

EasyTrack[®]3

USER MANUAL

including

Datapaq[®] ET3

Data Logger

and

insight
software

Issue 1



Fluke Process Instruments

EasyTrack[®]3

User Manual

including Datapaq[®] ET3 Data Logger and **insight**
software

Issue 1



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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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.

The following product types

Datapaq ET3 Thermocouple Data Logger
manufactured by Datapaq Ltd.,
Lothbury House, Cambridge CB5 8PB, UK
comply with the requirements of regional directives
as follows.

European Union

Directive 2014/30/EU – ElectroMagnetic
Compatibility (EMC).

EN 61326-1:2013 – Group I, Class B equipment



(emissions section only), and Industrial Location
Immunity (immunity section only).

Directive 2011/65/EU – Restriction of the use of
certain hazardous substances in electrical and
electronic equipment (RoHS).

Federal Communications Commission, USA

Electromagnetic Compatibility Directive for digital
devices

CFR47 Class A – Code of Federal Regulations:
Part 15 Subpart B, Radio Frequency Devices,
Unintentional radiators.



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

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Uffs version 1.3.6

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USB drivers – libusbK version 3.0.7.0

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CONTENTS

9 *Introduction*

11 *Logger Specifications and Operation*

- 12 Specifications**
- 13 Logger LEDs**
- 15 Start/Stop Button Actions**
- 15 Battery**
- 18 Over-temperature Protection**
- 19 Testing and Calibration**
- 19 Disposal of Batteries and Loggers**

21 *Thermal Protection – Barriers and Heatsinks*

- 21 Aluminum Thermal Barriers**
- 23 Stainless-steel Thermal Barriers**
- 24 Selecting a Thermal Barrier**
- 24 Care of Thermal Barriers**
- 25 System Carry Bag**

27 *Thermocouple Probes*

- 27 Thermocouple Specifications**
- 28 Thermocouple Cable Insulation**
- 29 Thermocouple Types and Accessories**
- 32 Working with Thermocouple Probes**

37 *The Basics of Insight Software*

- 37 Installing/Removing Insight**
- 38 Communications Setup**
- 41 User Interface**
- 49 File Management**
- 51 Logger Defaults and Details**

57 *Running a Temperature Profile*

- 57 Resetting the Data Logger**
- 61 Starting the Run**
- 63 Placing the System in the Oven**
- 63 Removing the System from the Oven**
- 64 Downloading Data**
- 65 The Next Profile Run**

67 *Using Hardwired Telemetry*

- 67 Running a Temperature Profile Using
Hardwired Telemetry**

71 *Data Analysis*

- 71 Specifying Oven Start and Process End**
- 77 Analysis Modes**
- 85 SmartPaq**
- 87 Working with the Graph**

93 *Troubleshooting*

- 93 Logger Download Error Messages**
- 93 Logger Communications Problems**
- 94 Checking the Data**
- 94 Testing the Logger and Thermocouples**
- 95 Printing Problems**
- 95 Datapaq Service Department**

96 INDEX

Introduction

The EasyTrack®3 system – part of the family of Datapaq® Tracker systems, incorporating Insight™ EasyTrack software – is a complete system for monitoring and analyzing the temperature profiles of products in the general coating and finishing industry; accurate data acquisition and powerful analysis techniques are combined with flexibility and ease of use.

Current temperature characteristics can quickly be compared with previously-stored reference curves to detect operating abnormalities – and innovative analysis techniques help in identifying problems, fine-tuning the process and reducing running costs.

A powerful and flexible printing option allows the user to generate and customize reports, including any or all of the analysis results as well as raw temperature data.

The basic EasyTrack3 system hardware comprises:

- Datapaq ET3 data logger and communications lead.
- One or more thermal barriers.
- Thermocouple probes.

The system is supplied in four variants, tailored to different areas of use:

EasyTrack3 Standard – General use in the powder-coating industry, including jobshops.

EasyTrack3 Advanced – Where there are specialist probe-attachment requirements.

EasyTrack3 HiTemp – For high-temperature applications.

EasyTrack3 Professional – Meeting the needs of manufacturers and suppliers of powder coatings.

The Professional system is supported by **Insight EasyTrack Professional** software, which includes numerous usability and analysis features additional to those in the standard Insight EasyTrack software. These include SmartPaq (p. 85), multiple runs (p. 60), process files (p. 74), oven zones (p. 76), wizards (p. 48), opening multiple files (p. 49), 3D and thermograph views (p. 47), customizable reports (p. 49) and data import (p. 51); see also p. 77.

Components of the systems are as below.

	EasyTrack3 Standard	EasyTrack3 Advanced	EasyTrack3 HiTemp	EasyTrack3 Low Height	EasyTrack3 Professional
Logger channels	4 or 6	4 or 6	4 or 6	4 or 6	4 or 6
Insight software (p. 37)	Insight EasyTrack	Insight EasyTrack	Insight EasyTrack	Insight EasyTrack	Insight EasyTrack Professional
Thermal barrier (p. 21)	TB0253	TB0253	TB5000-HT	TB2037	TB0263
Thermocouples (p. 27)	Exposed junction	Clip or magnetic	Glass fiber	Adhesive patch	Clip or magnetic
Carry bag (p. 25), probe ID tags (p. 31), probe clamp (p. 29)	–	–	–	–	•

This *User Manual* is a complete guide to use of the system, with major sections covering the following:

The data logger (p. 11) – Features and operation of the ET3 logger.

Thermal barriers (p. 21) and **thermocouple probes** (p. 27) – Selection and use.

Insight software (p. 37, p. 71) – All the key features of the Insight EasyTrack and EasyTrack Professional software, including those used when running a temperature profile (p. 57) and when analyzing the resultant data (p. 77).

Hardwired telemetry (p. 67) – Collecting and viewing temperature data in real time.

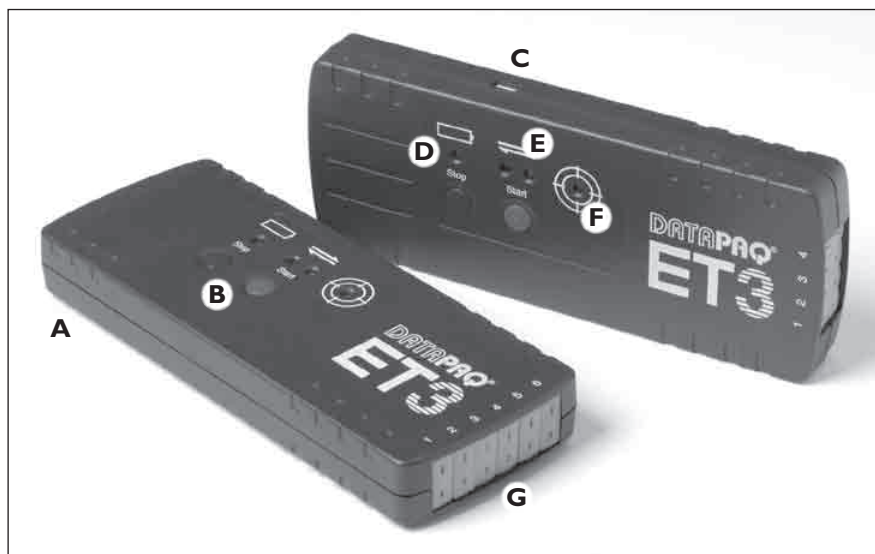
Troubleshooting (p. 93) – Software error messages and other problems, and testing operation of the logger and probes.

Logger Specifications and Operation

The ET3 data logger is at home in a wide range of coating and finishing applications. Its capacity for recording 18,000 data-points combined with simplicity in use makes it a powerful and flexible data-collection tool.

The logger's key features are:

- Large **memory capacity** for detailed process analysis: up to 18,000 data-points can be recorded on each thermocouple channel for each temperature profile run (p. 12).
- Either four or six **thermocouple channels** (depending on model; see below).
- Uses **type-K thermocouples** (see p. 27).
- Powered by standard **alkaline PP3 battery** (see p. 15).
- Short **sample intervals**, to collect maximum data in minimum time (p. 12).



ET3 loggers: 6-channel and 4-channel types.

A battery compartment-door (on rear, see p. 16); **B** stop/start buttons (p. 15);

C USB communications socket (p. 38); **D** battery-status LED (p. 13);

E logger-status LEDs (p. 14); **F** SmartPac LED (p. 85); **G** thermocouple sockets.

- High **accuracy** for compliance to tight specifications (see below): $\pm 0.5^{\circ}\text{C}/0.9^{\circ}\text{F}$.
- Data gathered by the logger but not yet downloaded ('**hot data**') is protected by non-volatile memory or by software warning if reset is attempted before download.
- **USB** communication (p. 38).
- **Hardwired telemetry** (p. 67) – with full analysis functions and alarms to warn the user if the process is out of specification.
- Four **LEDs** to show the exact status of the logger's activity and its batteries (p. 13).
- **Start and stop buttons** for easy user control (p. 15).
- **Rugged case** and **coated electronics** allow operation in industrial environments.
- **Reset** possible by start button alone, for speed and simplicity (p. 61).
- **Multiple-run capability** (p. 60) and instant **pass/fail SmartPaq analysis** (p. 85) (*Insight EasyTrack Professional software only*).

Specifications

Height 20.5 mm/0.8 in. **Width** 67 mm/2.65 in. **Length** 170 mm/6.7 in. **Weight** 200 g/0.44 lb.

Thermocouples	Type K.
Measurement range	-150°C to $500^{\circ}\text{C}/-238^{\circ}\text{F}$ to 932°F .
Accuracy*	$\pm 0.5^{\circ}\text{C}/0.9^{\circ}\text{F}$ (above $-100^{\circ}\text{C}/-148^{\circ}\text{F}$). (For thermocouple accuracy, see p. 27.)
Resolution	$0.1^{\circ}\text{C}/0.2^{\circ}\text{F}$.
Number of data channels	Four (logger part no. ET4043) or six (ET6063).
Operating temperature (of the logger itself)	$0-85^{\circ}\text{C}/32-185^{\circ}\text{F}$.
Humidity range	0–85% non-condensing.
Real-time monitoring	Hardwired telemetry via communications lead (p. 67).
Data capacity	18,000 data-points, regardless of number of channels in use. In multiple-run mode (p. 60), each channel can store up to 18,000 data-points on each of three runs.
Hot-data protection	By non-volatile memory, and software warning if reset attempted before download.
Logger reset	By Insight (p. 57) or by start button (using previous reset options) (p. 61).
Sample interval	0.5 s to 60 min. Intervals of 1 s and above can be set only in whole seconds.
Data-collection start (trigger mode)	Auto start, Start button, Rising temperature (see p. 59).
Pre-trigger data stored	Yes (configurable; see p. 51).

Multiple runs	Collect data from up to three runs before downloading (<i>EasyTrack Professional only</i> ; see p. 60).
Onboard features	Data analysis (SmartPaq function, <i>EasyTrack Professional only</i> ; see p. 85). Storage of calibration data (see p. 52).
Communications	USB 2.0, Mini-B socket.
PC/software compatibility	See p. 37.
Battery	Alkaline 9 V; PP3/6LR61/1604A (see p. 15). For battery life, see p. 16.
USB power	Logger is powered by USB when connected; no batteries are then required (except when being reset for a non-telemetry run; see p. 57).

* There will be an additional error of 0.01°C for every 1°C difference between the temperature at which the logger is operated (i.e. the logger's internal temperature) and the temperature at which it was calibrated. For more-detailed accuracy data, contact Datapaq.

Due to continuing product development, specifications are subject to change without notice.

