which enables the operator to transform data files, produced on Form Talysurf Series instruments, from their original binary format into the ASCII format. In addition to the conversion function, the utility can be used to interface with the RS232C serial port as either transmitter or receiver. All three data types (Raw, Modified and Parameter files) can be converted, transmitted and received.

Note The CONV_DEP program is run from the MSDOS command line within the FTS directory (from the prompt C:\FTS>) and **not** from within the Form Talysurf Series program.

FILE CONVERSION The CONV_DEP program must be executed with three parameters, these are:

The source path and filename.

The type of output required (-A for ASCII format or -B for Binary format).

The destination path and filename.

The command line, therefore takes the form:

CONV_DEP *space* NAME AND PATH OF FILE TO BE CONVERTED *space* OUTPUT FORMAT TYPE (-A or -B) *space* NAME AND PATH OF DESTINATION FILE.

Typical examples of commands are:

CONV_DEP RTH_00.PRF -A OUTPUT.DAT

The above command causes the data in raw profile file RTH_00.PRF to be converted into ASCII character format and output to the file

OUTPUT.DAT. If the file OUTPUT.DAT does not already exist, then it is automatically created. The original file, RTH_00.PRF, remains unchanged.

CONV_DEP A:INPUT.DAT -B C:\FTS\RTH\RTH_01.MOD

The above command causes the file INPUT.DAT on disk drive A to be converted into binary format and output to the modified profile file RTH_01.MOD on drive C in the RTH directory of the FTS system directory.

SERIAL PORT INTERFACING

The CONV_DEP routine incorporates both a transmitter and receiver which are compatible with the serial protocol used on the Form Talysurf instrument. To ensure successful transmission, software handshaking is employed based on the transmission of Xon and Xoff characters from the receiver to control the action of the transmitter.

The serial (RS232C) port is accessed by specifying COM1 as the source or destination file name, as follows:

CONV_DEP COM1 -A OUTPUT.DAT

The above command causes data from the serial port to be converted to ASCII character format and output to the file OUTPUT.DAT. If the file OUTPUT.DAT does not already exist, then it is automatically created.

CONV_DEP C:\FTS\RTH\RTH_00.PAR -A COM1

The above command causes data from the parameter data file RTH_00.PAR in the RTH directory of the FTS system directory on drive C to be converted to ASCII and be transmitted to the serial port.

RESTRICTIONS AND LIMITATIONS

The **Form Talysurf Series** can only transmit data to the serial port. No facility exists for receiving data from the serial port.

The **Form Talysurf Series** can only transmit data via the serial port 1 (COM 1) in **ASCII** format.

The **Form Talysurf Series** can only save data to disk in a **Binary** format.

The **CONV_DEP** utility is able to transmit and receive data via the serial port, in the **ASCII format only.**

SERIAL COMMUNICATION PROTOCOL

Serial communications are performed via the COM1 serial port at 9600 baud using no parity with 8 bits and 1 stop bit.

The control characters are:

XON	21_{oct} / 17_{dec}	Start transmission
XOFF	23_{oct} / 19_{dec}	Stop transmission
EOT	04_{oct} / 04_{dec}	End of transmission

The serial interface procedure is summarised as follows:

Transmitter	Receiver
Transmitter waits for XON character to be received.	Receiver Transmits XON and waits for data to be received.
Transmitter receives XON and starts transmitting up to 512 bytes of data.	Receiver collects data and places it into buffer. Checks are made for end of Transmission (EOT) character terminating the data file.
Transmission of data continues.	Receiver recognises that buffer is filled to threshold level and transmits XOFF signal.
Transmitter receives XOFF and stops transmitting data.	Receiver processes the recorded data and stores it to disk.
Transmitter waits.	Receiver transmits XON to continue the cycle.

SERIAL LEAD DETAILS

The pin-out details of the D-type connectors on the serial lead will vary according to the hardware configuration. The most typical configurations are detailed following:

Pc to PC (Female 25 way D-type to Female 25 way D-type).

Transmit Data	Pin 2	Pin 3	Receive Data
Receive Data	Pin 3	Pin 2	Transmit Data
Signal Ground	Pin 7	Pin 7	Signal Ground
Request to send	Pin 4	Pin 4	Request to send
Clear to send	Pin 5	Pin 5	Clear to send
Data set ready	Pin 6	Pin 6	Data set ready
Carrier Detect	Pin 8	Pin 8	Carrier Detect
Data terminal ready	Pin 20	Pin 20	Data terminal ready

Pc to PC (Female 25 way D-type to Female 9 way D-type)

Transmit Data	Pin 2	Pin 2	Receive Data
Receive Data	Pin 3	Pin 3	Transmit Data
Signal Ground	Pin 7	Pin 5	Signal Ground
Request to send	Pin 4	Pin 7	Request to send
Clear to send	Pin 5	Pin 8	Clear to send
Data set ready	Pin 6	Pin 6	Data set ready
Carrier Detect	Pin 8	Pin 4	Data terminal ready
Data terminal ready	Pin 20		

