Furnace Tracker®

insight software

Furnace Surveying

USER MANUAL

Issue 3

MA5580A

DATAPAQ®

A Fluke Company

Furnace Tracker®

insight software

Furnace Surveying

User Manual

Issue 3

Datapaq® is the world's leading manufacturer of process temperature-monitoring instrumentation. The company maintains this leadership by continual development of its advanced, easy-to-use Tracker systems.

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DATAPAQ PART NO. MA5580A

SAFETY WARNINGS

For safe use of Datapaq equipment, always:

- Take care to follow its supplied instructions.
- Observe any warning signs shown on the equipment.

Indicates **potential hazard**.
On Datapaq equipment this normally warns of high temperature, but, where you see the symbol, consult the manual for further explanation.

Warns of **high temperatures**.
Where this symbol appears on Datapaq equipment, its surface may be excessively hot (or excessively cold) and may thus cause skin burns.

Manual set in 10 pt Gill Sans.

User manuals are available in other languages; contact Datapaq for details.

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Introduction

In the Datapaq® Furnace Surveying system, Insight™ software is used to carry out a **temperature uniformity survey** to assess the accuracy and uniformity of heating within a furnace: with calibrated thermocouples placed at strategic points in the furnace (normally on a specially constructed survey rack or jig), the set temperature is increased to successive values, allowing the furnace time to stabilize at each point before increasing to the next set point. The actual temperatures recorded by the thermocouples in the measured temperature profile are then compared with each set temperature and its specified tolerance limits. Insight also automatically carries out a range of other analyses on the temperature data, including those necessary for compliance with the AMS 2750E standard.

Insight Furnace Surveying software allows simultaneous use of **multiple loggers** to record data during the temperature uniformity survey – thus you can monitor the furnace with more thermocouples than is possible when using a single logger.

While the system is gathering data, hardwired or radio **telemetry** can be used to monitor recorded temperatures in real time in order to see critical events such as temperature stabilization at each of the set points and whether survey time has been achieved at each set point.

Powerful **reporting** facilities allow the user to generate customized hard-copy reports complying with the AMS 2750E standard, including any or all of the analysis results or raw temperature data.

This manual contains the following sections:

- Basic Hardware (p. 9) – General considerations relating to use of the logger, survey rack, thermal barriers and thermocouple probes, including their specifications and their care and maintenance.
- Setting Up for a Survey (p. 13) – Preparing to classify the accuracy of a furnace by defining furnace classes, and setting up correction factors for the logger and thermocouples to ensure accuracy of measurements.
- Conducting a Temperature Uniformity Survey (p. 23) – All the stages of running the survey, using Insight software.
- Analysis (p. 35) – Using Insight to analyze data from the temperature uniformity survey and to generate a customized report.
- Further Useful Features of Insight (p. 43) – Other aspects of Insight which are particularly useful for Furnace Surveying.
- Troubleshooting (p. 47) – Some potential problems and their likely solutions.

The dedicated manual supplied with the data logger, and the *Furnace Tracker® General System User Manual*, should be read in conjunction with this manual. They provide information on operation of a Tracker system in general, and on operating the logger, including:

- Installing Insight and establishing communication between logger and PC.
- Resetting the logger with new data-collection parameters.
- Downloading the collected data to the PC.
- Use of telemetry.
- Troubleshooting logger problems.

For full details on use of the Insight software, refer to the online Help system available when the software is installed.

System Components

A typical Furnace Surveying system comprises:

- Data logger, with communications lead and charger; logger with radio-telemetry option includes internal transmitter.
- High-temperature transmitting antenna.
- Data logger user manual (specific to the logger model).
- Receiver (radio-telemetry option only).
- Receiving antenna.
- Thermal barrier (not required if using a logger external to the furnace).
- Thermocouple probes.
- *Furnace Tracker General System User Manual.*
- *Furnace Tracker Furnace Surveying User Manual.*
- Insight Furnace Surveying software.

Basic Hardware

For use of the data logger, and for other special-purpose hardware, see the documentation supplied with it.

Data Logger

Depending on your surveying process, you may choose to use a logger in one of two ways:

- **Internally** to the furnace: the logger is protected by a thermal barrier and accompanies the survey rack inside the furnace during the survey. If required, the TM21 radio-telemetry system can be used to watch the temperature profile developing in real time.
- **Externally** to the furnace: the logger remains outside the furnace, with thermocouples trailing from the furnace to the logger; if required, data being gathered by the logger can be transmitted directly to the PC via the communications lead (or Bluetooth if available), so that the temperature profile can be watched developing in real time. Any suitable Datapaq logger can be used externally, but the **XDL12 logger** is designed specifically for this purpose (and cannot be used internally).

General Considerations

- **Use high-quality extension cables and compensating cables** from the logger to the external furnace connection, preferably from the same batch.
- If using type-R or type-S noble-metal thermocouples, compensation cable can be used, but **only noble-metal wire will ensure full accuracy**. This is particularly important if significant temperature variation may occur down the length of the cable.
- When using mineral-insulated thermocouples in a vacuum furnace at relatively high temperatures, ensure that the diameter of the cable is big enough to avoid breakdown of the magnesium oxide insulation but small enough to allow the cable to be bent around the test jig. These requirements are generally met by **2-mm diameter, type-N, mineral-insulated thermocouples**.
- If the data logger is used externally to the furnace, **minimize the number of plug and socket or other connections** in the extension cables or compensating cables. In vacuum furnaces and autoclaves it is not possible to avoid such connections, but always check the condition of the sockets on

the inner wall of the furnace, and clean with a small-diameter wire brush if oxidized.

- If the data logger is used externally, and if it is connected to the mains electricity via its charger and/or via a PC which is itself attached to the mains, earth (ground) loops may develop in the system and cause erratic data (see p. 47). In this case, a Datapaq **opto-isolator** (part no. CS3091) should be connected between the logger and the PC (not necessary with the XDL12 logger, which has built-in protective circuitry). If using the **Datapaq TP3 logger**, this problem is solved by using **Bluetooth communication** between logger and PC rather than a physical connection (see the *Datapaq TP3 Data Logger User Manual*).

Best Practice with XDL12 Logger

The Datapaq XDL12 is a highly accurate logger which utilizes a specially-designed cold-junction compensating unit to minimize errors. But note that...

...the following guidelines must be observed to ensure maximum accuracy.

Temperature Stabilization

- When carrying out a survey, **let the logger stabilize at the ambient temperature** in the area where it will be used (i.e. near the furnace) for 1 hour before starting data-collection. This is especially important when bringing the logger from an air-conditioned office to a warm workshop, or from a warm office to a cool workshop.
- **Do not place the logger where there may be sudden temperature changes**.

Powering the Logger

- While a survey is in progress, whenever possible **run the logger only from its battery** – i.e. if it is avoidable, do not use the battery charger as a means of powering the logger from mains electricity. A fully-charged battery will last at least 60 hours with a sample interval of 10 seconds, and this is generally far longer than is required for a survey.

Using and Connecting Thermocouples

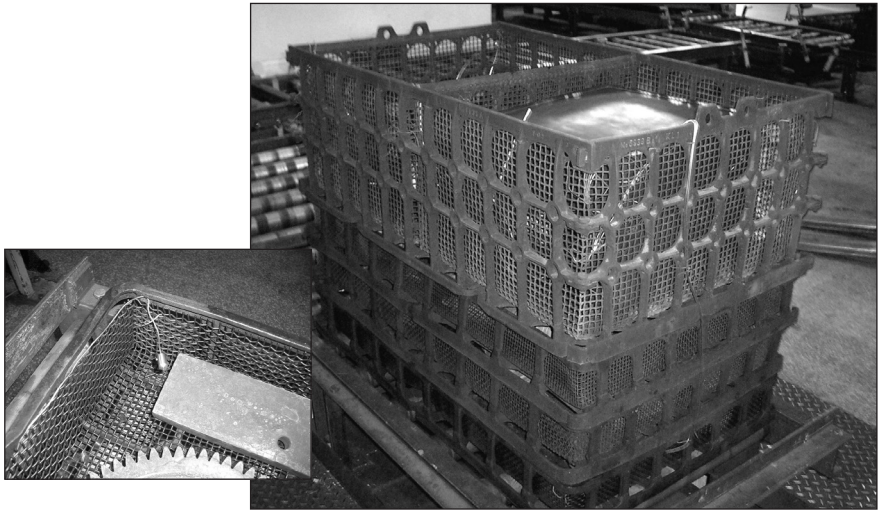
- For ease of use, the XDL12 utilizes standard thermocouple sockets. To ensure the highest accuracy, extension cables and compensating cables supplied by Datapaq have plugs from the same manufacturer as the sockets.

If providing your own connecting cables, make every effort to **ensure that the terminating plugs are from the same manufacturer**.

- The XDL12 will accept sub-miniature thermocouple plugs, but for highest accuracy **standard plugs are recommended**.

Survey Rack

The user will supply a rack (or jig) to support the system's thermocouples in positions suited to the individual furnace. If working to the AMS 2750E standard, see details of that specification for the number and positions of thermocouples on the rack.