Logger LEDs

The logger is equipped with four LEDs:

- **Yellow** LED shows the status of the **battery**.
- **Red** and **green** LEDs show the status of the **logger and its memory**.
- Bicolor **green/red** LED shows the SmartPaq result (*Insight EasyTrack Professional only*).

To see an **animated demonstration** of all the LED sequences: in Insight, select Help > LED Sequences; or, in Insight's Help system, select Introduction > Logger LEDs.

Battery Status LED

Yellow	Meaning
Off	Battery has at least 20% of full charge.
Flashing every second	Battery has 20% or less of full charge. Data-recording cannot then start until the battery is charged or replaced (unless the communications lead is left connected, as in hardwired telemetry, p. 67).

Logger Status LEDs

Red	Green	Meaning
Red and green LEDs each give 5 flashes, <i>alternating</i> with each other		Logger successfully reset.
Red and green LEDs flash continuously, <i>alternating</i> with each other, at sample interval *		Logger awaiting trigger (see p. 59) (in most situations, except as below).
Red and green LEDs continuously give double-flash <i>together</i> , every 5 seconds		Logger awaiting trigger for 2nd or 3rd run in multiple-run mode (see p. 60).
On	Flashing at sample interval *	Logger awaiting trigger, but one or more of the input channels is open circuit.
Red and green LEDs flash <i>together</i> , at sample interval *		All probes are above trigger temperature, and thus data-recording cannot be triggered by rising temperature. Reset temperature trigger (see p. 59).
Off	Flashing at sample interval *	Logger acquiring data.
Flashes 5 times	Off	Occurs when connection is made between logger and a working PC, using communications lead.
Flashing every 5 seconds	Off	Logger has data in memory which has not been downloaded. (Logger will power-off after 5 mins.)
2 quick flashes every second	Off	Logger too hot to start logging (after pressing start button).
Flashing every second	Off	Internal error. (Logger will power-off after 5 mins.)

* Flashing interval will actually fall in range 0.5–5 s.

SmartPaq LED

(For Insight EasyTrack Professional only.) If SmartPaq parameters have been setup for a profile run (see p. 85), the bicolor SmartPaq LED shows as below. SmartPaq analysis calculations are performed continually while the logger is collecting data; thus the LED indication may change during this time.

Green/Red	Meaning
Green	Pass.
Red	Fail.
Off	SmartPaq was not enabled during the last logger reset with Insight.

Four-LED Sequence

When green and red buttons are pressed, together, to **turn off logger** (see below), all four LEDs flash together, once.

Start/Stop Button Actions

Action	Results	Notes
Press GREEN button and hold for 1 second <i>after data from previous run has been downloaded and/or logger has been reset.</i>	Starts logging (even if logger was powered off).	If logger was not reset after previous run, the last data-collection options (sample interval, etc.) are used as default. In telemetry mode, logger also starts sending data.
Press GREEN button <i>when logger contains 'hot data', i.e. data which has not been downloaded.</i>	If in <i>single-run mode</i> or if in <i>multiple-run mode</i> and <i>three runs have been performed</i> (p. 60), logger powers up (but will not start a new run or delete data). If in <i>multiple-run mode</i> and <i>fewer than three runs have been performed</i> , logger starts logging.	Each run of a multiple run will be performed using the same data-collection options, until the logger is reset.
Press RED button.	Stops logging.	Data retained in memory. Logger cannot be restarted until data is downloaded (unless in multiple-run mode, p. 60). Red LED flashes every 5 seconds to warn of data in memory. If in telemetry mode, will also send 'end of run' signal to end real-time run.
Press GREEN and RED buttons together and hold for 5 seconds.	Turns logger off. All four LEDs flash together, once.	Data retained in memory. The previous reset options are retained as current default.

Battery

The ET3 logger requires one 9 V PP3 (6LR61 or 1604A) **alkaline** battery.

*Datapaq recommends the use of **Duracell, Varta or other quality batteries.** **Do not use** zinc-carbon or zinc-chloride batteries, rechargeable batteries, batteries that may have been used previously, or batteries outside their shelf life.*

The ET3 employs non-volatile memory, so – even when the battery is replaced – data stored in the logger will not be lost.

*When the communications lead is attached, the logger is **powered via USB.** Batteries can be left in the logger, but they are not then required (except when the logger is being reset for a non-telemetry run; see p. 57).*

Replacing Battery

1. Ensure the logger is **powered off**: press green and red buttons together, and hold for 5 seconds.
2. On the rear of the logger, press on the **battery-compartment door** and slide it open. See photo.
3. Remove the **old battery**, and dispose of it appropriately (see p. 19).
4. Place a **new alkaline battery** into the compartment, observing polarity.
5. **Secure the battery-compartment door** by sliding it back into place.



Opening the battery-compartment door.

For **disposal of batteries**, see p. 19.

Battery Life

Battery life is affected by the following factors.

- **Operating Temperature** – Essentially, the higher the ambient temperature the battery operates in, the shorter will be the life. Batteries that operate for a large part of the process cycle at relatively low temperatures will have a longer life than those that operate for the majority of the process cycle at the maximum operating temperature.
- **Sample Interval** – The shorter the sample interval, the shorter will be the battery life. This is because power is being consumed each time the logger takes a reading. A short sample interval will achieve the maximum amount of information, but this must be balanced against the greater battery charge required.
- **SmartPaq** – Using SmartPaq (p. 85) shortens battery life.

Given the factors that can affect the life of a battery it is obviously difficult to predict accurately. The LED on the logger will give the best indication of when the battery is low. In the user's own conditions, experience will quickly indicate typical battery life, and a log should be kept for the first few runs, noting sample interval.

The data below can serve as a guide – though the values given are no more than an indication of the battery life that can be expected.

No. of Channels	Sample Interval (sec.)	Logger Temperature	Using SmartPaq	Battery Life (hrs), Without Telemetry*
6	5	25°C/77°F	No	360
6	5	25°C/77°F	Yes	250
6	5	80°C/176°F	No	350
6	5	80°C/176°F	Yes	250

* Data gathered using Varta Industrial 4022; other batteries may give shorter life.

The logger will comfortably perform over 50 profile runs and downloads, logging for 1 hr at a logger temperature of 70°C with 5-s sample interval and SmartPaq enabled.

During hardwired telemetry (p. 67), the logger is powered via the communications lead, not from the battery.

Charge Level of Battery

When the battery's charge drops to 20% of the full level, this will be shown by the **logger LED** (p. 13).

When connected to the PC, the **Insight software** shows the logger's battery-charge level as a percentage of full charge, as follows:

- In the main Logger Reset dialog (p. 57).
- When using wizards which reset the logger (*Insight EasyTrack Professional only*).
- During communications setup (p. 39).

Battery-charge level displayed by Insight assumes use of Varta Industrial 4022 or Duracell Procell/Industrial MNI604. Using an inferior type may cause misleading percentages to be shown.

Auto Power-off

To save battery life, the logger will **power-off automatically** in the following situations.

- The communications lead is unplugged when the logger contains no data (e.g. after a data-download).
- The PC is powered down while the logger is connected to it.

- The logger contains data from a previous run which has not been downloaded (the logger-status red LED will be flashing every 5 seconds), and has been in this state for 5 minutes. Note that:
 - The power-off will not cause this data to be lost.
 - The data will continue to be marked as ‘not yet downloaded’, reducing the chance of it being accidentally deleted later.
- The logger-status LEDs have been indicating an error (red LED will be flashing every second) for 5 minutes.

*When the communications lead is attached, the logger is **powered via USB** and will not automatically power-off.*

The logger will **automatically come out of power-off mode** in the following situations.

- The communications lead (connected to a powered PC) is plugged in. The logger is then ready to communicate with the PC.
- The start button is pressed. The logger will then resume the mode that it was in when it powered-off, e.g. not-yet-downloaded data will continue to be protected from accidental deletion.

Over-temperature Protection

The logger and the Insight software work together to reduce the likelihood of corrupt or inaccurate data being recorded due to the logger’s internal temperature being too high. (For the logger’s operating-temperature range, see p. 12.)

- Insight can be instructed to **show a warning message if a reset is attempted**, or to **prevent a reset**, while the logger is above a specified temperature (default 45°C/113°F); see p. 53.
- If logging is started without resetting the logger using Insight (i.e. by simply pressing the start button and thus using the previous reset options; see p. 61), the logger **will not start logging** if its internal temperature is above 45°C/113°F. The logger-status red LED will show 2 quick flashes every second.
- If the logger’s internal temperature exceeds 85°C/185°F it shuts down, preserving data already collected. When the data is downloaded, Insight will give a warning that this has happened.

The logger records its internal temperature during a profile run. For access to this data, see p. 53.

To check the logger’s current internal temperature when connected to a PC running Insight, select Logger > Setup and click ‘Diagnostic’ (p. 40).

Testing and Calibration

It is recommended that the logger is tested and calibrated by Datapaq at least once a year. The Datapaq calibration procedure comprises:

- Inspection of the logger, externally and internally.
- Battery- and charge-testing.
- Heat-cycle test of up to 14 hrs in Datapaq's own ovens.
- Stability testing, using a stable temperature source and varying ambient temperatures.
- Calibration and updating of the logger's firmware.
- Issue of calibration certificate.

To calibrate your logger, please return it to the Service Department at Datapaq (see p. 95).

For full certification and traceability, calibration data is stored in each logger for instant access by Datapaq engineers. To **print a calibration certificate** for a logger, in Insight select File > Print Calibration Certificate, and then choose whether to print a certificate for:

- The logger which was used to create the currently-displayed paqfile (temperature profile). *or*
- The logger (if any) which is currently connected to the PC.

*To carry out your own **basic testing of the operation of the logger and its thermocouples**, see p. 94.*

Disposal of Batteries and Loggers

Always adhere to the applicable statutory regulations for recycling and waste disposal. For details of recycling Datapaq products within the European Union, see www.fluke.co.uk.



Under the European Union Batteries and Accumulators Directive, the used **alkaline batteries** which are removed from the logger by the user should be disposed of at an appropriate recycling center.



Under the European Union WEEE Directive, users should return **all loggers** (whether or not containing batteries) to Datapaq for disposal at the end of their useful life.

Thermal Protection – Barriers and Heatsinks

A Datapaq thermal barrier provides the thermal and mechanical protection necessary for the data logger to survive in the hostile environment of an industrial oven.

Ceramic insulation covered by a ceramic fiber cloth provides the primary thermal protection, and a heatsink filled with a non-toxic, non-flammable phase-changing material provides additional, secondary protection allowing the system to operate at high temperatures for extended periods. The phase-changing material absorbs the heat and maintains a temperature of 58°C/136°F until all the material has changed from solid to liquid state.

*The ceramic insulation material will absorb **moisture** if stored in a damp environment – and this may also happen during the thermal barrier's manufacture. Although this will not damage the barrier, its performance will be degraded until the moisture is removed. Thus, if you suspect this has happened, or if using a **new barrier**, run it (sealed and containing heatsinks if supplied, but excluding the data logger) once through your process to remove the moisture.*

*To eliminate risk of contamination, **it is strongly recommended that barriers are examined after each use** (see p. 24): check the seals and integrity of the insulation carefully. If damaged excessively, it is possible that insulation material may escape and cause particulate contamination within the oven. If in any doubt about the safety of the equipment, or contamination, contact Datapaq.*

Aluminum Thermal Barriers

These barriers' key features are:

- Casing made from deep-drawn **aluminum** for lightness.
- **Steel probe-plate on lid** for convenient attachment of magnetic probes.
- **Handles** for convenience of carrying and for hanging in the oven. Handles can be **locked** into position for extra ease and safety when recovering from hot oven.
- **Strong catches** with locking pins to maintain secure lid even if dropped (TB0263).
- **Angled heatsink** (TB0263) holds logger securely in open barrier, even if vertical, and allows strain-free routing of cables out of the barrier.