Terminal Module to PC (Male 15 way D-type to Female 25 way D-type)

Transmit Data	Pin 4	Pin 3	Receive Data
Receive Data	Pin 12	Pin 2	Transmit Data
Signal Ground	Pin 6	Pin 7	Signal Ground
Request to send	Pin 11	Pin 4	Request to send
Clear to send	Pin 5	Pin 5	Clear to send
		Pin 6	Data set ready
Carrier Detect	Pin 13	Pin 8	Carrier Detect
Data terminal ready	Pin 3	Pin 20	Data terminal ready

DATA EXCHANGE PROTOCOL (version 2.0)

INTRODUCTION The 'DEP v2.0' file protocol enables Raw profile, Modified profile and Parameter information to be saved with sufficient detail for the reproduction of the data at a later date.

RAW PROFILE DATA To provide the facility of reloading a saved profile, independent of the current system configuration and parameters, information is stored relating to:

Number of data points.

Data resolution.

Spacing of data points.

Measurement calibration coefficients.

Radius of the stylus tip used for the measurement.

The protocol for the Raw profile is divided into three separate sections or records.

RECORD 1 The first record contains a fixed header declaring:

1) The format in which the file is stored.
2) The revision of the data exchange protocol used.
3) The feature name, number and extension of the stored feature.
4) The number of data points in the profile.
5) The scaling of the data points.

These are followed by a declaration of the axis resolution and the amount of information contained in the file.

RECORD 2 This may contain information which relates to :

1) The tip radius of the stylus,
2) The spacing of mapped or incremental axes.
3) The calibration correction coefficients.
4) User comments related to the feature.

RECORD 3 The Third record contains the measured axis data.

Each record is terminated by an 'EOR' command and the file terminated by 'EOF'.

NOTES

1. When measurement data is saved via the CONV_DEP utility, the file created is identified by the Feature name and Number of the original measurement. This information is included in the record 1 of the data file and is **not** changed by renaming the file.
2. When it is not possible to evaluate a parameter, the normal Form Talysurf output is *****. The CONV-DEP utility, replaces this with a very large negative value i.e. (-3.937008e97).

CONVENTIONS In the descriptions which follow:

The *Italic Text* indicates mandatory text which appears at the start or end of the record.

** Indicates items not implemented or not used currently in DEP v2.0.

DESCRIPTION OF SPECIFIC TERMS VALID IN RECORD 1

Field Name	Example / Options	Comment
'Data format'	*:'0'*	*- Indication of binary file format.*
	: '1'	*- Indication of ASCII file format.*
'Revision No.'	*: '2'*	*- DEP Revision 2.00.*
'<cr><lf>'	*:*	*- Line Terminator*
'Feature Name'	*: 'RTH_'*	*- Name padded with spaces to 6 characters.*
'Feature No.'	*: 0.0e0*	*- Number in double precision floating point format.*
'Feature Type'	*: 'PRF'*	*- Raw PRoFile data.*
'<cr><lf>'	*:*	*- Line Terminator.*
'Axis'	: 'CX'	- Cartesian X axis data.
	: 'CZ'	- Cartesian Z axis data.
	: 'CY'	- Cartesian Y axis data**.
	: 'PR'	- Polar radial data**.
'Data Type'	: 'A'	- Absolute data.
	: 'R'	- Relative data**.
	: 'I'	- Incremental data**.
	: 'M'	- Mapped data.
'No. Data Points'	: 4.003e3	- Number of data points (double precision float).
'Units'	: 'M'	- Metres.
	: 'MM'	
	: 'UM'	
	: 'NM'	
	: 'PM'	
	: 'IN'	- Inches.
	: 'MIN'	
	: 'UIN'	
	: 'NIN'	
	: 'PIN'	
'Scale Value'	: 1.0e0	-Scale to indicated units.
'Axis Data Type'	: 'I'	- Integer**.
	: 'L	'- Double length integer.
	: 'F'	- Floating point**.
	: 'D'	- Double precision float.
'<cr><lf>'	:	- Line terminator.
'End Of Record'	*: 'EOR'*	*- Record Terminator.*
<cr><lf>'	*:*	*- Line terminator.*