A product basket in use as a survey rack for a temperature uniformity survey. Thermocouples are positioned at the corners and center of the basket.

Thermal Barrier

No thermal barrier is required if the logger is used external to the furnace, as with (e.g.) the XDL12 logger.

The thermal barrier provides the thermal and mechanical protection necessary for the data logger to survive in the hostile environment of the furnace, and a range of Datapaq barriers is available to suit different loggers and different survey durations. See the *Furnace Tracker General System User Manual*, and contact Datapaq if necessary.

Selection of the correct barrier is important, as it must have sufficient thermal capacity to withstand the entire survey, including not only the ramp up to the various temperature levels but perhaps also a cooling period after exiting the main furnace. For example, when leaving a sealed quench furnace the barrier must sit over the oil quench until it is cool enough to allow the quench doors to be opened.

Thermocouple Probes

The thermocouples used must adhere in accuracy, type and diameter to the requirements of the AMS 2750E standard or other specifications being used.

Various thermocouple types – of noble or base metal – are suitable. Type-N thermocouples are increasingly used as they are more stable and less prone to oxidation than type K, and can, within limits, be re-used. See also the *Furnace Tracker General System User Manual*.

Thermocouples will normally require a certificate of calibration from the manufacturer and in some cases may require re-calibration after a certain period of time. See p. 14 for creation and application of thermocouple correction factors as part of the temperature uniformity survey.

Setting Up for a Survey

Important aspects of setting up your system before conducting a temperature uniformity survey (p. 23) are:

- Establishing criteria (controlling specifications) for assessing the furnace's **furnace class** for different temperatures.
- Setting up **correction factors** to ensure accuracy of measurement by both data logger and thermocouples.

Furnace Classes and Controlling Specifications

For a given set temperature, Insight uses the results of the temperature uniformity survey to indicate the furnace's **furnace class**, i.e. the relative accuracy with which the furnace attains and holds that temperature set point. The furnace class is used to indicate the type or quality of product for which the furnace is suitable.

Furnace classes are defined by a **controlling specification** (e.g. the AMS 2750E or BAC 5621 standards) which specifies permitted tolerances in the furnace's actual temperature when it has been set to achieve a given **temperature set point**.

Class	TUS Tolerance (°C)	
1	3.00	-3.00
2	6.00	-6.00
3	8.00	-8.00
4	10.00	-10.00
5	14.00	-14.00

For each furnace class, a positive and negative tolerance is specified; if the furnace is to comply with this class, these tolerances must not be exceeded. In the example shown, if the results of a temperature uniformity survey (TUS) at a particular temperature set point are within ±3°C of that temperature, the furnace is considered class 1 for that temperature set point; if the deviation from the temperature set point is greater than ±6°C but within ±8°C, the furnace is considered class 3 for that temperature set point.

The tolerance data is stored in a **controlling specification file** with a .CSP extension, located by default in the default paqfile directory (to check the location, or change it, select Tools > Options > Paqfile Directories).

Creating a Controlling Specification File

Use the **Controlling Specification Wizard** (select File > New > Furnace Surveying > Controlling Specification, or Furnace Surveying > Setup Controlling Specification).

The procedure is largely self-explanatory: enter information as prompted by the wizard, as follows.

Setup

Use the wizard to define a **controlling specification** which you can later apply during a temperature uniformity survey in order to determine your furnace's **furnace class** for specific set temperatures.

Enter a **name** for the controlling specification. This will be used to identify it, and will form the default filename for the specification data.

Click the **Add** button until you have specified the total number of furnace classes to be defined. Then, for each furnace class, enter the positive and negative **tolerances** allowed to be recorded by the temperature uniformity survey (TUS).

To remove a furnace class, click on it in the grid and then click **Remove**.

To view or edit the data you enter here, after creating the controlling specification file, open it with File > Open > Furnace Surveying > Controlling Specification.

Save Controlling Specification

Data for your controlling specification file have now all been entered and you must give it a **filename**. The filename will be saved with a .CSP extension.

Controlling specification files are stored by default in the default paqfile directory, but you can **browse** to a directory of your choice.

Editing an Existing File

Select File > Open > Furnace Surveying > Controlling Specification. This opens the controlling specification file for editing in the Controlling Specification Wizard.

Applying a Controlling Specification

A controlling specification is applied to a temperature uniformity survey as part of running the Temperature Uniformity Survey Wizard (p. 24).

A temperature uniformity survey can have several controlling specifications applied to it. For a given temperature set point, Insight's Analysis Window (p. 35) will then show the furnace class according to each of those specifications. Furnace class is also shown in the printed report (select File > Print Options, and then Uniformity Survey and Measured Values).

Correction Factors

When a temperature uniformity survey is performed on a furnace, it is essential that the **thermocouples** and **logger** used for the survey have been accurately

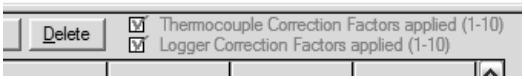
calibrated, and that **correction factors** are established so that they can be applied to the data.

If correction factors are known for the whole range of operating temperatures, and if a linear relationship assumed between adjacent temperature set points, corrections can be applied to all thermocouple data within the calibrated temperature range. Insight stores these correction factors in a **correction factor file**, and correction is achieved by applying this file to the data.

- With a **normal paqfile**, correction factors will be applied to the whole of the data which lies within the calibrated temperature range.
- In a **temperature uniformity survey**, correction factors are applied only to data relevant to the survey, i.e. between the upper and lower set points in the survey but extending this range to include also the tolerances specified for each set point (though excluding any data which lies outside the calibrated temperature range).

Insight stores correction factor files by default in the default paqfile directory (to check the location, or change it, select Tools > Options > Paqfile Directories).

If correction factors (below) are currently applied to the survey, this is indicated next to the set point Delete button in the Analysis Window, showing also the numbers of the thermocouples to which the factors are applied:



A paqfile cannot have more than one set of correction factors applied to it, nor can the same factors be reapplied successively, e.g. if a measurement was corrected from 302 to 300°C by applying correction factors, it is not possible to apply the factors again to obtain 298°C.

To safeguard against falsification of data, the application, removal and editing of correction factors is recorded in the **audit trail** (p. 45).

Thermocouple Correction Factors

Thermocouple wire is often supplied to the end user on spools, and the supplier calibrates (in a temperature-controlled bath) a thermocouple made from a sample of wire from the spool. Measurements thus taken indicate how far the thermocouple's readings deviate from a range of known set temperatures: e.g. at a true 800°C the thermocouple may read 801.7°C, and this **thermocouple correction factor** (also known as a calibration offset) of +1.7°C can be applied to thermocouple readings taken at this temperature. In practice, to allow for variation within the spool, correction factors are measured for samples from

the start and end of the spool, and these are averaged to give a final correction factor value for a given temperature set point.

Thermocouple correction factor files have a .CAL extension.

Creating a Thermocouple Correction Factor File

Use the **Thermocouple Correction Factor Wizard**. To run the wizard, click  or  – or select:

- Tools > Wizards, or
- File > New > Furnace Surveying > Thermocouple Correction Factors, or
- Furnace Surveying > Setup Thermocouple Correction Factors.

The procedure is largely self-explanatory: enter information as prompted by the wizard, then click **Next** at the end of each stage. The wizard proceeds as follows.

Number of Probes

Specify the **number of thermocouple probes** you will be using.

You may create a thermocouple correction factor file which contains data for more thermocouples than are supported by the logger to which it will be applied. Data for any thermocouple numbers in excess of those supported by the logger will be ignored by that logger – but, if **multiple loggers** are being used, data for those excess thermocouples will be applied, in order, to thermocouples attached to the next logger in the sequence. One thermocouple correction factor file can thus cover all thermocouples used in a multiple-logger temperature uniformity survey (in this case, the same thermocouple correction factor file must be applied to all loggers used).

Same Spool or Different Spools

If your thermocouples are made of wire from different spools, they will have different correction factors. Specify this here.

- If all thermocouples are from the **same spool**, after clicking **Next** you will proceed to enter calibration data.
- If thermocouples are from **different spools**, after clicking **Next** you will specify which thermocouples come from which spool.

Select Thermocouples

Select all the thermocouples which were made from any one spool of wire (if all were made from the same spool, click **Back** to return to the previous wizard stage).

If any thermocouples have already been set up, the **spool number** from which they came is shown.

The wizard will then prompt you to enter calibration data for the current spool – and the process will be repeated for any remaining thermocouples made from different spools.

Set Correction Factors

Enter calibration data for your thermocouples. The data you enter here will apply to all the thermocouples listed at the head of this wizard dialog.