- **Long thermal duration** gives assurance during multiple runs and process delays (see data below).



*EasyTrack3 aluminum thermal barriers and their heatsinks:
TB0253 (left) and TB0263 (right).*

TB0253 Standard EasyTrack3 (with Heatsink)

Typical applications: general paint/powder/E-coat processes.

Temp. °C	100	150	200	250	300
Temp. °F	212	302	392	482	572
Duration (mins)	330	180	120	75	40
Dimensions	Height	Width	Length	Weight	
	110 mm	185 mm	265 mm	3.0 kg	
	4.3 in.	7.3 in.	10.4 in.	6.6 lb	
Heatsink	1 × TB9550				

A wide range of thermal barriers is available from Datapaq for use with loggers other than the ET3.

TB0263 Professional EasyTrack3 (with Heatsink)

Typical applications: advanced paint/powder/E-coat processes, and paint-suppliers.

Temp. °C	100	150	200	250	300
Temp. °F	212	302	392	482	572
Duration (hours)	9	4.5	3.0	1.8	1.0
Dimensions	Height	Width	Length	Weight	
	125 mm	187 mm	297 mm	3.7 kg	
	4.9 in.	7.4 in.	11.7 in.	8.2 lb	
Heatsink	1 × TB9950				

Stainless-steel Thermal Barriers

TB2037 Low-height EasyTrack3

For short-duration processes.

Temp. °C	100	150	200	250	300
Temp. °F	212	302	392	482	572
Duration (mins)	30	18	13	–	9
Dimensions	Height	Width	Length	Weight	
	31 mm	90 mm	229 mm	0.5 kg	
	1.2 in.	3.5 in.	9.0 in.	1.1 lb	
Heatsink	None				

TB5000-HT High-temperature EasyTrack3 (with Heatsink)

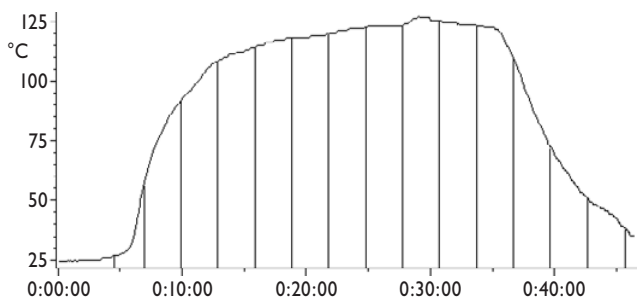
Fitted with glass-fiber-rope thermocouple-exit seal for high-temperature operation. Typical application: high-temperature coating cure, e.g. PTFE, Dacromet.

Temp. °C	100	150	200	250	300	400
Temp. °F	212	302	392	482	572	752
Duration (hours)	14.5	6.5	4.5	3.5	3	1.5
Dimensions	Height 130 mm 5.1 in.	Width 190 mm 7.5 in.	Length 292 mm 11.5 in.	Weight 6.2 kg 13.7 lb		
Heatsink	2 × TBI001					

Selecting a Thermal Barrier

The protection which the thermal barrier needs to provide for the logger depends on the nature of the process whose temperature is being profiled – primarily its temperature and duration. Selection of the appropriate barrier needs thus to be done carefully, as follows.

1. Plot a graph of the temperature versus time characteristics of the process.
2. Divide the horizontal axis into equal increments and draw verticals. Read the temperature at each vertical. (The number of verticals is determined by the complexity of the profile's shape: more are required when the shape is complex, fewer when it is simple.)



*A typical temperature profile experienced by an automotive component during curing.
The average temperature is 90°C/194°F.*

3. Divide the sum of the temperatures by the number of verticals to calculate the average temperature. Modify this temperature as follows:
4. Add 15% if the maximum temperature is reached in the first third of the process.
5. Add 10% if the maximum temperature is reached in the first half of the process.
6. Taking into account the process height and width restrictions, select a barrier meeting or exceeding this temperature/time profile.

Care of Thermal Barriers

Before using a new barrier for the first time, or if you suspect a barrier has absorbed moisture, you should run it once through your process without the logger to remove the moisture; see p. 21.

After every run through the oven, and once cooled, examine the thermal barrier and heatsink (if used) (and thermocouples) for damage.

Check the barrier's seals and closing mechanism, and rectify any damage before further use. Some sealing catches are designed to be set easily by hand, and may require some adjustment after the first four or five runs.

Examine the heatsink's **thermometer strip**. If the temperature has exceeded 77°C/171°F allow the heatsink to cool to around 15°C/60°F and then place it in a freezer at -20°C/-5°F overnight; this ensures the phase-change material crystallizes. After freezing, allow the heatsink to return to room temperature. If the thermometer strip has recorded a temperature greater than 77°C/171°F, peel it off and replace it.

If the heatsink phase-change material leaks, contact Datapaq. It is a non-toxic wax-like substance that dries hard powdery white and has a slight acidic smell. Wait until it is dry before scraping off any material that has leaked onto the surface of the barrier.

Store the thermal barrier in a dry environment to prevent its insulation from absorbing any water (see p. 21).

System Carry Bag

The Datapaq CC0049 soft carry bag (included with *EasyTrack3 Professional*) provides convenient transportability for a complete system, including a thermal barrier.



Soft carry bag (CC0049).

Thermocouple Probes

Thermocouple probes utilize the Seebeck effect, discovered in the nineteenth century, by which an e.m.f. is produced in any electrically conducting material that is not at uniform temperature. The actual voltage measured is proportional to the temperature difference between the thermocouple's 'hot' and 'cold' junctions (the hot junction being the measurement junction, and the cold junction being the junction of thermocouple and measurement instrumentation).

The practical implementation of thermocouples requires sophisticated electronics to eliminate potential measurement errors which include poor linearity over the measurement range, and inaccuracy due to temperature variations at the cold junction. To accommodate these the electronics in the measuring system must simulate a temperature of 0°C/32°F at the cold junction, as well as compensating for any non-linearity over the range of thermocouple operation.

Over the years, 'standard' thermocouples have been developed using materials chosen for sensitivity, linearity (consistency of sensitivity over the useful temperature range), price and availability. Current standards include types K, N, R, S and T, each type being identified by its connector color.

Thermocouple Specifications

The standard thermocouple probe for oven operation is **type K**, which has a hot junction combining nickel-chromium alloy and nickel-aluminum alloy. This is the only type which can be used with the ET3 logger. International specifications for type K define a sensitivity and linearity over the range 0–1,250°C/ 32–2,282°F, though operating range is limited in practice by the cable insulation (see below).

Type K thermocouples supplied by Datapaq are exceptionally durable, quad-wrapped, 10-strand 36 AWG (0.125 mm/0.005 inch); connectors and cables are green, following the IEC584 color standard.

Probe Type	Temperature Range	Cable Insulation	Accuracy of Probes Supplied by Datapaq
K	-150°C to 1,370°C/ -238°F to 2,498°F	PTFE, ceramic, mineral insulation, glass fiber	±1.1°C/2.0°F (or ±0.4% if greater) at 0–1,250°C/32–2,282°F

Thermocouple Cable Insulation

The practical operating temperature of the thermocouple probes is limited by the cable insulation material's temperature characteristics.

Insulation	Upper Temperature Limit
Glass fiber, thin	500°C/932°F
Glass fiber, thick	500°C/932°F continuous, 700°C/1,292°F peak
Mineral insulation (MI)	1,250°C/2,282°F
PTFE	265°C/509°F

Glass-fiber-insulated probes are available in both thin and thick forms. Impregnated with a silicone resin binder, thin-glass-fiber-insulated probes are more robust than thick-glass-fiber-insulated probes; they are suitable for use at temperatures up to 500°C/932°F. Thick-glass-fiber-insulated probes are more flexible than thin, being less impregnated with silicone resin; they are more suitable for oven use, and are capable of continuous operation at temperatures up to 500°C/932°F, and short-term operation at up to 700°C/1,292°F. They can be used when probe cables are close to heating elements.

Mineral-insulated (MI) probes have an enclosed junction providing increased immunity to electrical interference. Less flexible than PTFE or glass fiber, but suitable for use up to 1,250°C/2,282°F, they can be used when probe cables may be close to heating elements.

PTFE (polytetrafluoroethylene)-insulated probes are suitable for general-purpose use at temperatures up to 265°C/509°F. PTFE is a robust, flexible, non-stick material, with a low thermal mass and therefore a quick response time. This is the standard insulation for oven use, though **it cannot be used when probe cables may be close to infra-red heating elements.**

WARNING

PTFE does not support combustion, but decomposes above 265°C/509°F producing small amounts of toxic fumes.

The important products from PTFE thermal decomposition are as follows.

At Temperatures Greater Than	Product
400°C/752°F	See note*
430°C/806°F	Tetrafluoroethylene
440°C/824°F	Hexafluoropropylene
475°C/887°F	Perfluoroisobutylene
500°C/932°F	Carbonyl fluoride*, which, in moist air, converts to the acid gas hydrogen fluoride

* Carbonyl fluoride may also be produced if PTFE tape is kept at 400°C/752°F for an extended time.

Health-hazard Data

- Inhalation of decomposition products from PTFE can produce 'polymer fume fever', which has flu-like symptoms.
- There is no risk from ingestion or skin contact.
- There are no medical conditions generally aggravated by exposure to PTFE.

Emergency and First-aid Procedures

- If there is accidental contact with PTFE fumes, remove the person concerned to clean air.
- Self-contained breathing apparatus and protective clothing should be worn when fire-fighting.

Thermocouple Types and Accessories



Exposed-junction Thermocouples

Taped, spot-welded or soldered direct to components for measuring surface temperature. Can also be used to measure air/environmental temperature.

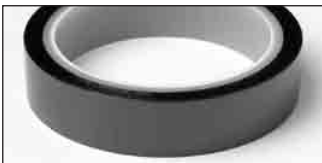
PTFE-insulated cable, maximum 265°C/509°F

- PA0063 1.5 m/5 ft
- PA0065 2.0 m/6.5 ft
- PA0064 3.0 m/10 ft



Glass-fiber-insulated cable, maximum 500°C/932°F

- PA0182 1.5 m/5 ft
- PA0181 2.0 m/6.5 ft
- PA0180 3.0 m/10 ft



High-temperature Adhesive Tape

For securing exposed-junction and patch thermocouples. Pressure-sensitive silicone adhesive. Maximum 400°C/752°F.

HT0090 30 m/98.4 ft



MicroMag Thermocouple Mount

For securing exposed-junction thermocouple to ferrous substrate to measure temperature of air or (using high-temperature tape) substrate.

PA0980



Adhesive-patch Thermocouple

Attaches directly to light-gauge metal or plastic with adhesive patch and/or high-temperature tape. Ideal where fast response is required or in infra-red processes. PTFE-insulated cable. Maximum 265°C/509°F.

PA0060 1.5 m/5 ft

PA0062 3.0 m/10 ft



MicroMag Magnetic Thermocouples

Attaches directly to ferrous substrate using strong SmCo magnet with diameter only 17 mm/0.67 in. Ideal for measuring temperature in tightest of recesses (aluminum knob can be removed). PTFE-insulated cable. Maximum 265°C/509°F.