DESCRIPTION OF SPECIFIC TERMS VALID IN RECORD 2

Field Name	Example / Options	Comment
'Stylus Tip Radius'	: 'STYLUS_RADIUS'	- Tip radius command.
'Value'	: 0.1234e05	- Double precision float.
'Units'	: 'M' to 'pm'	- Metric units.
	: 'IN' to 'pIN'	- Imperial units.
<cr><lf>	:	- Line terminator.
'Ordinate Spacing': 'SPACING'		- Spacing command.
'Axis'	: 'CX'	- Cartesian X axis data.
	: 'CZ'	- Cartesian Z axis data.
	: 'CY'	- Cartesian Y axis data.**
	: 'PR'	- Polar radial data**.
'Value'	: 0.123e04	- Double precision float.
'<cr><lf>'	:	- Line terminator
'Calibration'	: 'MAP'	- Mapping command.
'Map Type'	: 1.00e0	- Map type for CZ to CZ.
	: 2.00e0	- Map type for CZ to CX.
'Source Axis'	: 'CX'	- Cartesian X axis data**.
	: 'CZ'	- Cartesian Z axis data.
	: 'CY'	- Cartesian Y axis data**.
	: 'PR'	- Polar radial data**.
'Destination Axis'	: 'CX'	- Cartesian X axis data.
	: 'CZ'	- Cartesian Z axis data.
	: 'CY'	- Cartesian Y axis data**.
	: 'PR'	- Polar radial data**.
'Polynomial Order'	: 1.00e0	- One coeff only (A).
	: 2.00e0	- Two coeffs (E & F) [on CX].
	: 4.00e0	- Four coeffs (A,B,C & D).
'Values'	: 0.123e04	- Values for the calib coeffs.
.	:	- Repeated for number of coeffs.
.		
'<cr><lf>'	:	- Line terminator.
'Comments'	: 'COMMENT'	-Command.
'Comment Text'	: 'some text'	-Comments (60 characters max).
'<cr><lf>'	:	-Line terminator.
'End Of Record'	*: 'EOR'*	*- Record terminator.*
'<cr><lf>'	*:*	*- Line terminator.*

DESCRIPTION OF SPECIFIC TERMS VALID IN RECORD 3

Field Name	Example / Options	Comment
'Value'	:	- Value of specified type.
'<cr><lf>'	:	- Line terminator.
.		
.	:	- Repeated for number of axis points.
.		
'End Of Record'	*: 'EOR'*	*- Record terminator.*
'<cr><lf>'	*:*	*- Line terminator.*
'End Of File'	*: 'EOF'*	*- File terminator.*
'<cr><lf>'	*:*	*- Line terminator.*

EXAMPLE

1 0<cr><lf>
RTH_ 0.0e0 PRF<cr><lf>
CX M 4.003e3 mm 1.0e0 L<cr><lf>
CZ M 4.003e3 mm 1.6e-5 L<cr><lf>
EOR<cr><lf>
STYLUS_RADIUS 2.0e-3 mm<cr><lf>
SPACING CX 2.5e-4 <cr><lf>
MAP 1.0e0 CZ CZ 4.0e0 1.01e0 1.2e-02 2.3e-03 3.4e-4<cr><lf>
MAP 2.0e0 CZ CX 2.0e0 1.2e-2 2.3e-3<cr><lf>
COMMENT abcdefghijklmnopqrstuvwxyz 1234567890.<cr><lf>
COMMENT ABCD....XYZ !"£$%^&**(<cr><lf>
EOR<cr><lf>
128<cr><lf>
133<cr><lf>
156<cr><lf>
198<cr><lf>
187<cr><lf>
.
.
.
2345<cr><lf>
2643<cr><lf>
EOR<cr><lf>
EOF<cr><lf>

MODIFIED PROFILE DATA The format of the modified file follows the format of the raw profile specified above with the main changes occurring in the data stored in record 2 and in multiple profiles being stored in record 3 (X and Z data required).

The data required in record 2 includes:

1) Filter mode.
2) Filter type.
3) Form type.
4) Number of cutoffs.
5) Number of points per cutoff.
6) Bandwidth.
7) Cutoff length.

NOTE In the descriptions which follow:

The *Italic Text* indicates mandatory text which appears at the start or end of the record.

** Indicates items not implemented or not used currently in DEP v2.0.

[ ] Indicates optional parameters, i.e. as an example of use. The units for the aspheric coefficients only apply to coefficients 2 to 12, coefficient 1 has no units.

DESCRIPTION OF SPECIFIC TERMS VALID IN RECORD 1

Field Name	Example / Options	Comment
'Data format'	*:'0'*	*- Indication of binary file format.*
	: '1'	*- Indication of ASCII file format.*
'Revision No.'	*: '2'*	*- DEP Revision 2.00.*
'<cr><lf>'	*:*	*- Line Terminator*
'Feature name'	*: 'RTH_'*	*- Name padded with spaces to 6 characters.*
'Feature No.'	*: 0.0e0*	*- Number in double precision floating point format.*
'Feature Type'	*: 'MOD'*	*- Modified profile data.*
'<cr><lf>'	*:*	*- Line Terminator.*
'Axis'	: 'CX'	- Cartesian X axis data.
	: 'CZ'	- Cartesian Z axis data.
	: 'CY'	- Cartesian Y axis data**.
	: 'PR'	- Polar radial data**.
'Data Type'	: 'A'	- Absolute data.
	: 'R'	- Relative data**.
	: 'I'	- Incremental data**.
	: 'M'	- Mapped data.
'No. data points'	: 4.003e3	- Number of data points (double precision float).
'Units'	: 'm'	- Metric.
	: 'mm'	
	: 'um'	
	: 'nm'	
	: 'pm'	
	: 'IN'	- Imperial.
	: 'mIN'	
	: 'uIN'	
	: 'nIN'	
	: 'pIN'	
'Scale Value'	: 1.0e-3	- Scale to indicated units.
'Axis data type'	: 'I'	- Integer**.
	: 'L'	- Double length integer.**
	: 'F'	- Floating point.
	: 'D'	- Double precision float.
'<cr><lf>'	:	- Line terminator.
'End of record'	*: 'EOR'*	*- Record Terminator.*
<cr><lf>'	*:*	*- Line terminator.*