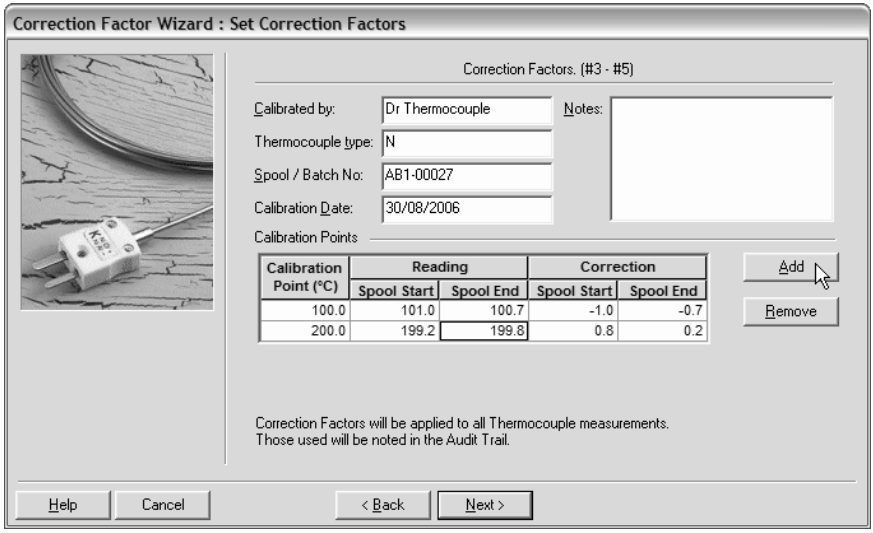
Click the **Add** button until you have specified the total number of set temperature **calibration points** for the spool from which these thermocouples were made.

Then, for each calibration point, enter the **temperature readings** obtained from a thermocouple made from the start and the end of the spool. **Corrections** are calculated automatically as you enter the readings.

To remove a calibration point, click on it in the grid and then click **Remove**.

> *To **view or edit** the data you enter here, after creating the thermocouple correction factor file, open it with File > Open > Thermocouple Correction Factors.*

If any thermocouples remain to be set up, after clicking **Next** the wizard will prompt you to enter further data.



Data for thermocouple correction factors being entered.

Save Correction Factors

Data for your correction factor file have now all been entered and you must give it a **filename**. The filename will be saved with a .CAL extension.

Correction factor files are stored by default in the **default paqfile directory**, but you can **browse** to a directory of your choice.

You may create a thermocouple correction factor file which contains data for more thermocouples than are supported by the logger to which it will be applied. Data for any thermocouple numbers in excess of those supported by

the logger will be ignored by that logger – but, if **multiple loggers** are being used, data for those excess thermocouples will be applied, in order, to thermocouples attached to the next logger in the sequence. One thermocouple correction factor file can thus cover all thermocouples used in a multiple-logger temperature uniformity survey (in this case, the same thermocouple correction factor file must be applied to all loggers used).

Editing an Existing Thermocouple Correction Factor File

Select File > Open > Furnace Surveying > Thermocouple Correction Factors. This opens the selected thermocouple correction factor file for editing in a modified version of the Thermocouple Correction Factor Wizard (see above).

Printing Thermocouple Correction Factor Data

To print the data in a thermocouple correction factor file, edit the file as above and click Print in the main editing dialog.

To print the correction factor data applied to a temperature uniformity survey, select File > Print Options, choose Uniformity Survey as the report type and check Correction Factors.

Applying Thermocouple Correction Factors

Correction factors will normally be applied to a uniformity survey as part of running the Temperature Uniformity Survey Wizard, but to apply them subsequently (or to any paqfile) select Furnace Surveying > Apply Thermocouple Correction Factors.

Removing Thermocouple Correction Factors

Select Furnace Surveying > Remove Thermocouple Correction Factors to remove the effect of the thermocouple correction factors from the currently displayed temperature uniformity survey or paqfile. The graph and analysis data on screen are updated accordingly.

Logger Correction Factors

Logger correction factor files have a .LCF extension.

Creating a Logger Correction Factor File

Use the **Logger Correction Factor Wizard**. To run the wizard, click  or  – or select:

- Tools > Wizards, or
- File > New > Furnace Surveying > Logger Correction Factors, or

- Furnace Surveying > Setup Logger Correction Factors, or
- Tools > Options > Logger > and click 'Setup' in the calibration grid.

The procedure is largely self-explanatory: enter information as prompted by the wizard, then click **Next** at the end of each stage.

*Certain models of Datapaq logger, e.g. the TP3, can **store calibration information internally**. If your logger is of this type, the wizard will guide you through the process of deciding whether to create a logger correction factor file by using the information stored in the logger, or whether to enter it manually.*

Otherwise, the wizard proceeds as follows.

Number of Probes

Specify the **number of thermocouple probes** you will be using.

To view or edit the data you enter here, after creating the logger correction factor file, open it with File > Open > Logger Correction Factors.

Logger Calibration Information

Enter calibration data for your logger:

- **Logger ID** The logger's 4-digit numerical ID (serial number) is on the rear of the logger.
- **Calibration Certificate Number and Notes** Enter text, for information only.
- **Calibration Expires On** Use the format dd/mm/yy or (if different) the short date format set in Windows (in Windows XP, see Control Panel > Regional and Language Options).

To set up a warning of when the logger's calibration is due to expire, select Tools > Options > Logger.

Thermocouple Types

Specify whether your logger has single or multiple thermocouple types (type K, type N, etc.).

For a logger with a single thermocouple type, you may (for information) specify the type here: click on the relevant thermocouple image.

After clicking **Next**, you will enter data for the logger correction factors and (in the case of loggers with multiple thermocouple types) specify the thermocouple types.

Select Thermocouples

Multiple thermocouple types only.

Specify one of the **thermocouple types** (type K, type N, etc.) which your logger uses: click on the relevant thermocouple image.

Check all the **thermocouple channels** which are of that type.

If the wizard has already guided you through the setup of correction factors for any of the logger's other thermocouple types, those types and their corresponding thermocouple channels are shown here for information.

After clicking **Next**, you will enter data for the logger correction factors for the channels you have specified here, and then go on to enter logger correction factor data for any remaining thermocouple type(s).

Setup Logger Correction Factors

Click the **Add** button until you have specified the total number of **temperature set points**, then enter the corresponding **actual readings** for each probe, taken from your logger's calibration certificate.

If you are adding factors for a 2nd or subsequent thermocouple type, the temperature set points may be different from those of the other thermocouple types.

To remove a set point, click on it in the grid and then click **Remove**.

To view or edit the data you enter here, after creating the logger correction factor file, open it with File > Open > Logger Correction Factors.

After clicking **Next**, you will either:

- (with multiple thermocouple types only) go on to enter logger correction factor data for any remaining thermocouple type(s), or
- save the data you have entered.

Save Logger Correction Factors

Data for your logger correction factor file has now all been entered and you must give it a **filename**. The filename will be saved with a .LCF extension.

Correction factor files are stored by default in the default paqfile directory, but you can **browse** to a directory of your choice.

Editing an Existing Logger Correction Factor File

Select File > Open > Furnace Surveying > Logger Correction Factors. This opens the selected logger correction factor file for editing in the Logger Correction Factor Wizard.

Printing Logger Correction Factor Data

To print the correction factor data applied to a temperature uniformity survey, select File > Print Options, choose Uniformity Survey as the report type and check Correction Factors.

Applying Logger Correction Factors

Logger correction factors will normally be applied to a uniformity survey as part of running the Temperature Uniformity Survey Wizard, but to apply them subsequently (or to any paqfile) select Furnace Surveying > Apply Thermocouple Correction Factors.

Removing Logger Correction Factors

Select Furnace Surveying > Remove Logger Correction Factors to remove the effect of the logger correction factors from the currently displayed temperature uniformity survey or paqfile. The graph and analysis data on screen are updated accordingly.

Conducting a Temperature Uniformity Survey

The process is carried out using the Temperature Uniformity Survey Wizard which guides you through the process of setting up the software and logger for the survey, carrying out the profile run and starting to analyze the data. The wizard can also be used on a suitable existing paqfile (temperature profile) to analyze survey data which has already been gathered.

In running a new uniformity survey on a furnace, the key stages of the wizard are:

- Specify the **number of thermocouples** being used, and whether this involves **multiple loggers** or just one.
- Specify the **temperature set points** whose accuracy you will measure, and select the **controlling specification** (p. 13) against which the accuracy will be classified.
- Select the method for determining **temperature stabilization** at each set point, and the **survey time** over which temperatures are measured.
- Apply **thermocouple correction factors** (p. 14) for accurate measurement.
- Set up **alarms/alerts** to show when temperatures stabilize or overshoot.
- Specify use of **serial or radio telemetry** (or none).
- **Reset the logger** by specifying data-collection parameters.
- Apply **logger correction factors** (p. 14) for accurate measurement.
- **Conduct the survey** by running the system through the furnace. or by using the logger external to the furnace.
- For each temperature set point, select the **range of measurements** on which the analysis will be performed.

For further background to the procedures involved, see your dedicated logger manual, the Insight Help system and the Furnace Tracker General System User Manual.

Using the Wizard

The **Temperature Uniformity Survey Wizard** takes you through the steps needed to perform your survey. To run the wizard, click  or  – or select:

- Tools > Wizards, or
- File > New > Furnace Surveying > Temperature Uniformity Survey, or
- Furnace Surveying > Temperature Uniformity Survey

The procedure is largely self-explanatory: enter information as prompted by the wizard, then click **Next** at the end of each stage. The wizard proceeds as follows.

Measure Furnace or Select Existing Paqfile

To provide survey data, choose here whether to **carry out temperature profile measurements on your furnace now**, or to use data already gathered and stored in an **existing paqfile or other data file**.