Air Thermocouple

PA0995 1.5 m/5 ft

PA0996 3.0 m/10 ft

PA0999 6.0 m/20 ft

Surface Thermocouple

PA0973 1.5 m/5 ft

PA0974 3.0 m/10 ft

PA0975 6.0 m/20 ft



Surface Offset Magnetic Thermocouple

Attaches directly to flat ferrous substrate to measure surface temperature. PTFE-insulated cable. Maximum 265°C/509°F.

PA0053 1.5 m/5 ft

PA0054 3.0 m/10 ft

PA0050 6.0 m/20 ft



Air Magnetic Thermocouple

Attaches directly to ferrous substrate to measure air/environmental temperature. PTFE-insulated cable. Maximum 265°C/509°F.

PA0055 1.5 m/5 ft

PA0056 3.0 m/10 ft

PA0059 6.0 m/20 ft



Washer Thermocouple

Screwed directly to large heavy metal substrate. PTFE-insulated cable. Maximum 265°C/509°F.

PA0081	1.5 m/5 ft
PA0082	3.0 m/10 ft



Clip Surface Thermocouple

Clips to non-ferrous component to measure surface temperature.

PTFE-insulated cable, maximum 265°C/509°F

PA0011	1.5 m/5 ft
PA0012	3.0 m/10 ft
PA0016	6.0 m/20 ft

Glass-fiber-insulated cable with stainless-steel outer braid, maximum 400°C/752°F

PA1710	1.5 m/5 ft
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Clip Air Thermocouple

Clips to non-ferrous component to measure air/ environmental temperature.

PTFE-insulated cable, maximum 265°C/509°F

PA0021	1.5 m/5 ft
PA0022	3.0 m/10 ft
PA0025	6.0 m/20 ft

Glass-fiber-insulated cable with stainless-steel outer braid, maximum 400°C/752°F

PA1720	1.5 m/5 ft
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IRMag Surface Thermocouple

Magnetic attachment (maximum 300°C/572°F), to measure surface temperature of ferrous substrate in infra-red cure oven. Easy attachment and fast thermocouple response. High-temperature glass-fiber-insulated cable with stainless-steel outer braid prevents damage from infra-red heaters (maximum 400°C/752°F).

PA1361A	1.5 m/5 ft
PA1362A	3.0 m/10 ft
PA0980	Replacement mount
PA1371	1.5 m/5 ft Replacement cable and guide
PA1372	3.0 m/10 ft Replacement cable and guide



Thermocouple ID Tags

Aluminum tags fitted to sensor end of thermocouple cable to allow clear identification of probe number even when thermal barrier is closed.

PA2051A	Set numbered 1–8
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Working with Thermocouple Probes

Datapaq probes cover a huge range of possible usages. Choose suitable types for your process, and for the individual probes' locations, from the those listed above.

The process temperature may determine the choice of thermocouples' insulation material. PTFE is to be preferred if the temperature of the process is low enough to permit its use; see p. 28.

Probe Location

The product's geometry and the process's thermal requirements define the number and location of the thermocouples required for the test. In some instances it is necessary to install an array of thermocouples to provide coverage over the entire area of the product. In others, the thermocouples are located to monitor a specific part of the product.

An array of air probes can provide a view of temperature distribution across the oven, enabling adjustment of heaters and/or baffles. Measurements on the surface of the product characterize heat absorption from the air and thus determine the actual temperature/time profile to which it is subjected.

A combination of air and surface probes enables the rate of heat absorption to be determined, and thus permits adjustments to optimize thermal efficiency and product quality.

If required, data acquisition can be triggered by temperature, in which case the trigger is normally taken from an air probe. On the ET3 logger, this may be connected to any thermocouple channel.

Thermocouple probes measuring air and/or product temperature will be attached to any combination of:

- The product.
- A reusable product sample (a test-piece).
- A test-fixture (a structure simulating the product, with probes positioned appropriately).

In assessing oven performance, to ensure repeatability and ease of use, test-pieces or test-fixtures with permanently mounted thermocouples should be used whenever possible.

Placing a probe between the source of heat and the product can affect the rate of heating. To minimize the effect, attach the probe to the product's unheated side where possible, and/or reduce the probe's thermal mass.

Glass-fiber or mineral insulation must be used if thermocouple cables are close to infra-red heating elements or are subject to temperatures over 260°C/500°F.

Route cables to ensure that they are:

- Secured in position along their length.
- Not fouling elements in the oven.
- Not thermally shading the product.
- Not too close to heater elements.

Methods of Probe Attachment

*The tip of the thermocouple probe must be in **good mechanical contact** with the product when monitoring surface temperature. Poor thermal contact will at best result in slowing the rate at which the product heats the probe and at worst prevent the probe from achieving the same temperature. Ensure probe tips are clean before attaching.*

The following methods may be used.

Surface Measurement

- **Adhesive (patch)** A self-adhesive, rapid-response probe recommended for all small test-pieces and materials less than 1.0 mm/0.04 in. thick. Attach to the product, test-piece or test-fixture using high-temperature adhesive tape. When attached to a re-usable test-piece or test-fixture, the probe may be coated with powder/paint enabling reliable, repeatable beneath-coating temperature measurements to be made; this is a major advantage when using infra-red heaters as the absorption of radiation, and thus heat, is affected by the coating's color.
- **Bolt-on (washer)** A rapid-response probe normally permanently mounted on a re-usable test-piece or test-fixture. Provides reliable, repeatable measurements. Attach to the product, test-piece or test-fixture using a bolt or self-tapping screw.
- **Clamp-on** A quick and easy method suitable for ferrous and non-ferrous materials. The product must have a thin, flat surface to ensure good thermal contact.
- **Magnetic** A quick and easy method suitable for ferrous materials. The product must have a flat surface to ensure good thermal contact.
- **Welding/soldering** A rapid-response probe normally mounted permanently on a re-usable test-piece or test-fixture. Provides reliable, repeatable measurements. *Ensure probes are not connected to the logger when they are being welded.*

Air Measurement

- **Adhesive (patch)** Recommended for use where rapid response is required, but used for air measurement only where clamp-on or magnetic probes cannot be used due to product shape, etc. Secure the cable to the product, test-piece or test-fixture using high-temperature adhesive tape ensuring the probe is in space and able to measure the air temperature.
- **Clamp-on** A quick and easy method suitable for ferrous and non-ferrous materials. The product must have a thin, flat surface to ensure continuing attachment.
- **Magnetic** A quick and easy method suitable for ferrous materials. The product must have a flat surface to ensure continuing attachment.

Probe Installation

The presence of a probe on the product will inevitably affect the product's temperature: it adds to its thermal mass and thus changes, however slightly, the rate of heating and cooling. Probes of large thermal mass are unsuitable for use with small, lightweight products.

Measuring the product's surface temperature requires good thermal contact between probe and product. Poor thermal contact will at best result in slowing the rate at which the product heats the probe and at worst prevent the probe from achieving the same temperature. Ensure probe tips are clean before attaching.

Placing a probe between the source of heat and the product can affect the rate of heating. To minimize the effect, attach the probe to the product's unheated side where possible, and/or reduce the probe's thermal mass.

Glass fiber or mineral insulation must be used if thermocouple cables are close to infra-red heating elements or are subject to temperatures over 260°C/500°F.

Route cables to ensure that they are:

- Secured in position along their length.
- Not fouling elements in the oven.
- Not thermally shading the product.
- Not too close to heater elements.

When locating each probe in its correct position on the product, identification of the probe cables is aided by use of Datapaq's thermocouple ID tags (p. 31; *supplied with EasyTrack3 Professional*).

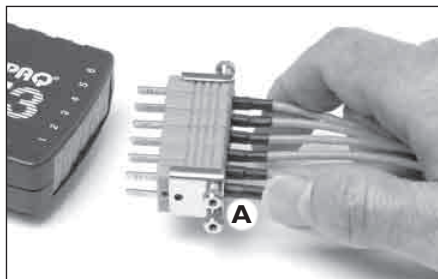
EasyTrack3 Probe-clamp Kit

To assist in the installation and removal of the thermocouples, use the EasyTrack3 probe-clamp kit (*supplied with EasyTrack3 Professional*).

This kit is designed for use with test pieces that are routinely used to monitor a particular process. Using the clamp kit, thermocouples can be left attached to the test-piece between runs. When performing another test, the probes will be automatically connected into the same thermocouple plugs on the logger, speeding up setup and providing repeatable test conditions.

To use the clamp kit:

1. Align all the thermocouple plugs within the clamp bracket as shown in photograph, each plug with wide pin uppermost.
2. Slide the clamping rod(s) through the holes in the bracket and plugs and tighten the knurled nuts on the ends of the rod(s), with lock-washers in place. *If your plugs each have two open holes near the cable-end of the plug, two rods are used (A), passing through both these holes; otherwise, pass one rod through the single hole near the plug's pins.*



Using the probe clamp.

Testing Thermocouple Probes

Although thermocouples are generally robust, they can be damaged during handling. To confirm their correct operation after installation, see p. 94.

Care of Thermocouples

When coiling thermocouple cables for storage, ensure the diameter of the coil is not less than 40 cm (16 in.).

Examine the cables after each profile run, and replace any found to have damaged insulation.

Do not lift the data logger by the thermocouple cables. This will damage the cables and connectors.

The Basics of Insight Software

Installing/Removing Insight

Datapaq Insight used with the ET3 logger requires the following minimum **computer specification**.

- 1 GHz processor.
- 2 Gb RAM.
- Monitor resolution 1024 × 768, 256 colors.
- 100 Mb free hard disk space.
- DVD drive.
- 1 free USB port.
- Microsoft Windows™ XP SP3, Vista, 7, 8, 10 or above.
- Microsoft Internet Explorer 4 or above.

The ET3 logger operates only with Datapaq Insight v.8.5 and above.

Installation

Ensure you are logged into Windows in Administrator mode.

For most systems, installation will start automatically on placing the Insight DVD in the drive. (If installation does not start, click the Windows Start button and select Run; browse to your DVD drive, and run Setup.exe.) As part of the installation, you can choose PDFs of Datapaq user documentation to be copied to your PC for rapid on-demand viewing through Insight.

Follow the on-screen instructions. You will need your license number to hand, which is to be found on:

- Your license agreement.
- The outside of the DVD case.
- The outside of the system packaging.

Insight's link with the logger must also be made while Windows is in Administrator mode, and it is thus best to do this now, as part of the Insight installation: connect the logger to the PC and follow the procedure under 'Communications

Setup' (below). Once this has been done, an operator will be able to use Insight with the logger connected to the PC without being in Administrator mode.

Upgrading

It is not necessary to remove an existing version of the software before installing a new one. Settings and data files used with the current installation will be maintained.

Removal

Use the standard procedure for your Windows version, e.g.

- *In Windows XP* – Start button > Settings > Control Panel > Add/Remove Programs, select Datapaq Insight and click Add/Remove.
- *In Windows 7* – Start button > Control Panel > Programs and Features, and double-click Datapaq Insight.
- *In Windows 10* – Start button > Settings > System > Apps & features, and click Datapaq Insight.

Using the Software

Full details on using the Insight software are contained entirely within its online Help system: access this by clicking Help, and then Contents, on Insight's main menu. Then, within Help, click on Contents headings and topics to expand and read them.

You may also click the Help button in any dialog – or press the F1 key – to bring up help information relevant to the task being performed.

Communications Setup

After Insight has been installed, it is necessary to establish communication between the data logger and the PC, as follows.

*If using the logger for the first time, ensure that you have **installed the battery** in the logger (p. 15) before connecting it to the PC.*

***Only one logger at a time** can be connected to the PC. It is not possible to connect simultaneously more than one logger to different USB ports on the PC and then to choose which logger to use.*

1. Using the communications lead supplied, connect the logger to a free USB 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 connection between the communications lead and the logger has been made.