DESCRIPTION OF SPECIFIC TERMS VALID IN RECORD 2

Field Name	Example / Options	Comment
'Filter Mode'	: 'FILTER_MODE'	- Command.
'Type'	: 'NO_FILTER' :'ROUGHNESS' : 'WAVINESS' : 'R_AND_W'	
'<cr><lf>'	:	- Line terminator.
'Filter Type'	: 'FILTER_TYPE'	- Command.
'Type'	: 'ISO_2CR' : 'PC_2CR' : 'GAUSSIAN'	
'<cr><lf>'	:	- Line terminator.
'Form Type'	: 'FORM'	- Command.
'Type'	: 'DATUM' : 'LS_LINE' : 'MZ_LINE' : 'LS_ARC' : 'LS_ABS_ARC' : 'ELLIPSE_HYP' : 'ASPHERIC' : 'GOTHIC' : 'CONVEX' : 'CONCAVE'	
'<cr><lf>'	:	- Line terminator.
'Interruption indication'	: 'INTERRUPTED'	Command (only if form type is Aspheric and interruptions exist).
'Value'	: 1.000000e+000	- Number of interruptions.
'<cr><lf>'	:	- Line terminator.
'Interruption start and end'	: 'INT-START'	- Start of interruption command (only if form type is Aspheric and interruptions exist).
'Value'	: 8.147142e-001	- Position of start of interruption in X axis.
'Units'	: 'M' to 'pm' : 'IN' to 'pIN' : 'INT-END'	- Metric units. - Imperial units. - End of interruption.
'Value'	: 1.734226e+000	- Position of end of interruption in X axis.
'Units'	: 'M' to 'pm' : 'IN' to 'pIN'	- Metric units. - Imperial units.
'<cr><lf>'	:	- Line terminator.
'Cutoff Information'	: 'CUTOFF'	- Command.
'Value'	: 0.25e0	- Cutoff length ie. 0.25mm.
'Units'	: 'M' to 'pm' : 'IN' to 'pIN'	- Metric units. - Imperial units.

Field Name	Example / Options	Comment
'Number of Cutoffs'	:3	- ie. 3 cutoffs.
'Points per Cutoff'	:500	- ie. 500 points per cutoff.
'<cr><lf>'	:	- Line terminator.
'Bandwidth'	:'BANDWIDTH'	- Command.
'Value'	:50e0	- 50:1
	:64e0	- 64:1
	:100e0	- 100:1
	:312.5e0	- 312.5:1
	:320e0	- 1000:1
	:1000e0	
'<cr><lf>'	:	- Line terminator.
'Roughness cutoff'	:'ROUGHNESS_CUTOFF'	- Command (only valid for R&W filter mode).
'Value'	:1.5e0	- Cutoff value.
'Units'	:'M' to 'pm'	- Metric units.
	:'IN' to 'pIN'	- Imperial units.
'<cr><lf>'	:	- Line terminator
'Waviness cutoff'	:'WAVINESS_CUTOFF'	- Command (only valid for R&W filter mode).
'Value'	:3.5e0	- Cutoff value.
'Units'	:'M' to 'pm'	- Metric units.
	:'IN' to 'pIN'	- Imperial units.
'<cr><lf>'	:	- Line terminator.
'Length of profile'	:'ASSESSMENT_LENGTH'	- Command.
'Value'	:1.75e0	- Length of profile.
'Units'	:'M' to 'pm'	- Metric.
	:'IN' to 'pIN'	- Imperial.
'<cr><lf>'	:	- Line terminator.
'No. mod points'	:'NUMBER_MOD_POINTS'	- Command.
'Value'	:4.003e3	- Number of points.
'<cr><lf>'	:	- Line terminator.
'Replica Surface'	:'REPLICA'	- Command / flag.
'<cr><lf>'	:	- Line terminator.
'Absolute Arc'	:'ABS_RADIUS'	- Command.
'Value'	:15.0e0	- 15mm abs arc radius.
'Units'	:'M' to 'pm'	- Metric.
	:'IN' to 'pIN'	- Imperial.
'<cr><lf>'	:	- Line terminator.
'Aspheric Coefs'	:'ASPHERIC_COEFF'	- Command.
'Value'	:1.23e-02	- Single aspheric value.
['Units']	:'M' to 'pm'	- Optional metric units.
	:'IN' to 'pIN'	- Optional Imperial units.
['Order']	:-1e0	- Coefficient order.
'<cr><lf>'	:	- Line terminator.