If you choose to carry out measurements now, your next step will be to specify the number of probes to be used.

Select Paqfile to Use – if using existing data

Choose a source for your existing survey data:

- Use the **current paqfile**, i.e. the one currently displayed on screen.
- **Load from file**, i.e. specify a paqfile on disk.
- **Import** raw data from another source. This must be in the correct format.

Click **Browse** to locate paqfiles and data files; the lists shown for selection comprise files in the default paqfile directory, but you can also browse to files which you may have stored elsewhere.

Number of Probes

Specify whether you will be using **multiple loggers** or just one for the survey, and the total **number of thermocouple probes** that will be used.

If using **hardwired (serial) telemetry**, you may attach multiple loggers to the PC simultaneously only by connecting them all to USB ports; if connection for hardwired telemetry is to be by COM (serial) port, only one logger can be connected.

If you are using **control thermocouple probes**, whose data should not be used in the Temperature Uniformity Survey analysis, click on the relevant buttons to **deselect those probes** which will not be used.

Omitting control thermocouples from the analysis can also be selected after the survey is completed by using the Analysis Options dialog.

Specify Temperature Set Points

Click the **Add** button until you have specified the total number of temperature **set points** to be used in the survey, and then for each value enter its **tolerance**, i.e. the amount by which it is acceptable for the furnace's actual temperature to deviate from its set temperature. Positive and negative tolerance values (i.e. the allowable deviation above and below the set point) are set separately.

To remove a set point, click on it in the grid and then click **Remove**.

Select the **controlling specifications** (see p. 13) which are to be used during the survey. The list of controlling specification files shown for selection are those contained in the default paqfile directory, but you can also click **Browse** to locate files which you may have stored elsewhere.

Round measurements up and down Check this option to round measurements to the nearest degree according to specification ASTM E29 which uses the following rules:

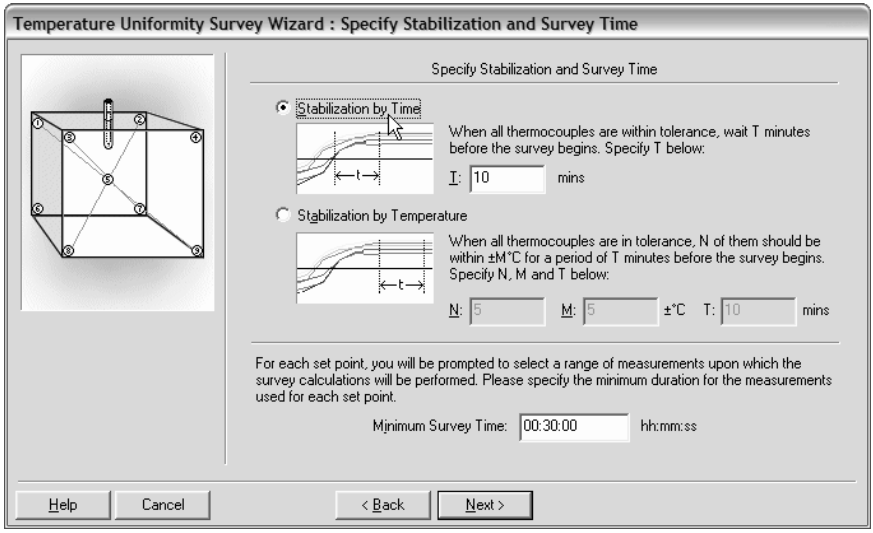
- If the next digit beyond the last place to be retained is less than 5, round down – e.g. 30.4° becomes 30°
- If the next digit beyond the last place to be retained is greater than 5, round up – e.g. 30.6° becomes 31°
- If the next digit beyond the last place to be retained is exactly 5, round to the nearest whole even number – e.g. 41.5° becomes 42° and 52.5° becomes 52°

When rounding is applied, this is noted above the results in the Analysis Window, in the printed report, and in the audit trail.

Rounding may also be applied or removed later.

Specify Stabilization and Survey Time

For each temperature set point, the furnace's recorded temperature must have stabilized for a period before the survey time starts (see below); this is a requirement of (e.g.) the AMS 2750E standard. Select here the method that Insight will use to determine when the furnace's recorded temperature has stabilized at each of the selected temperature set points:



Specifying the method used to determine stabilization.

- **Stabilization by Time** After all probe temperatures have come within tolerance, Insight waits a specified time (default 10 minutes) before the survey time starts.
- **Stabilization by Temperature** After all probe temperatures have come within tolerance, and a specified number of them (default 5) have been within a specified temperature range (default 5°C) for a specified period (default 10 minutes), the survey time will start.

Minimum Survey Time Specify the length of time over which the survey will examine temperature data at each set point, i.e. the period for which the temperature is expected to be stable after the set point has been achieved.

Apply Thermocouple Correction Factors

You may apply correction factors (p. 14) to improve the accuracy of the temperature data recorded by the **thermocouples**. (Logger correction factors are applied in a later stage of the wizard.)

Choose an option (the options presented depend on the selections you made earlier in the wizard):

Use Thermocouple Correction Factors in Paqfile If your survey is using an existing paqfile which already has correction factors applied, you can use these. The pathname of the correction factor file is shown.

Apply Thermocouple Correction Factors from File You may choose to apply correction factors from any thermocouple correction factor file – whether you are making furnace measurements as part of the wizard, or whether you are using an existing paqfile (with or without thermocouple correction factors applied). Click **Browse** to locate a correction factor file; the list shown for selection comprises files in the default paqfile directory, but you can also browse to files which you may have stored elsewhere.

Do Not Apply Thermocouple Correction Factors You may choose not to apply correction factors at this stage. They can be applied later.

You will be warned if the correction factors chosen do not cover the whole of the survey's temperature range. If you ignore the warning and use the chosen correction factors anyway, this will be logged in the audit trail. For example, the warning would be displayed if the survey was performed between 200 and 1,200°C but the correction factors were only measured between 100 and 1,000°C.

After clicking **Next**:

- If your survey is using an **existing paqfile**, you will go on to select data for the temperature set points.
- If you are making **furnace measurements**, you will go on to set up alarms/alerts and prepare the logger for receiving data.

Alarm/Alert Setup

Alarms/alerts can be set up which register if certain conditions are detected when furnace measurements are being made. These are especially useful if telemetry is being used, i.e. during a real-time survey.

Check for Overshoot If telemetry is used, an overshoot alarm dialog is shown when temperatures recorded by one or more thermocouples exceed a temperature set point by more than its specified tolerance value. An overshoot may be considered a critical error, invalidating a survey, and it may be decided to abandon the survey if an alarm occurs. After the survey has been completed and the data downloaded (whether or not telemetry has been

used), an overshoot will cause an alarm to be shown in the Alarms tab of the Analysis Window.

Inform When Probes Are in Tolerance If telemetry is used, an alert dialog is shown when all thermocouples come within their specified tolerances for the current temperature set point.

Inform on Stabilization An alert dialog is shown when the thermocouple measurements have stabilized at each temperature set point according to the method (time or temperature) selected earlier in the wizard.

Inform When Survey Time Achieved An alert dialog is shown when the furnace has maintained its set temperature for the specified time (usually 30 minutes) after stabilization has occurred.

Select Reset Logger or Logger Listen Mode

Normally, you will select **Reset Logger** here.

However, if you are using telemetry, and if display of the arriving data was interrupted (e.g. by a power failure to the PC), you may resume the display by restarting the Temperature Uniformity Survey Wizard and re-entering information as necessary. You should then select **Logger Listen Mode** here; in this case you will next be prompted to add any logger correction factors and will then be returned directly to the real-time display of data being received.

In the case of an interruption, data collection and storage by the logger will have continued without pause, so you should be careful to ***download results from the logger*** (*rather than using the real-time data*) *later in the wizard.*

Position Thermocouples

Ensure thermocouples are correctly positioned on the survey rack (jig) according to AMS 2750E or other controlling specification in use. The picture in the wizard dialog is of a typical survey rack and its thermocouple arrangement.

For details of thermocouples and their attachment, see the Furnace Tracker General System User Manual.

Connect Communications Lead

You are now ready to perform a temperature profile run in the furnace using your survey rack. You need first to reset the data logger to prepare it to receive fresh data.

If **multiple loggers** are being used, the dialog will show a number for the logger which is to be attached: first logger to be attached = 1, etc.

Start by using the **communications lead** supplied to connect the data logger to a free COM (serial) port on the PC (to minimize communications problems, connect the lead first to the PC and then to the logger). The red LED on the logger should flash five times to confirm that the cable–logger connection has been made.

If using **hardwired (serial) telemetry**, you may attach multiple loggers to the PC simultaneously only by connecting them all to USB ports; if connection for hardwired telemetry is to be by COM (serial) port, only one logger can be connected.

After clicking **Next** in this dialog, the wizard will get reset parameters from the logger.

For details of using the logger, see your dedicated logger manual.

Battery Charge

The type of logger you have connected is shown.

If **multiple loggers** are being used, the dialog will show an identifying **sequential number** for the logger currently attached, and the logger's **serial number**.