If the PC is having a Datapaq logger connected for the first time, Windows will display a 'Found New Hardware' message and the PC is then ready to work with the logger. If any warnings are displayed about driver-signing, confirm them (Datapaq drivers have been tested, and were installed when Insight was installed).

In case of problems in establishing communication, see p. 93.

2. On the Insight software's menu bar, select Logger > Setup to open the Communications Setup dialog.
3. Click Test.

Communications Setup

Please indicate how to communicate with your logger:

☒ USB Port
(Your logger is connected to a USB port. Note that you don't have to specify which USB port is being used.)

☐ Serial Port: COM1

If you do not know which port your logger is connected to, click on 'Detect' and the software will try to find it for you. **Detect**

Logger

Click on 'Test' to see if the software can communicate with your logger. **Test**

Datapaq ET3 (#110) found on USB port

Diagnostics << **Advanced**

Logger	Datapaq ET3
Major Firmware Version	4
Minor Firmware Version	00
Maximum Temperature	85.0°C
Battery	73% (Alkaline)
Serial Number	#110
Range	-200.0°C to 1370.0°C

Probe	Readings
#1 (°C) K	24.0
#2 (°C) K	24.3
#3 (°C) K	24.0
#4 (°C) K	24.0
#5 (°C) K	24.3
#6 (°C) K	23.8
Internal (°C)	23.8

OK **Cancel** **Help**

The Communications Setup dialog for the ET3 logger, with Diagnostic section expanded.

If the logger is detected, its type and the port to which it is connected are displayed.

SHORTCUT

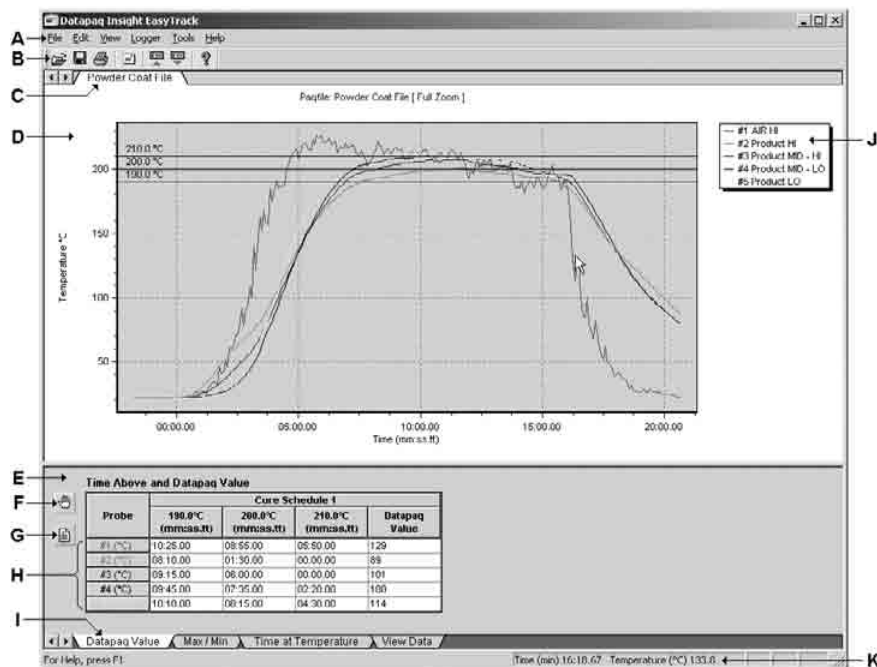
Pressing F4 on the keyboard opens the Communications Setup dialog, tests for communication with a logger, and displays the logger type and other data (equivalent to clicking Test in the dialog).

For more information on the logger in use, click the Diagnostic button which now appears. Additional data shown covers firmware version, maximum permitted internal logger temperature, battery charge status, serial number and temperature recording range. Current temperature of the probes (updated every 5 seconds) is also shown – or open circuit (*OC*) if no probe is attached; the temperature of the thermocouple cold junction is effectively the current internal temperature of the logger.

*It is advisable at this stage to set the **frequency of the local electricity supply** within Insight. See p. 52.*

User Interface

The default view is a conventional two-dimensional graphical representation of the data in the upper part of the screen (the **Graph Window**). This is separated from the **Analysis Window** below it by a movable splitter bar; click on it and drag to change the proportion of the screen occupied by each window.



The Insight EasyTrack user interface. Additional features found only in Insight EasyTrack Professional are described in the text.

- A Main menu** – The available menu options.
- B Toolbar** – Buttons to access frequently-used software functions.
- C Filename** – The currently-open file.
- D Graph Window** – The data in graphical form.
- E Analysis Window** – Numeric results calculated for the current analysis mode.
- F Options button** – Set up parameters for the current analysis mode.
- G Probe Names button** – Specify names for each of the probes.
- H Probe buttons** – Click individual buttons to turn probes on and off, i.e. to remove their data from the graph and from the data grid; right-click to show one probe alone.
- I Analysis tabs** – Click tabs to switch between analysis modes.
- J Probe Key** – Shows the color used for each probe, with its name and number.
- K Status bar** – Shows the coordinates of the mouse cursor on the time/temperature graph.

Toolbar














Insight EasyTrack






Each button on the toolbar provides single-click access to the main software functions.

Insight EasyTrack Professional



-  **Open** – Opens data for a previously-saved temperature profile, referred to as a 'paqfile'; see p. 49. In *Insight EasyTrack Professional*, can also open a tolerance curve for editing; see p. 89.
-  **Save** – Saves the currently-displayed results in a paqfile. See p. 49.
-  **Save All*** – Saves all the paqfiles which are currently open.
-  **Print Paqfile** – Prints a report for the current paqfile. See p. 49.
-  **Send Paqfile** – Opens a new email message in your default email program with the currently displayed paqfile attached (or select File > Send on the main menu; see below).
-  **Reset Logger** – Resets the data logger to receive fresh data for a new temperature-profile run. See p. 57).
-  **Download from Logger** – Downloads results from the logger into Insight. See p. 64.
-  **Radio Receivers*** – During radio telemetry (*not available with the ET3 logger*), gives the status of the attached receivers.
-  **Process Details*** – View and specify the process which is applied to the current paqfile. See p. 74.
-  **Real Time Tool*** – During radio telemetry (*not available with the ET3 logger*), confirms data being transmitted and received, and its quality.
-  **Add Event Marker*** – During telemetry, marks a specific event on the graph, as it occurs. See p. 69.
-  **2D Graph*** – Click to return to the default view of the graph.
-  **3D Graph*** – See the graph with the different probe traces set along a third dimension. This gives a 3D surface which can be useful in highlighting differences in the shapes of the individual probe traces.

-  **Thermograph*** – A view of the temperature profile as if the product were seen from above, with probe positions along the y-axis and temperatures shown by colors. For details, see Insight's online Help system.
-  **Wizards*** – Guiding you step by step through key operations. See p. 48.
-  **About** – Displays the About dialog, showing the software version number and Datapaq contact details.

* *Insight EasyTrack Professional only.*

*In Insight EasyTrack Professional, the **toolbar and menus may be customized.** See p. 48.*

Main Menu

Options on the menu bar are as follows.

File

Options for file operations, such as opening, saving and printing:

- **New*** – This starts either:
 - the Logger Reset Wizard, which prepares the logger for a new temperature profile run (see p. 57), or
 - the Tolerance Curve Wizard, to create a new tolerance curve (see p. 89).
- **Open** – Opens a previously saved paqfile. See p. 49.
- **Save** – Saves results in a paqfile; if the paqfile has not been previously saved, you are prompted to specify a filename. If the paqfile has been previously saved, any changes are saved to the existing file. See p. 49.
- **Save As** – Saves results in a paqfile, prompting you for a filename.
- **Save All*** – Saves all the paqfiles which are currently open.
- **Close*** – Closes the currently-viewed paqfile without exiting Insight.
- **Close All*** – Closes all the open paqfiles without exiting Insight.
- **Properties*** – Shows information about the logger and the data-collection process for the paqfile (including time/date, trigger mode and maximum internal logger temperature).
- **Utilities*** – Processes for importing existing data into Insight. See p. 50.
- **Print, Printer Setup** – Prints a report for the current paqfile to the default printer. See p. 49.
- **Print to PDF** – Generates a PDF of the printed report. See p. 49.
- **Print Calibration Certificate** – See p. 19.

- **Print Preview** – Displays a preview of the printed report.
- **Print Options** – Allows you to set up a report title and margins for the report. *In Insight EasyTrack Professional*, you may set many further options to customize your report. See p. 49.
- **Send** – Opens a new email message in your default email program with the currently displayed paqfile attached. In case the email recipient does not have Insight, the email contains a link to download free Paqfile Viewer software (from www.flukeprocessinstruments.com) with which to view the temperature profile.
- **Import from Clipboard** – Opens the Clipboard Paste Wizard, which guides you through the process of selecting data in a spreadsheet application and importing it to a new or existing paqfile. See p. 50. (*In Insight EasyTrack Professional*, find this option under Utilities; see above.)
- **Recently Used Files** – Names of the eight most-recently-used paqfiles are added to the menu. Select one to open it.
- **Exit** – Exits Insight.

* *Insight EasyTrack Professional only.*

Edit

Options for data export, editing notes or probe names, memos, and for adjusting the oven start.

- **Copy** – Exports a paqfile. See p. 51.
- **Notes** – Store any textual notes and a picture which you may wish to associate with the profile-run data. This will be saved with the paqfile, and included in the printed report (p. 49).
- **Probe Names** – Enter names for a paqfile's probes. These names are shown on the graph and in the printed report.
- **Memos** – Annotate your results directly on the graph (see p. 89).
- **Adjust Oven Start** – Position the markers for oven start and process end in a paqfile. See p. 71. (*In Insight EasyTrack Professional*, find this option on the Process menu.)
- **Add Event Marker*** – During telemetry, allows you to mark a specific event on the graph, as it occurs. See p. 69.

* *Insight EasyTrack Professional only.*

View

Options for access to the analysis mode options, and for customizing the screen view. For details, see Insight's online Help system.

- **2D Graph*** – The default view of the graph.

- **3D Graph*** – See the graph with the different probe traces set along a third dimension. This gives a 3D surface which can be useful in highlighting differences in the shapes of the individual probe traces.
- **Thermograph*** – A view of the temperature profile as if the product were seen from above, with probe positions along the y-axis and temperatures shown by colors. For details, see Insight's online Help system.
- **Probe Window*** – Shows the product picture (if one has been used), together with the probes in position.
- **Probe Toolbar*** – Displays/hides the probe toolbar. Click individual buttons to turn probes on and off, i.e. to remove their data from the graph and from the data grid; right-click to show one probe alone.
- **Logger Toolbar*** – Displays/hides the logger toolbar when viewing a paqfile containing data from multiple loggers. Click on individual logger buttons to turn data on and off, as for probe toolbar (see above).
- **Overlay** – For purposes of comparison, an additional temperature profile (*or up to three in Insight EasyTrack Professional*) can be overlaid on the current paqfile. See p. 88.
- **Graph Options*** – Settings to customize the view in the Graph Window. For details, see Insight's online Help system.
- **Analysis Options** – Set parameters and display options for the current analysis mode. See p. 77.
- **Zoom options** – Sets the magnification (zoom) level of the Graph Window. See p. 87.
- **Radio Receivers*** – During radio telemetry (*not available with the ET3 logger*), gives the status of the attached receivers.
- **Real Time Tool*** – During radio telemetry (*not available with the ET3 logger*), confirms data being transmitted and received, and its quality.
- **Toolbar** – Show or hide the toolbar.
- **Status Bar** – Show or hide the Insight window's status bar.