DESCRIPTION OF SPECIFIC TERMS VALID IN RECORD 3

Field Name	Example / Options	Comment
'Aspheric Constant'	: 'ASPHERIC_K'	- Command.
'Value'	: 1.23e-02	- Single aspheric value.
'<cr><lf>'	:	- Line terminator.
'Aspheric Radius'	: 'ASPHERIC_RADIUS'	- Command.
'Value'	: 1.23e-02	- Single aspheric value.
'Units'	: 'M' to 'pm'	- Metric units.
	: 'IN' to 'pIN'	- Imperial units.
'<cr><lf>'	:	- Line terminator.
'Comments'	: 'COMMENT'	- Command.
'Comment Text'	: 'some text'	- Comments (60 characters max).
'<cr><lf>'	:	- Line terminator.
'End of record'	*: 'EOR'*	- *Record Terminator.*
<cr><lf>'	*:*	- *Line terminator.*
'Value'	:	- Value of specified type.
'<cr><lf>'	:	- Line terminator.
.		
.	:	- Repeated for number of axis points and for number of axes.
.		
'End Of Record'	*: 'EOR'*	- *Record terminator.*
'<cr><lf>'	*:*	- *Line terminator.*
'End of File'	*: 'EOF'*	- *File terminator.*
'<cr><lf>'	*:*	- *Line terminator.*

Example 1

1 2<cr><lf>
RTH_ 1.0e0 MOD<cr><lf>
CX A 4.003e3 mm 1.0e-3 D<cr><lf>
CZ A 4.003e3 mm 1.0e-3 D<cr><lf>
EOR<cr><lf>
FILTER_MODE ROUGHNESS<cr><lf>
FILTER_TYPE GAUSSIAN<cr><lf>
FORM LS_LINE<cr><lf>
CUTOFF 0.25 mm 3 500<cr><lf>
ASSESSMENT_LENGTH 1.75e0 MM<cr><lf>
NUMBER_MOD_POINTS 4.003e3<cr><lf>
BANDWIDTH 100e0<cr><lf>
EOR<cr><lf>
0.0
0.001
0.002
.
.
.
4.001
4.002
0.5232
0.5133
0.5022
.
.
.
-0.4593
-0.4673
EOR<cr><lf>
EOF<cr><lf>

Example 2

1 2<cr><lf>
RTH_ 2.0e0 MOD<cr><lf>
CX A 4.003e3 mm 1.0e-3 D<cr><lf>
CZ A 4.003e3 mm 1.0e-3 D<cr><lf>
EOR<cr><lf>
FILTER_MODE NO_FILTER<cr><lf>
FORM CONVEX<cr><lf>
ASSESSMENT_LENGTH 1.75e0 MM<cr><lf>
NUMBER_MOD_POINTS 4.003e3<cr><lf>
COMMENT Measurement 5 27-11-90 11:23<cr><lf>
COMMENT Part number 112/2000<cr><lf>
EOR<cr><lf>
0.0
0.001
0.002
.
.
.
4.001
4.002
0.5232
0.5133
0.5022
.
.
.
-0.4593
-0.4673
EOR<cr><lf>
EOF<cr><lf>

Example 3

1 2<cr><lf>
RTH_ 3.0e0 MOD<cr><lf>
CX A 4.003e3 MM 1.0e-3 D<cr><lf>
CZ A 4.003e3 MM 1.0e-3 D<cr><lf>
EOR<cr><lf>
FILTER_MODE NO_FILTER<cr><lf>
FORM ASPHERIC<cr><lf>
INTERRUPTED 1.000000e+000
INT_START 8.147142e-001MM INT_END 1.734226e+000MM (only if form type is ASPHERIC and interruptions exist).
ASSESSMENT_LENGTH 1.75e0 MM<cr><lf>
NUMBER_MOD_POINTS 4.003e3<cr><lf>
ASPHERIC_COEFF 1.23e-3<cr><lf>
ASPHERIC_COEFF 0.0e0 MM -1e0<cr><lf>
ASPHERIC_COEFF 0.0e0 MM -2e0<cr><lf>
ASPHERIC_COEFF 0.0e0 MM -3e0<cr><lf>
ASPHERIC_COEFF 0.0e0 MM -4e0<cr><lf>
ASPHERIC_COEFF 0.0e0 MM -5e0<cr><lf>
ASPHERIC_COEFF 0.0e0 MM -6e0<cr><lf>
ASPHERIC_COEFF 0.0e0 MM -7e0<cr><lf>
ASPHERIC_COEFF 0.0e0 MM -8e0<cr><lf>
ASPHERIC_COEFF 0.0e0 MM -9e0<cr><lf>
ASPHERIC_COEFF 0.0e0 MM -10e0<cr><lf>
ASPHERIC_COEFF 0.0e0 MM -11e0<cr><lf>
ASPHERIC_RADIUS 15.0e0 mm<cr><lf>
ASPHERIC_K 1.23e3<cr><lf>
EOR<cr><lf>
0.0
0.001
0.002
.
.
.
4.001
4.002
0.5232
0.5133
0.5022
.
.
.
-0.4593
-0.4673
EOR<cr><lf>
EOF<cr><lf>

PARAMETER DATA The protocol used for DEP v2.0 Format, is as the Raw Data Exchange Protocol with modifications to records 1,2 and 3, as follows:

The data required in record 1 includes:

1) Specification of the number of parameters stored.