The charge indicator gives both the current percentage of full charge held by the logger battery, and a color-coded report:

GREEN	Sufficient charge to perform a run.
YELLOW	May be enough charge for a run, but battery getting low.
RED	Insufficient battery charge; recharge immediately.

Rechargeable nickel-metal-hydride batteries discharge slowly even when not in use and will need charging if left for more than three weeks. With the Datapaq 9000 and XDL12 loggers a full charge can be completed in two hours; with the Tpaq21 logger a full charge takes 2–3 hours.

The battery charge level will not be displayed if the logger is on charge: disconnect the charger to verify battery status.

The display is invalid for lithium batteries.

If in any doubt, abort the procedure by clicking **Cancel**, and recharge the logger.

Select Telemetry

If your data logger supports telemetry – the capability to transmit data to your computer in real time, i.e. as it is being gathered – you will be able to select here which mode to use:

- **No Telemetry** Data is collected by the logger and stored internally – until it is downloaded to the PC after the run is completed.
- **Serial Telemetry** Data is transmitted direct to the PC, as it is collected, via the communications lead.
- **Radio Telemetry** Data is transmitted to the PC, as it is collected, via a radio transmitter in the logger and a receiver attached to the PC.

If **multiple loggers** are being used, the selection made here will apply to all loggers. If a logger subsequently attached does not have a transmitter fitted and 'Radio Telemetry' has been selected here, a warning will be displayed but the logger may still be used.

If using **hardwired (serial) telemetry**, you may attach multiple loggers to the PC simultaneously only by connecting them all to USB ports; if connection for hardwired telemetry is to be by COM (serial) port, only one logger can be connected.

Select Probes and Sample Interval

If **multiple loggers** are being used, the dialog will show an identifying **sequential number** for the logger currently attached, and the logger's **serial number**.

To conserve memory in the logger, click on the relevant buttons to deselect those **probes** which will not be used. The number of probes available and the logger memory size are dependent on the logger used (see the dedicated manual for your logger).

- **Probe 1 (or, if multiple loggers are being used, the first probe in the sequence) must always be one of those selected.**

If **multiple loggers** are being used, the probe numbers shown will be adjusted to make them run sequentially across all loggers. For example, if two 10-channel loggers are used, the probes for logger 2 will be numbered 11–20 – and probe 11 must be inserted into the logger's probe 1 socket, etc.

Set the time which is to elapse between each set (sample) of data points (one data point for each probe) that the logger will collect. This **sample interval** is normally specified by the controlling specification in use (e.g. AMS 2750E). The shorter the sample interval the better you will be able to record short-term variations in your temperature regime – but the total recording time available to you will be reduced, and the data will take longer to download to the PC after the run. With the Datapaq logger supplied, however, memory capacity is not likely to be a problem. When using **telemetry** for real-time data-collection, a 10-second interval is normally used to avoid a long delay between incoming signals.

The **memory calculator** calculates the maximum time for which the logger can collect data, given the sample interval, the number of probes and the logger's memory size. The time available may be further limited by the level of battery charge.

Select Trigger Mode

Select here a trigger mode, i.e. the means which will start the logger recording data.

- **No Trigger** Data recording starts immediately the reset is complete and the communications lead has been disconnected from the logger. (Not available for all logger types.)
- **Start Button** After reset, data recording starts when the logger's green start button is pressed and held for about 1 second.
- **Date and Time** Data recording starts at a specified date and time. The current date appears by default.
- **Rising Temperature** Data recording starts when the temperature of any probe rises to the specified value.
- **Falling Temperature** Data recording starts when the temperature of any probe reaches the specified value as it is falling. (If rising or falling temperature trigger mode is set, the logger records data from the time it is disconnected from the PC – but, once the trigger temperature has been reached, the logger keeps only a maximum of 60 data points before the trigger point and discards any others.)

Apply Logger Correction Factors

If multiple loggers are being used, the dialog will show an identifying sequential number for the logger currently attached, and the logger's serial number.

Certain loggers can be set to apply logger correction factors to data automatically as it is downloaded, but this setting is ignored by the Wizard, which will use the selection made here.

You may apply **logger correction factors** to improve the accuracy of the temperature data recorded by the logger. (Thermocouple correction factors are applied in an earlier stage of the wizard.)

Choose an option:

- **Use Logger Correction Factors from Earlier Version** Shown if logger correction factors are detected from a previous installation of Insight.
- **Apply Logger Correction Factors from File** You may choose to apply correction factors from any logger correction factor file – whether you are making furnace measurements as part of the wizard, or whether you are using an existing paqfile (with or without correction factors applied). Click **Browse** to locate a logger correction factor file; the list shown for selection comprises files in the default paqfile directory, but you can also browse to files which you may have stored elsewhere.
- **Do Not Apply Logger Correction Factors** You may choose not to apply logger correction factors at this stage. They can be applied later (see p. 20).

After clicking **Next** in this dialog, the wizard will **reset the logger**.

Logger Has Been Reset

The logger has now been reset and is ready for you to start your survey run. The sample interval and trigger mode you have just set are confirmed here.

Events then depend on your use of telemetry:

- **No telemetry** – Disconnect the communications lead from the logger, and the logger's status LEDs briefly flash red and green alternately to confirm logger reset.
- **Serial telemetry** – Leave the communications lead connected, and click OK.
- **Radio telemetry** – Disconnect the communications lead from the logger and connect it to the receiver; the logger's red and green status LEDs then briefly flash alternately to confirm logger reset; click OK.

Connect the thermocouples to the logger according to their correct channel numbers.

If the trigger mode is **Start Button**, press and hold the logger's start button for about 1 second until the green LED starts to flash at the sample interval.

At this point, load the logger into the thermal barrier, if one is being used.

After clicking **Next**, carry out your survey run as follows.

- If you are **not using telemetry**, carry out your survey run and then continue using the wizard to download the furnace measurements.
- If you are **using serial or radio telemetry**, the wizard disappears while the survey run is proceeding. The graph and analysis grid will update in real time as the data is received, and you may use the **Real Time Tool** dialog to check the individual data packets as they are received, as well as the status of the logger (click  on the toolbar, or select View > Real Time Tool); see below. End the run by plugging the communications lead into the logger, by pressing the logger's Stop button, or by selecting Logger > Stop Real Time Mode on the main menu. The wizard then reappears.
- With **serial telemetry**, you will go on to select data for the temperature set points.
- With **radio telemetry**, you will first select whether or not to download the furnace measurements.

If using a thermal-barrier system, see the Furnace Tracker General System User Manual for details of installing the logger in the thermal barrier, placing the system in the furnace, and recovering it.

If **multiple loggers** are being used. and further loggers are still to be attached, the wizard will then prompt you to attach the next one.

If the final logger has been attached and reset, the dialog shows a **summary of the loggers' details**: sequential number, serial number, number and type of thermocouples, IEC thermocouple plug color, and the range of thermocouple numbers allocated to each logger. You may **print a report** of the summary.

Radio Telemetry Select Download Method

If you have used radio telemetry, it is possible to use the furnace measurement data received during the profile run for the uniformity survey analysis. To do this, select **Use Real-time Results**.

However, as data is also stored internally in the logger during the run, it is usually preferable instead to download the data from logger to PC after the run is finished. This means there is less chance of missing data points due to losses in transmission. To do this, select **Download Results**.

Download from Logger

You are now ready to download data from the logger.

If **multiple loggers** are being used, you will be prompted to **download each logger in order**, and will in turn be given each logger's identifying sequential number and serial number. Note, however, that – even if the loggers are attached in the wrong order – Insight will correctly identify the data from each logger and will assign the correct probe number to each probe's data.

Start by using the **communications lead** to connect the logger to a free USB or COM (serial) port on the PC (to minimize communications problems, connect the lead first to the PC and then to the logger). The red LED on the logger should flash five times to confirm that the cable–logger connection has been made.

After clicking **Next** in this dialog, downloading will start.

Download Completed

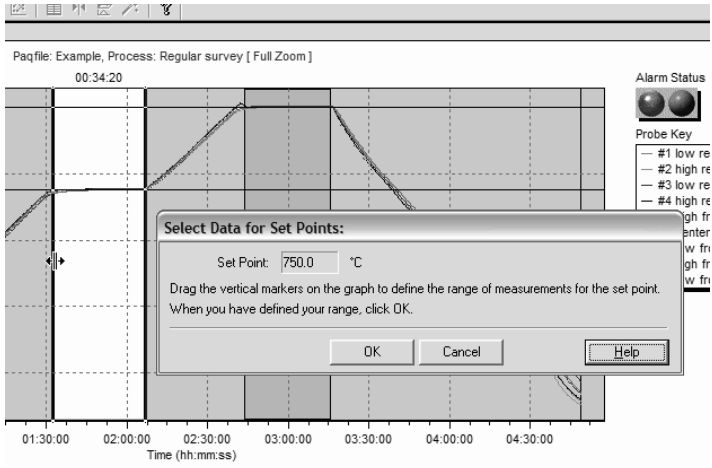
The temperature profile data from your run have now been downloaded from the logger to the PC. Disconnecting the communications lead will preserve the charge in the logger's battery.