* *Insight EasyTrack Professional only.*

Logger

Options to reset, download and set up the logger.

- **Reset** – Set the logger's collection parameters for a new profile run. See p. 57.
- **Download** – Download collected data from the logger into Insight. See p. 64.
- **Setup** – Setup communications between the logger and the PC, and get diagnostic information from the logger. See p. 38.

- **Logger Listen Mode** – During hardwired telemetry, allows you to resume the collection of transmitted data after it has been paused. See p. 69.
- **Stop Real-time Mode** – During hardwired telemetry, allows you to pause the collection of transmitted data. See p. 69.

Process

Control all aspects of your process applied to the current paqfile (*Insight EasyTrack Professional only*).

- **Process Details** – View and specify the process which is applied to the current paqfile. See p. 74.
- **Apply New Process** – Apply stored process parameters. See p. 74.
- **Adjust Oven Start** – Position the markers for oven start and process end in a paqfile. See p. 71.
- **Adjust Zone Lengths** – Set the length of each oven zone. See p. 76.
- **Adjust Probe Alignment** – Compensate for the time delays between different probes passing through the oven. See p. 74.
- **Adjust Overlay Alignment** – Correct the alignment of profiles overlaid on one graph. See p. 88.
- **Edit Tolerance Curves** – See p. 89.

Tools

- **Options** – On the Global Options dialog, set up advanced features of Insight (see p. 48 and p. 51).
- **Customize*** – Disable features of Insight which you do not expect to use (see p. 48).
- **Wizards*** – Guiding you step by step through key operations. See p. 48.
- **Registration** – If upgrading from Insight EasyTrack to Insight EasyTrack Professional, enter your new license number here.

* *Insight EasyTrack Professional only.*

Help

Access to the online Help, and direct online access to user-document PDFs.

- **Contents** – Displays the online Help contents.
- **New Features** – Brief description of the features new to the current version of Insight EasyTrack.
- **Logger LED Sequences** – Shows animated displays and descriptions of the ET3 logger's LED sequences.
- **Quick Reference Guide, Accessories List, Manuals** – Displays PDFs of user documents copied to your hard disk during installation. To locate

additional manuals on the installation DVD: select Help > Manuals, click Check Disk and then select the required items and their language; click to View (single items only) or Copy to your hard disk.

- **Service** – Emails key diagnostic information to Datapaq in the case of problems (see also p. 94).
- **About** – Displays the About dialog box, showing the software version number and Datapaq contact details.

Right-click Menu

Right-clicking with the mouse **on the graph** brings up a shortcut menu of useful key features.

Options* – Settings to customize the view in the Graph Window. For details, see Insight's online Help system.

Overlay – For purposes of comparison, an additional temperature profile (*or up to three in Insight EasyTrack Professional*) can be overlaid on the current paqfile. See p. 88.

Adjust Oven Start – Position the markers for oven start and process end in a paqfile. See p. 71.

Adjust Zone Lengths* – Set the length of each oven zone. See p. 76.

Adjust Probe Alignment* – Compensate for the time delays between different probes passing through the oven. See p. 74.

Adjust Overlay Alignment* – Correct the alignment of profiles overlaid on one graph. See p. 88.

Edit Tolerance Curves* – See p. 89.

Add Memo – Annotate your results directly on the graph. See p. 89.

Add Slope Marker – Annotate the graph with a marker showing the slope automatically. See p. 90.

2D Graph* – The default view of the graph.

3D Graph* – See the graph with the different probe traces set along a third dimension. This gives a 3D surface which can be useful in highlighting differences in the shapes of the individual probe traces.

Thermograph* – A view of the temperature profile as if the product were seen from above, with probe positions along the y-axis and temperatures shown by colors. For details, see Insight's online Help system.

Copy – Exports a paqfile. See p. 51.

Zoom options – Sets the magnification (zoom) level of the Graph Window. See p. 87.

Wizards* – Guiding you step by step through key operations. See p. 48.

Properties* – Shows information about the logger and the data-collection process for the paqfile (see p. 43).

* *Insight EasyTrack Professional only.*

Customizing Insight

From the Tools menu, select Options to display the **Global Options dialog**. Here, the General and Units tabs allow you to customize the way Insight displays information.

The **General** tab has the following options:

- **Show Large Buttons on Toolbar** – Replaces the default small toolbar buttons with larger ones.
- **Show Colored Dots on Analysis Tabs** – Adds a different colored dot to each of the Analysis Window tabs, making them easier to identify.
- **Display Messages with Dr Thermocouple** – Message boxes are accompanied by the appearance of the amusing Dr Thermocouple.




On the **Units** tab, select the units that Insight will use for **temperature**, **time** and **distance**.

In Insight EasyTrack Professional only, select Tools > **Customize** to disable features of Insight which you do not expect to use. Features which are disabled will then not appear in Insight's menus or toolbar until you select them again in this dialog.

Wizards

In Insight EasyTrack Professional only, you may use wizards to guide you, step by step, through key operations. All can be carried out by other means, and, once you are familiar with the software, you may find it easier and/or quicker to use these other methods. But, while you are less confident, wizards are simple means of carrying out some of the more complicated procedures:


- **Resetting** the logger (see p. 57 for the procedure without using the wizard).
- **Downloading** data from the logger to the PC (p. 64).
- Creating a **Datapaq Value file** (see p. 80).

To access the wizards: click , or select Tools > Wizards, or select Wizards from the graph right-click menu.

File Management

Once the data for a temperature profile is downloaded from the logger and saved in Insight, it is referred to as a **paqfile**.

Opening a Paqfile


1. Click the  button on the toolbar or select File > Open. The Open Paqfile dialog is displayed. When you click on a filename, a preview of the paqfile is shown to help you find the paqfile you wish to load.




2. Click Open, and the selected file is opened.


In Insight EasyTrack Professional only, you can open more than one paqfile at a time. Click the tabs at the top of the Graph Window to select the file you wish to view. The corresponding numerical data will be displayed in the Analysis Window below. Close a file by right-clicking the relevant tab at the top of the Graph Window.

Saving a Paqfile

If you have just downloaded **new temperature data** but have not yet saved it, click the  button on the toolbar, select File > Save or File > Save As and the Save Paqfile dialog is displayed.

If the currently-displayed paqfile has been **previously saved**, clicking on the  button on the toolbar or selecting File > Save saves any changes to that paqfile. If you select File > Save As, the Save Paqfile dialog is displayed allowing you to save your changes to the file under a different filename. If you specify, in the Save Paqfile dialog, a filename which already exists, you are asked if you wish to overwrite the file. If you select Yes, then the file is overwritten. Selecting No allows you to enter an alternative filename.

Printing a Report

Click the  button on the toolbar or select File > **Print** to print a report containing the graph and analysis results on the default printer.

Selecting File > **Print Preview** displays the report format on the screen.

Select File > **Print Options** to display a dialog box where you can specify the report title and margins. Once set up, the report title and margins are used for all reports.

Information about the paqfile which has been entered in the **Notes dialog** (see p. 44), is included in the report (in *Insight EasyTrack Professional*, it can be excluded if desired; see below).

To **create a PDF** of the report, first check the selections in the Print Options dialog, and then select File > Print to PDF.

In *Insight EasyTrack Professional*, the Print Options dialog permits great flexibility in **customizing the content** of the report.

Importing Data from a Spreadsheet

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.

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.

Alternatively, in *EasyTrack Professional* only, you may **import data directly from a file**, in .TXT or .CSV format; in each case, the data file must start with a correctly-formatted file header (for details, see Insight's online Help). Select File > Utilities > Import from File.

Data Export

Insight allows you to export data from the current paqfile. Right-mouse-click on the graph and select Copy, or select Edit > Copy and the **Copy to Clipboard** dialog is displayed.

You can export your temperature profile data, analysis results or the graph in order to use them in other applications. Select which type of data to export, and the format you wish to use. The information is then placed on the Windows clipboard and can be pasted into (e.g.) a word-processor, spreadsheet or bitmap-editing application.

The options available are:

- **Analysis Results** – Export the data analysis performed on the collected data. Everything contained in the analysis grid at the time of export is included, so you need to select the analysis mode you wish to export before opening the Copy to Clipboard dialog.

- **Raw Measurements** – Export the raw temperature/time data as gathered by the logger. All the profile's raw data is exported, regardless of the how the graph is zoomed.

Under 'Export Every', select the proportion of the raw data to export. Thus enter '1' to export every data point or (e.g.) '5' to export every fifth one.

Choose whether or not to include a file header with the exported data; this is necessary if you may later want to import the data into Insight Oven Tracker.

- **Graph** – Export a bitmap image of the graph.
- **Text** – Export data as simple text.
- **CSV** – Export data in Comma Separated Value format – useful for pasting into spreadsheet applications (NB This format will not paste into Microsoft Word or into most text editors).

Logger Defaults and Details

Defaults for several of the logger's variables can be set using Insight's Global Options dialog. Select Tools > Options > Logger (and click 'Advanced' for most features):

- **Model** and **identification number** (serial number) of the logger.
- Parameters for **manual reset**. See p. 61.
- **Calibration** information. See below.

- Use of warning message and/or disabling of reset if the **logger is too hot**. See p. 53.
- Ability to download and display profiles of the logger's **internal temperature** for the run. See p. 53.
- Ability to download and display **pre-trigger data** (see below).
- **Frequency of the local electricity supply**. See p. 53.

For full details of using the dialog, see Insight's online Help.

Pre-trigger Data

If a temperature trigger (see p. 59) is used to start data-logging, the logger also records data before this point is reached. The most-recent c. 60 of these data-points are retained by the logger. You can download this pre-trigger data by setting a default (see above), and it will then form part of the temperature profile, falling before the zero time point.

If the logger does not reach the temperature required to start data-logging, Insight will always download the pre-trigger data, in order to aid the user in determining why triggering did not occur.

Calibration Information

When Insight communicates with a logger (resets it, downloads from it or performs a communications setup), it automatically stores the logger model, ID (serial number) and number of probes that the logger has. This information is displayed in the Global Options dialog box (Tools > Options > Logger tab).

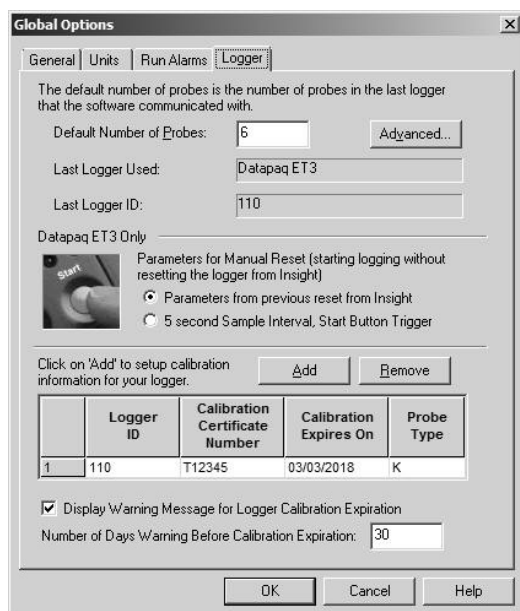
In addition to this, the Logger tab allows you to enter the calibration information for your logger(s), and be warned when re-calibration is due.

To do this, click the Add button to add information for a new logger, and enter:

- **Logger ID** – Enter the logger ID as shown in the Last Logger ID field. If this is blank, you should enter the four-digit serial number on the back of your logger.
- **Calibration Certificate Number** – Your logger will have come with a Calibration Certificate. Enter the certificate number for your logger (this is optional).
- **Calibration Expires On** – Date on which the logger calibration expires.
- **Probe Type** – For the ET3 logger, this is always thermocouple type K (this is optional).