The data required in record 2 includes:

1) Specification of further parameters included.
2) Specification of further parameter information
3) Specification of further parameter information value
4) Specification of further parameter units.

The data required in record 3 includes:

1) Definition of Parameter text.
2) Definition of Parameter value.
3) Definition of Parameter units.

NOTE In the descriptions which follow:

The *Italic Text* indicates mandatory text which appears at the start or end of the record.

** Indicates items not implemented or not used currently in DEP v2.0.

[ ] Indicates optional parameters, i.e. as an example of use. The units for the aspheric coefficients only apply to coefficients 2 to 12, coefficient 1 has no units.

DESCRIPTION OF SPECIFIC TERMS VALID IN RECORD 1

Field Name	Example / Options	Comment
'Data format'	*:'0'*	*- Indication of binary file format*
	: '1'	*- Indication of ASCII file format.*
'Revision No.'	*: '2'*	*- DEP Revision 2.00.*
'<cr><lf>'	*:*	*- Line Terminator*
'Feature name'	*: 'RTH_'*	*- Name padded with spaces to 6 characters.*
'Feature No.'	*: 0.0e0*	*- Number in double precision floating point format.*
'Feature Type'	*: 'PAR'*	*- Parameter data.*
'<cr><lf>'	*:*	*- Line Terminator.*
'Info type'	: 'PA'	- Parameter data.
'No. parameters'	: 4.0e0	- Number of parameters
'<cr><lf>'	:	- Line terminator.
'Info type'	: 'AD'	- Amplitude distribution.
	: 'BR'	- Bearing ratio.
	: 'RK_BR'	- Rk bearing ratio.
	: 'PDF'	- Power density function.
'Data type'	: 'A'	- Absolute data.
	: 'R'	- Relative data**.
	: 'I'	- Incremental data.**
	: 'M'	- Mapped data**.
'No. points'	: 1.01e2	- number of points.
'Units'	: '%'	- Percentage.
	: 'PTS'	- Amplitude distribution points.
	: 'SQR(((UM*UM)/MM)*(CYCLES/MM))'	- PDF units.
'Scale'	: 1.0e-3	- Scale to units.
'Data type'	: 'I'	- Integer.**
	: 'L'	- Long.
	: 'F'	- Floating point**.
	: 'D'	- Double precision float.
'<cr><lf>'	:	- Line terminator.
'End of record'	*: 'EOR'*	*- Record Terminator.*
<cr><lf>'	*:*	*- Line terminator.*

DESCRIPTION OF SPECIFIC TERMS VALID IN RECORD 2

Field Name	Example / Options	Comment
'Filter Mode'	: 'FILTER_MODE'	- Command.
'Type'	: 'NO_FILTER'	
	: 'ROUGHNESS'	
	: 'WAVINESS'	
	: 'R_AND_W'	
'<cr><lf>'	:	- Line terminator.
'Filter Type'	: 'FILTER_TYPE'	- Command.
'Type'	: 'ISO_2CR'	
	: 'PC_2CR'	
	: 'GAUSSIAN'	
'<cr><lf>'	:	- Line terminator.
'Form Type'	: 'FORM'	- Command.
'Type'	: 'DATUM'	
	: 'LS_LINE'	
	: 'MZ_LINE'	
	: 'LS_ARC'	
	: 'LS_ABS_ARC'	
	: 'ELLIPSE_HYP'	
	: 'ASPHERIC'	
	: 'GOTHIC'	
	: 'CONVEX'	
	: 'CONCAVE'	
'<cr><lf>'	:	- Line terminator.
'Interruption indication'	: 'INTERRUPTED'	Command (only if form type is Aspheric and interruptions exist).
'Value'	: 1.000000e+000	- Number of interruptions.
'<cr><lf>'	:	- Line terminator.
'Interruption start and end'	: 'INT_START'	- Start of interruption command (only if form type is Aspheric and interruptions exist).
'Value'	: 8.147142e-001	- Position of start of interruption in X axis.
'Units'	: 'M' to 'pm'	- Metric units.
	: 'IN' to 'pIN'	- Imperial units.
	: 'INT-END'	- End of interruption.
'Value'	: 1.734226e+000	- Position of end of interruption in X axis.
'Units'	: 'M' to 'pm'	- Metric units.
	: 'IN' to 'pIN'	- Imperial units.
'<cr><lf>'	:	- Line terminator.