If **multiple loggers** are being used. and further loggers are still to be downloaded, the wizard will then prompt you to download the next one.

Select Data for Set Points

With the survey temperature profile displayed on screen, the range of measurements to be used for each temperature set point can be selected directly on the graph.

Insight calculates what it thinks are the measurements to use for the set point and draws vertical markers on the graph at the start and end of the range, with the area between them white. **Drag the markers** into position to select the range of measurements you wish to use. The duration of the range (the survey time) is shown above the graph (in red if the duration of the selected measurements is less than the specified minimum survey time). The graph can be zoomed to help precise positioning of the markers.



Selecting the range of data to be used for one temperature set point.

Horizontal lines on the graph within each of the set-point ranges show the permitted tolerance in temperature for that set point.

When measurements for one set point have been selected, click **Next** to repeat the process for successive set points.

When the survey is complete, you can move on to analyze and save the survey data (p. 35).

Real-time Display When Using Telemetry

After the first few data packets have been received, the data starts to be displayed in the Graph and Analysis Windows, scrolling in real time as new data is received. You may change the way the data is displayed with the Axes tab of the Graph Options dialog (from the right-click menu, or from the main menu select View > Graph Options): under Telemetry, specify how much of the recently received data is displayed, and whether you wish to see only a certain temperature (y-axis) range, centered on a the latest data.

You may **zoom** the display as when viewing a paqfile (see the online Help system), except that:

- Double-clicking on the graph (or selecting Real Time Zoom from the View menu or right-click menu) shows only the most recently received portion of the data on the scrolling graph (see above).
- Saved zoom modes are not available.

If the **y-axis** is not set to be centered (see above), the default y-axis zoom changes as more data is received, in order to accommodate all received data.

To **move the graph** across the viewing area, hold Shift and drag the mouse pointer.

You may adjust the **furnace start** position while a real-time run is in progress (select Process > Adjust Oven Start, or use the right-click menu).

Calculations shown in the **Analysis Window** for the chosen data analysis mode update continuously as new data is received. As for non-real-time runs, calculations are performed only on the currently zoomed area shown on the graph. However, if the graph is scrolling and showing just the most recently received portion of the results, the analysis calculations will be performed as if on the full zoom view.

If you wish to **view another paqfile** while the logger is in listen mode, i.e. while data is being received and viewed in real time, you must first stop real time mode (see 'Ending the Run', below).

While a radio-telemetry run is in progress, you may use the **Real Time Tool** dialog to check the integrity of data-packets as they are received, as well as the

status of the logger(s) and (if using the TM21 radio-telemetry system) the receiver(s) (click  on the toolbar, or select View > Real Time Tool).

*If the logger's **internal temperature** approaches the maximum-permitted value, Insight will show a warning message. If this internal temperature is exceeded, another message will be shown and data-recording will stop. The logger may have suffered damage, and the reason for the excessive temperature – which may be the result of process operational problems or the use of an inappropriate thermal barrier – must be resolved before further profile runs take place; contact Datapaq for advice.*

*If the logger's **battery level** declines to 25% of full charge, Insight will show a warning message. If the battery discharges completely, another message will be shown and data-recording will stop.*

In both cases, data recorded up to that point will have been preserved.

Ending Real-time Data Collection

You may wish to **end data-collection** when the logger is removed from the furnace: press and hold the stop button until the red and green status LEDs are on simultaneously; a flashing red LED indicates data stored in the logger but not yet downloaded to the PC.

Alternatively, by selecting Logger > Stop Real Time Mode, you may end or pause it while a telemetry run is still in progress. Data then continues to be collected by the logger, but it is no longer received in real time by Insight (download from the logger after the run is finished to retrieve the full data). The graphical and numerical data received up to that point remain on screen, available for viewing and analysis, and can be saved as a paqfile.

While the logger is still transmitting, you may **resume the collection of transmitted data** (select Logger > Logger Listen Mode). After the first few data packets have been received, the data starts to be displayed in the Graph and Analysis Windows. This second bout (and any subsequent bouts) of data-collection can also be ended and saved as a separate paqfile, as above.

If **Autosave** is enabled (select Tools > Options > General), the data being gathered is automatically saved periodically during a telemetry run. If the system fails during the run, the last-autosaved version of the data is displayed automatically when Insight is next run, and you may then choose to save it as a paqfile.

If you are using telemetry, and if display of the arriving data is **interrupted** (e.g. by a power failure to the PC), you may resume the display by restarting the Temperature Uniformity Survey Wizard; see p. 24.

Password Protection

As required by the AMS 2750E standard, it is possible to password-protect Insight in order to prevent unauthorized personnel running the software. You may also password-protect against closing Insight while telemetry is use.

To set password protection, select Tools > Options > General, check the required options, and click 'Password' to define the password.

On this tab of the dialog, you may also password-protect against alteration of the selections in the Global Options dialog itself: click 'Password' and enter your password in both the boxes. A warning message in red then appears alongside the 'Password' button, and settings on all pages of the dialog become uneditable. In order to keep password-protection, you must click OK to close the dialog. To enable editing of Global Options, click 'Password' and enter the password; the warning message changes to black.

Passwords are case-sensitive but do not have a minimum number of characters.

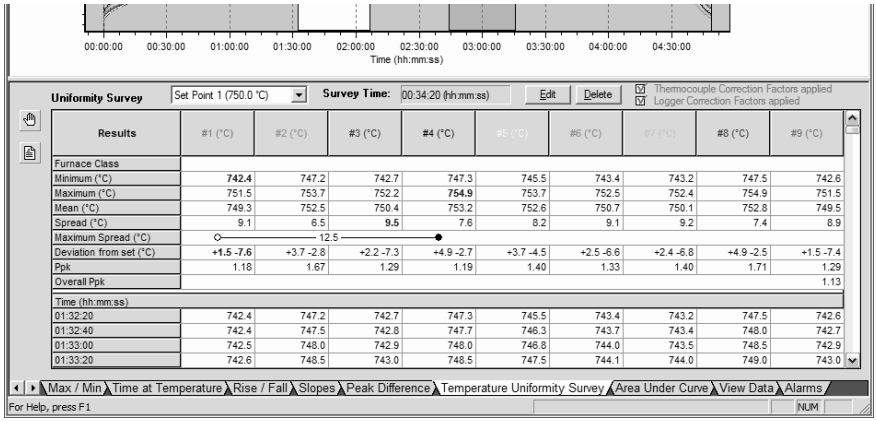
To remove a password: set the password afresh, entering nothing in both boxes.

Analysis

When the temperature uniformity survey (p. 23) is completed – with the survey temperature profile displayed on screen, and the range of measurements for each temperature set point selected (p. 31) – analysis data are displayed below the graph in the Analysis Window on the **Temperature Uniformity Survey tab**.

Using the Analysis Results

From the dropdown box above the grid, select the **temperature set point** whose data is to be shown. The duration of the range – the **survey time** – is shown alongside. The set point's range is highlighted on the graph (in white by default; see below).



Results	#1 (°C)	#2 (°C)	#3 (°C)	#4 (°C)	#5 (°C)	#6 (°C)	#7 (°C)	#8 (°C)	#9 (°C)
Furnace Class									
Minimum (°C)	**742.4**	747.2	742.7	747.3	745.5	743.4	743.2	747.5	742.6
Maximum (°C)	751.5	753.7	752.2	**754.9**	753.7	752.5	752.4	754.9	751.5
Mean (°C)	749.3	752.5	750.4	753.2	752.6	750.7	750.1	752.8	749.5
Spread (°C)	9.1	6.5	**9.5**	7.6	8.2	9.1	9.2	7.4	8.9
Maximum Spread (°C)	12.5								
Deviation from set (°C)	**+1.5 -7.6**	+3.7 -2.8	+2.2 -7.3	+4.9 -2.7	+3.7 -4.5	+2.5 -6.6	+2.4 -6.8	+4.9 -2.5	+1.5 -7.4
Ppk	1.18	1.67	1.29	1.19	1.40	1.33	1.40	1.71	1.29
Overall Ppk									1.13
Time (hh:mm:ss)									
01:32:20	742.4	747.2	742.7	747.3	745.5	743.4	743.2	747.5	742.6
01:32:40	742.4	747.5	742.8	747.7	746.3	743.7	743.4	748.0	742.7
01:33:00	742.5	748.0	742.9	748.0	746.8	744.0	743.5	748.5	742.9
01:33:20	742.6	748.5	743.0	748.5	747.5	744.1	744.0	749.0	743.0

The Analysis Window showing data for a uniformity survey's first temperature set point.

In the **top part of the analysis grid** are shown, for each thermocouple, the following **calculated values** for the range of data covering the chosen set point's survey time:

- **Furnace Class** – the furnace class (or classes) achieved by the furnace for the selected temperature set point, according to the controlling specification(s) applied (see p. 13).
- **Minimum** temperature within the range of measurements used for each set point (**lowest** value is shown **in bold**).