Select whether you wish to be warned before expiration of the logger's calibration, and specify how many days notice is to be given: if the warning is due, a message will appear when Insight is opened, and the logger should be returned to Datapaq for re-calibration.

To remove a logger's calibration information, click on it in the calibration grid and then click Remove.



Logger tab of the Global Options dialog, with calibration information in place.

For details of the **calibration process**, and a description of how to **print a calibration certificate**, see p. 19.

Logger Internal Temperature, and Electricity Supply

These options lie in the Global Options dialog (Tools > Options > Logger tab, and click the Advanced button). Here you may choose to:

- Enable a **warning and/or disabling of reset if the logger is too hot** while being reset (default 45°C/113°F).
- Download the **profile of the logger's internal temperature** for each profile run: this appears in the Graph and Analysis Windows as if it is data from an additional probe (download of the data from the logger is disabled by default, and, if you wish to view this data, download must be enabled in the Logger tab of the Global Options dialog *before running the profile*). Display is also disabled by default: to enable, in Insight select File > Properties > Advanced.

- Set the **frequency of the local electricity supply**. Setting this correctly increases the efficiency of the logger's noise rejection, and thereby provides more stable measurements: 50 Hz is most widely used, but 60 Hz is used in North America, several countries in South America, and in Japan and Korea.

Run Alarms

You can be warned if the following events are detected during a logger download, reflecting incomplete or invalid data recorded during the profile run. Set such run alarms in the Global Options dialog (Tools > Options > Run Alarms tab.

- **Logger Stopped Due to Going Over Temperature** – Repeated use of the logger with short intervals for cooling can result in a rise in the logger's internal temperature, leading to logging errors and ultimately to serious damage. This alarm warns if reliable data collection stopped during a run due to excessive internal logger temperature (greater than 70°C/160°F).
- **Logger Stopped Due to Low Battery** – Warns if reliable data collection stopped during a run due to an exhausted logger battery.
- **Paqfile Contains Invalid Measurements** – Warns if the paqfile contains invalid data such as open circuits (*OC*). See p. 94.

When triggered, an alarm is shown in two ways:

- In the Analysis Window, an additional **Alarms tab** appears, giving detailed information on the alarm triggered.
- In addition, **alarm-status traffic lights** are shown in the Graph Window and in the printed report. See below

Alarm-status Traffic Lights

By default, the Insight has all run alarms disabled. When this is the case, no alarm-status traffic lights are displayed or printed.

When alarms are enabled, but are not triggered, i.e. there were no problems with the temperature-profile run, the alarm-status traffic lights in the Graph Window show green. In the printed report, they are as shown here:



The Advanced dialog used to set options for logger internal temperature and local electricity supply.

When alarms are triggered, the alarm-status traffic lights in the Graph Window show red, and in the printed report look as follows:



For further features of the Insight software see the online Help system (on Insight's menu bar, select Help > Contents).

Running a Temperature Profile

Before the logger is used for the first time, you must:

1. **Install** Insight software (see below).
2. Establish **communication** between the logger and the computer/software (p. 38).

Before each profile run, you will:

3. **Reset** the logger to prepare it to receive fresh data (p. 57).

After the logger/barrier assembly is recovered from the oven/furnace/kiln, you will then:

4. **Download** the data from the logger (p. 64).

You can then:

5. **Analyze** the data as you wish (p. 71).

By following the procedure described in this chapter, you will use the Logger Reset and Logger Download dialogs to run a temperature profile **without telemetry**, i.e. data is collected by the logger and stored internally – until it is downloaded to the PC after the run is completed and then saved as a new 'paqfile' (p. 49). (To run a profile using hardwired telemetry, see p. 67.)


*When the logger is plugged into the PC – whether or not Insight is running – the logger is automatically detected: you will by default be presented with a **popup option to reset the logger or to download data** from it. If you accept one of these options, the operation will start (Insight will first open if necessary). If you disable the popup feature and wish later to re-enable it, right-click the logger icon in the Windows system tray (notification area).*

Resetting the Data Logger

The data logger needs to be reset, as follows, before it can receive fresh data.


It is not necessary to go through the reset procedure if the previous reset options are to be re-used: see p. 61.

If the logger is **too hot** from the previous run, Insight will (by default) display a warning message – showing the logger's current internal temperature – until it cools; Insight can also be set to prevent reset in these circumstances (this feature is configurable; see p. 51).

The procedure described here uses the Insight software's Reset dialog. In Insight EasyTrack Professional only, you can instead use the **Logger Reset Wizard** to guide you, step-by-step, through this stage of running a profile: click  on the Insight toolbar, or select Tools > Wizards from the menu.

Any data stored in the logger but not yet analyzed must be downloaded before proceeding, as **resetting the logger will permanently erase all data stored in it**. If the reset process is started on a logger which contains data from a previous run which has not been downloaded, a warning message will show this (and the logger-status red LED will be flashing every 5 seconds).

When the communications lead is attached, the logger is **powered via USB**, but – for a normal (non-telemetry) profile run – batteries must be in place in the logger during reset to ensure a power supply when the communications lead is later removed (batteries are not required if resetting for hardwired telemetry; see p. 67).

1. Use the communications lead supplied to connect the logger to a free USB 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 connection between the communications lead and the logger has been made (if it does not, see 'Communications Setup', p. 38).
2. Open the Reset dialog (respond to the popup on connecting the logger, or click  on the Insight toolbar, or press function key F2, or select Logger > Reset from the menu bar) and specify your reset options.

Battery Status The charge indicator gives both the current percentage of full charge held by the logger battery (see p. 17), and a color-coded report:

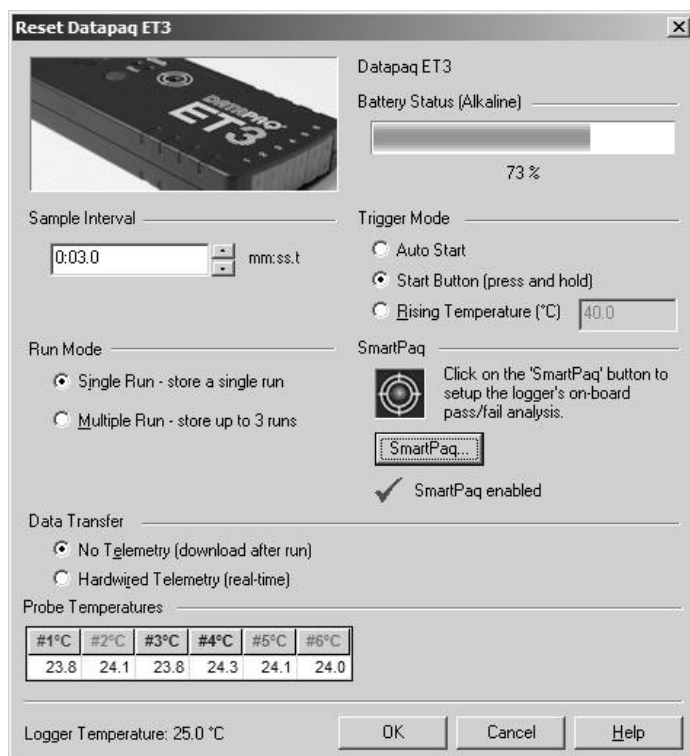
- GREEN** Sufficient charge to perform a run.
- YELLOW** May be enough charge for a run, but battery getting low.
- RED** Insufficient battery charge: recharge immediately.

For battery life, see p. 16.

If in any doubt that battery charge is sufficient for the next run, abort the procedure by clicking 'Cancel', and recharge the logger. *If the battery has less than 20% of full charge, data-recording cannot start until the battery is charged or replaced.*

Sample Interval 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. Interval can be 0.5 s to 60 min.; intervals of 1 s and above can be set

only in whole seconds. The shorter the sample interval the better you will be able to record short-term variations in the temperature regime – but the total recording time available will be reduced, data will take longer to download to the PC after a run, and battery life could be shortened so much that it will not be enough for a particularly long process. For example, with a sample interval of 0.5 s, the maximum run time (before the logger memory is full) is 2.5 hrs.



Reset dialog for the ET3 logger. Run Mode (p. 60) and SmartPaq (p. 85) are present only in Insight EasyTrack Professional.

Trigger Mode Select here a means to start the logger recording data (not all modes are available if using multiple-run mode; see above).

Auto Start Data-recording starts when the communications lead is disconnected after reset. If possible, connect the thermocouples to the logger before disconnecting the logger from the PC; this avoids the logger recording invalid data (open-circuit errors; see p. 94) until the thermocouples are connected.

Start Button After reset, data-recording starts when the logger's green start button is pressed and held for 1 second.

Rising Temperature Data-recording starts when the temperature of *any* probe reaches the specified value as it is rising. The logger will also record pre-trigger data; see p. 52.

Run Mode (*selectable in Insight EasyTrack Professional only*) If using Insight EasyTrack, the logger operates in single-run mode, i.e. it has to download data at the end of every profile run. In Insight EasyTrack Professional, the logger can alternatively collect data for up to three runs before downloading (multiple-run mode; see below, and also p. 65).

In single-run mode:

- Data must be downloaded after every run.
- When starting the next profile run, the data held in the logger will be deleted automatically (this is prevented if the data has not yet been downloaded), so there is no need to reset the logger unless you wish to change the data-collection options. (See p. 61 for starting a new run using previous reset options.)
- Any trigger mode (see p. 59) can be selected.
- Hardwired telemetry can be used.

In multiple-run mode (Insight EasyTrack Professional only):

- The logger can collect data from up to three profile runs before it needs to be downloaded (p. 64).
- Each channel can store up to 18,000 data-points on each of three runs.
- After three profile runs have been performed, the logger must be reset using Insight in order to delete data from the logger and empty it for further runs.
- Individual profile runs can be downloaded from the logger at any time, but this does not free up any space in the logger's memory until the whole memory is emptied by performing a reset using Insight.
- Each multiple run will be performed using the same data-collection options, until the logger is reset.
- To start data-collection for each run, only the start button and temperature trigger modes can be selected (see p. 59).
- Stop data-collection after each run by using the stop button.
- Hardwired telemetry cannot be used.

SmartPaq (*Insight EasyTrack Professional only*) For instant quality assurance, click the button to enable or disable SmartPaq, or to create or edit the pass/fail criteria; see p. 85 for details. The current status (enabled/disabled) is shown.

Telemetry Select 'No Telemetry'. (For use of hardwired telemetry, see p. 67.)

Probe Temperatures The current temperature measured on each of the logger's channels is shown, updated every 5 seconds. This serves as a useful check that thermocouples are working properly.

3. After clicking OK, the logger is reset and a message box confirms the sample interval and trigger mode you have set.
4. Disconnect the communications lead from the logger; the logger's status LEDs briefly flash red and green alternately to confirm logger reset – then continue flashing alternately, at the chosen sample interval (maximum 5 seconds between flashes), to show that the logger is waiting to be triggered (or logging starts immediately, if the trigger mode is auto start).

Using Previous Reset Options

The default setting of the ET3 logger is that the logger retains the last-programmed set of reset options from run to run – even if the battery has been removed in the meantime. Thus it is not necessary to go through the reset procedure if the same reset options are to be re-used: instead, simply press the start button (and hold until LEDs flash) to start data-collection with the same reset options as before (i.e. a **manual reset**). Temperature data which is still held in the logger and which has been downloaded will then be overwritten.