Field Name	Example / Options	Comment
'Cutoff Information'	: 'CUTOFF'	- Command.
'Value'	: 0.25	- Cutoff length ie. 0.25mm.
'Units'	: 'M' to 'pm'	- Metric units.
	: 'IN' to 'pIN'	- Imperial units.
'Number of Cutoffs'	: 3e0	- ie. 3 cutoffs.
'Points per Cutoff'	: 500	- ie. 500 points per cutoff.
'<cr><lf>'	:	- Line terminator.
'Bandwidth'	: 'BANDWIDTH'	-Command.
'Value'	: 50e0	- 50:1
	: 64e0	- 64:1
	: 100e0	- 100:1
	: 321.5e0	- 312.5:1
	: 320e0	- 320:1
	: 1000e0	- 1000:1.
'<cr><lf>'	:	- Line terminator
'Roughness cutoff'	: 'ROUGHNESS_CUTOFF'	- Command (only valid for R&W filter mode).
'Value'	: 1.5e0	- Cutoff value.
'Units'	: 'M' to 'pm'	- Metric units.
	: 'IN' to 'pIN'	- Imperial units.
'<cr><lf>'	:	- Line terminator.
'Waviness cutoff'	: 'WAVINESS_CUTOFF'	- Command (only valid for R&W filter mode).
'Value'	: 3.5e0	- Cutoff value.
'Units'	: 'M' to 'pm'	- Metric units.
	: 'IN' to 'pIN'	- Imperial units.
'<cr><lf>'	:	- Line terminator.
'Length of profile'	: 'ASSESSMENT_LENGTH'	- Command.
'Value'	: 1.75e0	- Length of profile.
'Units'	: 'M' to 'pm'	- Metric.
	: 'IN' to 'pIN'	- Imperial.
'<cr><lf>'	:	- Line terminator.
'No. mod points'	: 'NUMBER_MOD_POINTS'	- Command.
'Value'	: 4.003e3	- Value.
'<cr><lf>'	:	- Line terminator.
'Datum'	: 'X_DATUM'	- Command.
	: 'Z_DATUM'	
'Value'	: 1.25e-3	- Datum position.
'Units'	: 'M' to 'pm'	- Metric
	: 'IN' to 'pIN'	- Imperial
'<cr><lf>'	:	- Line terminator.

Field Name	Example / Options	Comment
'Replica Surface'	:'REPLICA'	- Command / flag.
'<cr><lf>'	:	- Line terminator.
'Absolute Arc'	:'ABS_RADIUS'	- Command.
'Value'	:15.0e0	- 15mm abs arc radius.
'Units'	:'M' to 'pm'	- Metric.
	:'IN' to 'pIN'	- Imperial.
'<cr><lf>'	:	- Line terminator.
'Aspheric Coefs'	:'ASPHERIC_COEFF'	- Command.
'Value'	:1.23e-02	- Single aspheric value.
['Units']	:'M' to 'pm'	- Optional metric units.
	:'IN' to 'pIN'	- Optional Imperial units
['Order']	:-1e0	- Coefficient order.
	'<cr><lf>':	- Line terminator.
'Aspheric Constant'	:'ASPHERIC_K'	- Command.
'Value'	:1.23e-02	- Single aspheric value
'<cr><lf>'	:	- Line terminator.
'Aspheric Radius'	:'ASPHERIC_RADIUS'	- Command.
'Value'	:1.23e-02	- Single aspheric value.
'Units'	:'M' to 'pm'	- Metric units.
	:'IN' to 'pIN'	- Imperial units.
'<cr><lf>'	:	- Line terminator.
'Parameter'	:'TP%'	- Bearing ratio.
'Type'	:'BELOW_PEAK'	- Reference line position.
	:'ABOVE_MEAN'	
	:'ABOVE_VALLEY'	
'Value'	:2.34e-3	- Line position value.
'Units'	:'M' to 'pm'	- Metric.
	:'IN' to 'pIN'	- Imperial.
'<cr><lf>'	:	- Line terminator.
'Parameter'	:'HSC'	- High spot count.
	:'TP%'	- Bearing ratio.
'Value type'	:'BELOW_PEAK'	- Reference line position.
	:'ABOVE_MEAN'	
'Value'	:1.23e-4	
'Units'	:'M' to 'pm'	- Metric.
	:'IN' to 'pIN'	- Imperial.
'<cr><lf>'	:	- Line terminator

Field Name	Example / Options	Comment
'Parameter'	: 'HTP'	-Distance between tp% values.
'Value'	: 45.0e0	- tp% 1.
'Unit'	: '%'	- Percentage.
'Value'	: 65.0e0	- tp% 2.
'Unit'	: '%'	- Percentage.
'<cr><lf>'	:	- Line terminator.
'Parameter'	: 'VO'	- Volvo.
	: 'HSC'	- High spot count.
'Value type'	: 'TP%'	- At tp% height.
'Value'	: 45.0e0	- tp% 1.
'Unit'	: '%'	- Percentage.
'<cr><lf>'	:	- Line terminator.
'Parameter'	: 'VO'	- Volvo / volume parameter.
'Value type'	: 'TP%'	- Reference level.
'Value'	: 2.0	- tp% ref height.
'Unit'	: '%'	- Percentage.
'Depth'	: 'DEPTH'	- Bearing surface depth.
'Value'	: 2.34e-3	- 2.34 um depth.
'Units'	: 'M' to 'pm'	- Metric.
	: 'IN' to 'pIN'	- Imperial.
'<cr><lf>'	:	- Line terminator.
'Parameter'	: 'PC'	- Peak count.
'Value type'	: 'TP%'	- At tp%.
	: 'BELOW_PEAK'	- Reference line position.
	: 'ABOVE_MEAN'	
'Value'	: 45.0e0	- tp%.
'Units'	: '%'	- Percentage.
	: 'M' to 'pm'	- Metric.
	: 'IN' to 'pIN'	- Imperial.
'Value type'	: 'BANDWIDTH'	- Bandwidth.
'Value'	: 4.0e-3	- Bandwidth about ref line 4um.
'Units'	: 'M' to 'pm'	- Metric.
	: 'IN' to 'pIN'	- Imperial.
'<cr><lf>'	:	- Line terminator.
'Comments'	: 'COMMENT'	- Command.
'Comment Text'	: 'some text'	- Comments (60 characters max).
'<cr><lf>'	:	- Line terminator.
'End of record'	*: 'EOR'*	*- Record Terminator.*
<cr><lf>'	*:*	*- Line terminator.*