- **Maximum** temperature within the range of measurements used for each set point (**highest** value is shown **in bold**).
- **Mean** of the temperature measurements for each set point.
- **Spread** – the range of temperature measurements used for each set point (**greatest** spread is shown **in bold**).
- **Maximum Spread** – highest measured temperature of any thermocouple minus the lowest measured temperature of any thermocouple; the thermocouples concerned are marked in this row of the grid, joined by a horizontal line.
- **Deviation from Set** – maximum differences (positive and negative) between the set point and the measured values (**greatest** deviation is shown **in bold**).
- **Max Deviation from Set** – deviation values as above, but given only for those probes which have the highest positive and highest negative values; if all values are positive (or all are negative), the smallest positive (or negative) value is given.
- **Recovery Time** – time between the first thermocouple reaching the lower tolerance temperature limit and the last thermocouple reaching that limit; the thermocouples concerned are marked in this row of the grid, joined by a horizontal line.
- **P_{pk}** and **Overall P_{pk}** (i.e. for all probes as a group) – verifies that the actual performance of a system meets a specified standard. In most cases, a value greater than 1.33 is acceptable.

In the **lower part of the analysis grid** are the **measured values** for each data point within the chosen set point's survey time. Use the scroll bar to view all values; the calculated results for the set point remain visible in the upper part of the grid.

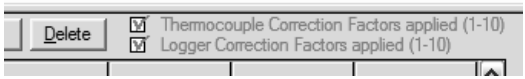
If the lower part of the analysis grid is not visible, drag and raise the splitter bar between the Graph and Analysis Windows. Display of the measured values may also be turned off in Analysis Options (*see below*).

Click **Edit** to change the range of measurements (and thus the survey time) used for each temperature set point: on the graph, drag the vertical markers into position as necessary; the graph can be zoomed to help precise positioning of the markers (for zoom options, see the Help system: Menu > View > Zoom).

Click **Delete** to remove the currently selected set point from the graph and from the analysis.

If **thermocouple correction factors** and/or **logger correction factors** (p. 14) are currently applied to the survey, this is indicated next to the set point

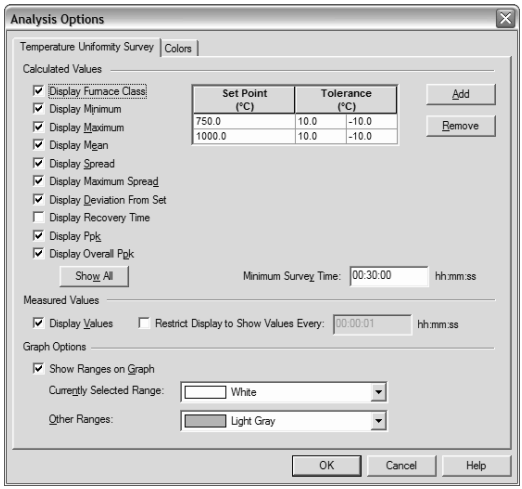
Delete button, showing also the numbers of the thermocouples to which the factors are applied:



If temperature profile data is imported from the clipboard (p. 42) and merged with a temperature uniformity survey, the new data is assigned to additional thermocouple numbers. This data is shown in the lower part of the analysis grid but is not included in the analysis calculations.

Analysis Options and Alarms

To open the Analysis Options dialog for the temperature uniformity survey, click in the Analysis Window, or select View > Analysis Options.



The Analysis Options dialog for a temperature uniformity survey.

Select individually whether to display each of the calculated values: Furnace Class, Minimum, Maximum, Mean, Spread, Maximum Spread, Deviation from Set, Max Deviation from Set, Recovery Time, P_{pk} and Overall P_{pk}.

Click the **Add** button to specify additional set points. To remove a set point, click on it in the grid and then click **Remove**.

The **tolerance** for each set point – i.e. the amount by which it is acceptable for the furnace's actual temperature to deviate from its set temperature – has already been specified while running the temperature uniformity survey wizard,

but you may also edit it here (as well as the value of the set point itself). Positive and negative tolerance values (i.e. the allowable deviation above and below the set point) are set separately. If deviation from the set point exceeds the tolerance, an alarm is triggered.

Specify a **minimum survey time** over which the survey will examine temperature data at each set point, i.e. the period for which the temperature is expected to be stable after the set point has been achieved. If the actual survey time chosen (see 'Edit', above) is below this, the time is shown above the graph in red rather than black.

Select whether or not to **display the measured values** (in the lower part of the analysis grid), and whether to **restrict the values listed** to a specified interval, thus showing a value (e.g.) every 1 minute rather than showing every measured value (this frequency is still within the AMS 2750E specification, but will make the data appear less 'noisy'); the interval will be a multiple of the sample interval (NB this affects the display only; analysis calculations use all recorded values).

You may **check for overshoot**. If this option is selected, the range of measured values displayed for each temperature set point is extended backwards in time to include values which may have overshot the permitted tolerance for that set point before recorded temperatures stabilized. The start point for this extension of values is defined by specifying a **temperature to be subtracted from the set point**: thus, if the set point is 950°C, and 20°C is subtracted, the displayed values will be extended back to the point where the first probe exceeds 930°C (shown on the graph by a cross-hatched background). If the displayed data then includes values which exceed the set point + tolerance, an alarm is triggered. The range of measurements used for analyzing performance at each temperature set point (and thus also the survey time) are not altered by using the overshoot check. Measured values which are added to the data grid by the overshoot check are marked in the grid by a black spot •.

*If telemetry is used, it is also possible to **check for overshoots in real time**, while a survey is in progress, by selecting this option in the Temperature Uniformity Survey Wizard.*

If one or more of the probes used in the current Temperature Uniformity Survey were **control thermocouples**, whose data should not be used in the analysis, click on the relevant buttons to **deselect those probes**. They will then not be used in analysis calculations.

Omitting control thermocouples from the analysis can also be selected while you are setting up the survey with the Temperature Uniformity Survey Wizard.

Choose whether to **highlight the temperature set point ranges** on the graph; colors used for the currently selected range and for the other ranges are selectable.

Choose whether to show horizontal marker lines for the **temperature tolerance limits** for each temperature set point.

Saving an Analysis

An analysis can be saved as a paqfile. There is a default directory in which paqfiles are stored, but you can browse to a directory of your choice.

To save the current analysis, select File > Save, or File > Save As > Paqfile.

To open an existing temperature uniformity survey, select File > Open > Paqfile.

The Printed Report

You can produce a customized printed report of the temperature uniformity survey. To specify the information to include in it, select File > **Print Options**. To print the file, click **Print** in the Print Options dialog, or select File > Print from the main menu. If you wish, preview it with File > **Print Preview**.

The printed report includes sections to be filled out after printing: for pass/fail acknowledgement, certifying signature, etc.

Settings chosen in Print Options are effective globally, i.e. they remain in force for all files until changed again. The settings are not stored within individual temperature uniformity survey files.

For use of the Print Options dialog with other aspects of Insight, see the Help system: Menu > File > Print Options.

*You may also specify the contents of your report, and print it, in a step-by-step process using the **Report Wizard**.*

Tabs in the Print Options dialog contain options as follows.

Report Sections

Under **Report Type**, select **Uniformity Survey**. This allows you to print a report comprising practical survey details, the calculated values, and items checked under Additional Information (see below).

It can be useful to leave Uniformity Survey selected as the default: if a uniformity survey is currently displayed on screen, a survey report will be printed; if any other paqfile is currently displayed, a full report (graph and analysis results) will be printed.

Under **Additional Information** you may select:

- **Graph** Shows the graph.
- **Measured Values** Shows the temperature values for each data point.
- **Correction Factors** Shows thermocouple correction factor data. (To print the correction factors alone, select File > Open > Furnace Surveying > Correction Factors.)
- **Audit Trail** Show the audit trail (see p. 45). (To print the audit trail alone, select 'Audit Trail' under 'Report Type' in this dialog.)

Click **Uniformity Survey** to choose further options for printing a temperature uniformity survey report (see below).

Layout

Report Title You may enter a title to appear on the report.

Margins Define distances from the text area to the edges of the page.

Temperature Uniformity Survey Print Options

Tabs in the Temperature Uniformity Survey Print Options dialog contain further options as follows.

Temperature Uniformity Survey

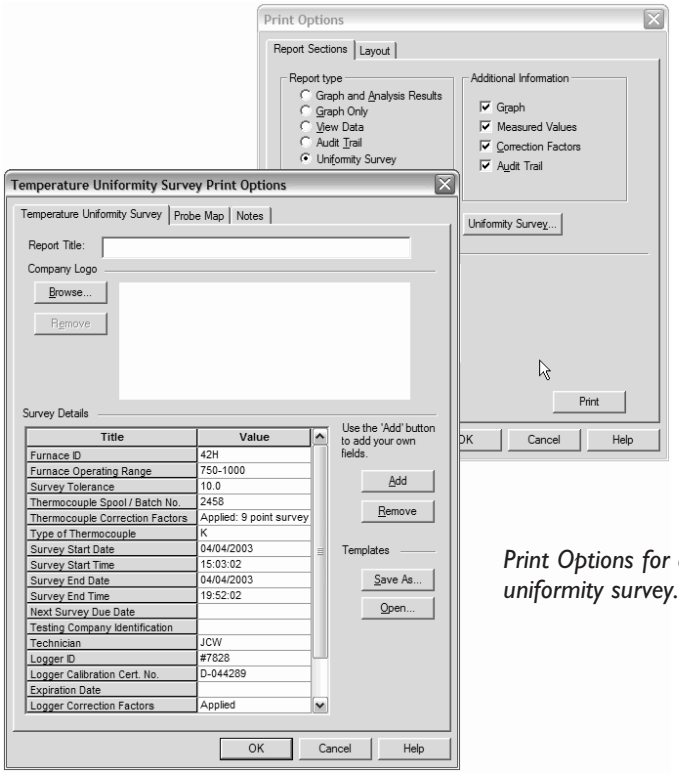
You may enter a **report title**. If you have a company logo to include, click **Browse** to locate the file. Any title and logo entered will become the new default.