DESCRIPTION OF SPECIFIC TERMS VALID IN RECORD 3 ROUGHNESS MODE

Field Name	Example / Options	Comment
'Parameter'	:'RA'	
	:'RQ'	
	:'RP'	
	:'RV'	
	:'RT'	
	:'RTI'	
	:'RSK'	
	:'RKU'	
	:'DELQ'	
	:'LAMQ'	
	:'S'	
	:'RY'	
	:'RZ ISO'	
	:'RZ DIN'	
	:'RPM'	
	:'R3Y'	
	:'R3Z'	
	:'RK'	
	:'RPK'	
	:'RVK'	
	:'MR1'	
	:'MR2'	
	:'SM'	
	:'LO'	
	:'HSC'	
	:'PC'	
	:'TP'	
	:'HTP'	
	:'VO'	
'Value'	:1.23e-3	
['Units']	:'M' to 'pm'	- Metric.
	:'IN' to 'pIN'	- Imperial.
	:'%'	- Percentage.
	:'mm3/cm2'	
	:'pks/cm'	
	:'pks/IN'	
'<cr><lf>'	:	-Line terminator.

DESCRIPTION OF SPECIFIC TERMS VALID IN RECORD 3 WAVINESS MODE

Field Name	Example / Options	Comment
'Parameter'	: 'WA'	
	: 'WQ'	
	: 'WP'	
	: 'WV'	
	: 'WT'	
	: 'WTI'	
	: 'WSK'	
	: 'WKU'	
	: 'DELQ'	
	: 'LAMQ'	
	: 'S'	
	: 'WY'	
	: 'WZDIN'	
	: 'WPM'	
	: 'SM'	
	: 'LO'	
	: 'HSC'	
	: 'PC'	
	: 'TP'	
	: 'HTP'	
	: 'VO'	
'Value'	: 1.23e-3	
['Units']	: 'M' to 'pm'- Metric.	
	: 'IN' to 'pIN'- Imperial.	
	: '%'- Percentage.	
	: 'pks/cm'	
	: 'pks/IN'	
'<cr><lf>'	:	-Line terminator.

DESCRIPTION OF SPECIFIC TERMS VALID IN RECORD 3
NO FILTER MODE

Field Name	Example / Options	Comment
'Parameter'	'PRA'	
	:'PRQ'	
	:'PRP'	
	:'PRV'	
	:'PRT'	
	:'PRSK'	
	:'PRKU'	
	:'DELQ'	
	:'LAMQ'	
	:'S'	
	:'PRZISO'	
	:'SM'	
	:'LO'	
	:'HSC'	
	:'PC'	
	:'TP'	
	:'HTP'	
	:'VO'	
	:'RT'	- Aspheric
	:'RA'	- Aspheric
	:'XP'	- Aspheric
	:'XV'	- Aspheric
	:'SMIN'	- Aspheric
	:'SMAX'	- Aspheric
	:'TILT'	- Aspheric
	:'FIG'	- Aspheric
	:'XT'	- Aspheric
'Value'	:1.23e-3	
['Units']	:'M' to 'pm'	- Metric.
	:'IN' to 'pIN'	- Imperial.
	:'%'	- Percentage.
	:'pks/cm'	
	:'pks/IN'	
'<cr><lf>'	:	-Line terminator.

DESCRIPTION OF SPECIFIC TERMS VALID IN RECORD 3 R&W MODE

Field Name	Example / Options	Comment
'Parameter'	: 'PT'	
	: 'R'	
	: 'AR'	
	: 'RX'	
	: 'WT'	
	: 'W'	
	: 'AW'	
	: 'WX'	
	: 'TP'	
	: 'HTP'	
	: 'SA'	
	: 'SAR'	
	: 'SW'	
	: 'SWR'	
'Value'	: 1.23e-3	
['Units']	: 'M' to 'pm'	- Metric.
	: 'IN' to 'pIN'	- Imperial.
	: '%'	- Percentage.
'<cr><lf>'	:	-Line terminator.