Survey details which already form part of the file are included. You may add text for others listed as you wish.

Click **Add** to add additional fields of your own to the list. To remove a field you have added, click on it in the grid and then click **Remove**.

Any new fields added can be saved in a **survey details template file**. Click **Save As** to create a template file based on the current details, or **Open** to apply an existing template. Survey details template files carry a .RTM extension.

Whenever a template file is created or opened, its contents become the new default, i.e. the list of details for a new survey will include the new field(s). The contents of the field(s) are not part of the template.



Print Options for a temperature uniformity survey.

Probe Map

You may enter descriptive **names** for the probes.

If you have a **picture** of the survey rack (jig) – in BMP, JPG or GIF format – you can insert it here for identification and reference. If necessary, click to **rotate** it (clockwise, 90° at a time). To **remove** a picture, click .

You may display a **3D survey jig** on which probes may be positioned. Select the **jig shape** (cube, cylinder or hexagonal prism). To move a probe between the faces of the jig, click on it and then use the up and down keyboard cursor keys; drag it with the mouse to move it into final position. Click elsewhere on the image and use the mouse cursor to rotate it in three dimensions. An arrow shows the direction of travel.

Click **Large View** to see a bigger view of the product image in a separate window – and then re-size the image as you wish by dragging on the window's edges or maximizing it. This will enable you to see the probes more easily and to position them more precisely.

You can show the relative positions of the probes by dragging the yellow probe markers into position on the diagram/picture; positioning is much easier if a picture of the product is being used.

To add pictures of individual probe placements, which are linked to probe positions on the main picture, click **Probe Pictures**.

Probe names, positions and image can all be saved together in the product file. Click **Save** to save any changes you have made to the current details, **Save As** to create a new file containing the current details, or **Open** to apply the details contained in an existing file.

Changes made here to probe information become part of the uniformity survey file's process details, e.g. they will appear on the Product tab of the Process Details dialog (in the Help system, see 'Process Files: Furnace, Recipe, Product').

Notes

Enter any notes you might wish to record about the survey. These are additional to any notes entered in the Edit Notes dialog, which are also included in the printed report. If you have a picture – in BMP, JPG or GIF format – which you wish to include with the notes, you can insert it here. If necessary, click  to **rotate** it (clockwise, 90° at a time). To **remove** a picture, click .

Further Useful Features of Insight

Insight is a comprehensive and feature-packed analytical tool for use with heat-treatment processes. For a full description of the features and their use, see the software's Help system. The features described below are, however, of particular use or importance for temperature uniformity surveys.

Event Markers

In order to mark specific events as they occur during a real-time telemetry run, event markers can be inserted at any point while the run is actually in progress:

1. As the event occurs, click the event-marker button on the main toolbar or select Edit > Add Event Marker.
2. The Add Memo dialog appears, with **vertical-line memo** selected as default.
3. Enter any **text** for the memo, select a **color** for the line and click OK.
4. The position on the time/distance axis of the graph is marked by a thick, colored, vertical line; the memo text appears when the cursor is hovered over this.

Editing Memos

1. To reach the Edit Memo dialog, either:
   - Right-click on the memo on the graph, and select 'Edit', or
   - On the main menu select Edit > Memos, then
     Click in the text of the memo you wish to change, and click 'Edit' (or double-click on the text).
2. Edit the text, or change the background color (box memo only), or change the memo to/from a vertical-line memo.
3. Click OK.

From the Memos dialog you may also remove memos or add new ones.

Moving Memos

Box memo Move the memo's pointer by holding Control as you click on its arrowhead and drag it to a new position; the box and pointer move together. If necessary, then move the box alone by holding Control as you click within it and drag; the arrowhead stays fixed in its new position.

Vertical-line memo Move the marker line by holding Control as you click on and drag the line.

Hiding Memos

On the Profile Options tab of the Graph Options dialog (from View menu or right-click menu), uncheck **Memos Visible**.

Printing

When the graph is printed (p. 37), box memos appear as they do on screen; vertical-line memos appear with their text displayed.

Import from Clipboard

You may select data from a spreadsheet application and import it to a new or existing paqfile. This is accomplished by running the **Clipboard Paste Wizard** (select File > Utilities > Import from Clipboard).

The procedure is largely self-explanatory: enter information as prompted by the wizard, then click **Next** at the end of each stage. The wizard proceeds as follows.

Copy to Clipboard

In this first wizard stage, open your spreadsheet application, select the required range of temperature data, and copy it into the Windows clipboard.

Paste

On clicking **Paste**, Insight interprets the contents of the Windows clipboard and displays the first few measurements.

If the data in the clipboard is not in the correct format, an error message will suggest what is wrong.

Paqfile Information

To make the data suitable for a paqfile, enter the **sample interval** and **temperature units** of the original data.

If you wish, add **probe names**, and **date** and **time** for the original data; use the date format dd/mm/yy or (if different) the short date format set in Windows (in Windows XP, see Control Panel > Regional and Language Options).

Create or Merge

Choose whether the pasted measurements should be used to **create a new paqfile** or whether to **merge them with an existing paqfile**.

If being merged, specify whether to:

- Merge with the current paqfile (the one currently displayed on screen), or

- Load a new paqfile with which to merge the pasted measurements; browse to select the paqfile required.

When merging, you may apply thermocouple correction factors to the imported measurements; browse to select the thermocouple correction factor file.

If imported measurements are merged with an existing paqfile:

- *The new data is assigned to **additional thermocouple numbers**. For example, if merging with a paqfile with probes numbered 1 to 6, the imported probes would be numbered from 7 onwards.*
- *The paqfile will have entries added to its **audit trail** to indicate that some of the probes were imported and (if used) that thermocouple correction factors were applied to the imported measurements.*
- *You may need to **adjust probe alignment** for the imported measurements if they do not correspond with the existing data's time axis; select Process > Adjust Probe Alignment.*

To import data in the whole of an existing file which is in .TXT or .CSV format, select File > Utilities > Import from File.

To export data from a uniformity survey or other paqfile, zoom the display to restrict it to the required data, and select Edit > Copy.

Emailing a Paqfile

To send the currently displayed uniformity survey (or other paqfile) as an email, select File > Send. This opens a new email message in your default email program with the paqfile attached.

Audit Trail

The audit trail is contained within a saved uniformity survey (or other paqfile) and summarizes key events in the history of the paqfile which may have affected the integrity of the data. Events are listed in the order in which they happened. The date/time of the event and the operator responsible are shown unless not appropriate to the entry.

To view the audit trail, select File > Properties to open the Paqfile Properties dialog, and click Audit Trail.

The Paqfile Properties dialog is also available from the graph right-click menu.

To print the Audit Trail, select File > Print Options from the main menu.

Troubleshooting

Some potential problems and their likely solutions are as follows.

Stabilization at one or more temperature set points has been achieved, but stabilization at the next set point takes so long that the data logger is close to going over its maximum permitted temperature (an alarm is shown).

Remove the system from the furnace at once to avoid damaging the logger. Conduct the survey on a subsequent day, starting with the temperature set point that caused the problem, and proceeding to any set points above that. In the meantime, the furnace can be used at the lower set points if their required tolerances were achieved.

When running a uniformity survey with telemetry, and with alerts set for stabilization and minimum survey time, alerts do not appear even though stabilization for the specified time has clearly been achieved.

Check that you have deselected unused thermocouples when resetting the logger as part of the Temperature Uniformity Survey Wizard ('Select Probes and Sample Interval' stage, p. 28).

When running a uniformity survey with telemetry, receipt of signals fails at certain furnace temperatures, but the logger subsequently downloads the survey's full data.

Check the PC's specification (especially older laptops), as the PC may be running out of resources at the same point in each survey, making the problem appear to be temperature-related. The recommended combination is at least 1 GHz processor, 2 Gb of RAM and 100 Mb free hard disk space.

When the data logger is used externally to the furnace, and is connected to the mains electricity via its charger and/or via a PC which is itself attached to the mains, data gathered is erratic.

Isolate the system from the mains electricity by running the logger and/or PC (as necessary) from their internal battery power. If the problem is then resolved, it is caused by earth (ground) loops developing. In this case, a Datapaq opto-isolator (part no. CS3091) should be connected between the logger and the PC (not necessary with the XDL12 logger, which has built-in protective circuitry). If using the TP3 logger, this problem is solved by using Bluetooth communication between logger and PC rather than a physical connection (see the *Datapaq TP3 Data Logger User Manual*).

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