The behavior above can, however, be changed, such that a manual reset always produces a 5-s sample interval and sets the trigger mode to start button: select Tool > Options and, on the Logger tab, set the option (see p. 53).

The logger will not start logging if:

- The logger contains data which has not been downloaded (thus, either download the data, p. 64, or reset the logger using Insight and thereby delete the data, p. 57).

or

- The logger is too hot (see p. 53).

*If using **multiple-run mode** (p. 60), you must reset the logger using Insight before starting a new series of runs.*

Starting the Run

See the chapter 'Thermocouple Probes' (starting p. 27) for details of **choosing appropriate probes and installing them on your product**. Then, when the logger has been reset as above, proceed as follows.

Ensure the **thermal barrier has cooled** sufficiently since its last use.

Before using a new barrier for the first time, or if you suspect a barrier has absorbed **moisture**, you should run it once through your process without the logger to remove the moisture; see p. 21.

For correct selection of a suitable barrier, see p. 24.

1. Plug the **thermocouples** into the logger's numbered sockets. If you are using a process file (*Insight EasyTrack Professional only*; see p. 74), ensure that the probe/socket numbers on the logger correspond to those used to define probe numbers and locations in that file.

Do not lift the data logger by the thermocouple cables. This will damage the cables and connectors.

2. The indication from the logger's **red and green LEDs** (p. 14) depends on its current status:
 - *Logging has already started (auto start was set; p. 59)* – Green LED flashing at sample interval.
 - *Logger waiting for start of data-collection to be triggered* – In most situations (except as below), red and green LEDs flash alternately, at the sample interval.
 - *Logger in multiple-run mode and waiting to start 2nd or 3rd run of a series, with start button as trigger* – Continual double-flashes, both LEDs together.If there is any other LED indication, logging may be unable to start; see p. 14.
3. 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.

*Data-recording cannot start until the **logger has cooled** sufficiently from the previous run. If it is still too hot, pressing the start button will cause the logger-status red LED to give two quick flashes every second.*

If the battery has less than 20% of full charge, data-recording cannot start until the battery is replaced.

4. Ensure the **barrier's sealing surfaces are clean and undamaged**. A good seal between barrier and thermocouple cables is essential if the logger is to be protected. Put the **logger in place in the barrier** (within the heatsink if used), laying the thermocouple cables across the sealing material to exit the barrier at the cutout, ensuring they are side by side and not crossing each other.
5. **Fit the lid**, ensuring a good seal around the thermocouple cables. Secure the lid's catches with the locking pins, if fitted.

The EasyTrack3 system is designed to pass through the oven after the product has been coated. Any coating which has become attached to the probes during a previous run will influence the measurements, and it must be removed before the next run starts.

Placing the System in the Oven

SAFETY

Discuss the application of the EasyTrack3 system with your Health and Safety officer.

Wear appropriate protective clothing.

Load the test piece or product so that it enters the oven before the thermal barrier and logger.

Do not lift the data logger by the thermocouple cables. This will damage the cables and connectors.

Check the **minimum height and width through the process** to ensure the clearance for the system and thermocouple probes is adequate. If necessary, secure the thermocouple cables using high-temperature tape ensuring they do not get too close to heating elements.

Removing the System from the Oven

SAFETY

*The thermal barrier – and the logger inside it – will be **hot**. Use protective gloves. If appropriate, use lifting equipment when recovering the system.*

Recover the system from the oven as soon as the run is over. Heat absorbed by the thermal barrier will continue to affect the temperature of the heatsink and logger: remove them from the thermal barrier as soon as it is safe to do so.

Failure to remove the logger from the hot thermal barrier could damage the logger.


Stop data-collection by pressing and holding the logger's red stop button until the red and green logger-status LEDs are on simultaneously. A red logger-status LED flashing every 5 seconds indicates data stored in the logger but not yet downloaded to the PC.

Leave the thermal barrier and heatsink in the open to **cool to ambient temperature**.

Once cool, **examine the system for damage**:

- Examine the **thermal barrier** and heatsink (if used). See p. 24.
- Examine the **thermocouple cables**, and replace any found to have damaged insulation.

Downloading Data


The procedure described here uses the Insight software's Logger Download dialog. If you are less sure of the process, you can instead use the Logger Download Wizard to guide you, step-by-step, through this stage of running a profile: click  on the Insight toolbar, or select Tools > Wizards from the menu.

1. Use the communications lead supplied to connect the logger to a free USB port on the PC.

If data-collection has not already stopped (see above), connecting the communications lead will stop the logger collecting data.

To minimize communications problems: a) connect the lead first to the PC and then to the logger; b) always use the same USB port – the one which was first used to set up communications (p. 38).

The red LED on the logger should flash five times to confirm that the connection between the communications lead and the logger has been made.

2. Open the Logger Download dialog (respond to the popup on connecting the logger, or click  on the toolbar, or press function key F3, or select Logger > Download from the menu bar) and wait while the data is downloaded to the PC. If in multiple-run mode (*Insight EasyTrack Professional* only; p. 60), individual runs cannot be selected for download; all profiles in memory will be downloaded.

If you see the message

Logger stopped due to going over temperature

the data logger's maximum-permitted internal temperature has been exceeded, and it may have suffered damage. 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.

*A warning message will also be shown if the logger has stopped recording data due to a **low battery**.*

In all cases, data recorded up to the point of error will have been preserved.

*For **recommended actions** to take in response to error messages, see p. 93.*

3. In *Insight EasyTrack Professional* only, the **Select Process** dialog then appears in order that you may choose a process file (see p. 74) which will be applied to the results. Click 'No Process' or 'Cancel' if you do not want to apply one. (To check if this option is enabled, select Tools > Options > Process Files.)
4. The newly downloaded data then appears on screen numerically and graphically. Save the data as a 'paqfile' (select File > Save or Save As; see p. 49).

The data from your profile run can now be displayed, printed and analyzed as you wish; see p. 71 and *Insight's* online Help system for full details.

Open Circuits

An open circuit can occur during a profile run if a thermocouple becomes damaged. The logger will then continue sampling on that channel, but, by default, an alarm will be registered. To disable the alarm, select Tools > Options > Run Alarms.

The Next Profile Run

The means of proceeding to the **next profile run** after a logger download depends on the contents of the logger memory, on whether the logger is in multiple- or single-run mode, and on whether you wish to change the data-collection options.

- Logger in **multiple-run mode** (*Insight EasyTrack Professional* only, see p. 60):
 - If the logger memory contains **no more than two profile runs, data-recording for the next run can be started by using the trigger selected in the previous reset** (start button or rising temperature; see p. 59); the other previous data-collection options will then also be used.
 - If the logger memory contains **three profile runs, a new run cannot be started until the logger memory has been emptied by resetting using Insight** (p. 57).

cont. >>

- Logger in **single-run mode**:
 - When starting the next profile run, the data held in the logger will be deleted automatically (this is prevented if the data has not yet been downloaded), so there is no need to reset the logger unless you wish to change the data-collection parameters (see p. 61).
- For both **multiple- and single-run modes**:
 - To start a new run with **different data-collection options**, reset the logger using Insight (p. 57).

Using Hardwired Telemetry

In addition to the standard off-line analysis, real-time analysis by **hardwired telemetry** is possible with Insight software when used with an intermittent or periodic oven (a batch process).

Thus, with thermocouples trailing from the oven and attached to the logger outside it, data being gathered by the logger is transmitted via the communications lead directly to the PC, and the temperature profile can be watched developing in the Insight software as data is received, i.e. in real time.

Some processes can have long durations. In these instances telemetry can allow you to identify possible problems during the process, and make adjustments. You can then use a second system to confirm that the remedial action has been satisfactory.

Running a Temperature Profile Using Hardwired Telemetry

By following the procedure in this chapter, you will use the Logger Reset and Logger Download dialogs to run a temperature profile using hardwired telemetry.

Running a profile in real time is performed in essentially the same way as a normal (non-telemetry) run (see p. 57), but, in addition:

- The **communications lead** is left in place, connecting the PC to the logger.
- A **process file** can be applied before the run starts in order that the data can be understood more readily as it appears on screen (*Insight EasyTrack Professional only*).
- There will normally be no need to use a thermal barrier to protect the logger.
- While the run is in progress, the **real-time display** of incoming data can be customized as preferred.

Resetting and Starting the Logger When Using Hardwired Telemetry

The logger is reset and started exactly as for a normal (non-telemetry) profile run (see p. 57), except that:

- In the Reset dialog, select **Hardwired Telemetry**.
- **Multiple-run** mode (p. 60) is not available with hardwired telemetry.

- After clicking OK in the Reset dialog:
 - *In Insight EasyTrack Professional only*, the Select Process dialog then appears in order that you may choose a process file (see p. 74) which will be applied to the results as the profile appears on screen during the run; this allows you to see the temperature profile in relation to the oven zones. Click 'No Process' or 'Cancel' if you do not want to apply one. (To check if this option is enabled, select Tools > Options > Process Files.)
 - If trigger mode is set to **auto start** (p. 59), logging starts immediately.
- **Leave the communications lead attached** to the logger and PC.

*With the communications lead attached, the logger is **powered via USB**. Batteries can be left in the logger, but they do not need to be fitted during hardwired telemetry.*

*In Insight EasyTrack Professional, you may specify that a **password** is required when an attempt is made to close Insight while a real-time telemetry run is in progress: select Tools > Options > General.*

*If the **logger's memory becomes full** during hard-wired data-collection, the logger will continue gathering data, but excess data will be passed to the PC and not stored by the logger. When the profile run is complete, the full data can then be saved as a paqfile within Insight (see p. 49).*

Real-time Display During the Run

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. *In Insight EasyTrack Professional only*, 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 Real Time Zoom, 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 p. 87), 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 (*Insight EasyTrack Professional only*) are not available.

If the **y-axis** is not set to be centered (*Insight EasyTrack Professional only*, 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 **overlay** a paqfile on the graph to compare with the data as it is being received (see p. 88).


In Insight EasyTrack Professional, you may:

- Overlay up to three paqfiles and/or **tolerance curves** (see p. 88).
- Open one or more existing paqfiles in **separate tabs** and switch between them and the real-time data (see p. 49).

You may adjust the **oven start** position while a real-time run is in progress. See p. 71.

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.

In Insight EasyTrack Professional only, while a real-time run is in progress, you may:

- Apply a **process file** (p. 74) to the incoming data (or change the one currently being used). This allows you to see the temperature profile in relation to the oven zones (p. 76) as the profile appears on screen during the run. Select Process > Apply New Process.
- Add an **event marker** to mark specific events, as they occur, by inserting a vertical-line memo (see p. 89) at that point while the run is actually in progress:
 1. Select Edit > Add Event Marker, or click  on the toolbar.
 2. The Add Memo dialog then 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 memo appears on the graph marking the point at which the event marker was created.

Ending the Run

To **end or pause data-collection** while a telemetry run is still in progress, select Logger > Stop Real Time Mode. 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 in order to retrieve the full data; see p. 64). 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 (p. 49).

While the logger is still operating, you may **resume the collection of data** by Insight: select Logger > Logger Listen Mode. This second bout (and any subsequent bouts) of data-collection can also be ended and saved as a separate paqfile, as above.

*In Insight EasyTrack Professional, if **autosave** is enabled (select Tools > Options > General), the data being gathered is automatically saved during a telemetry run. If the PC system fails during the run, the 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 the run is still in progress, re-starting logger listen mode will **resume data-collection in the same paqfile**, appending new data at the correct time in the file.*

When the run is complete, **stop the logger** by pressing the stop button. Ensure that data received by Insight has been **saved as a paqfile**. If you wish, you may download the data held in the logger (p. 64), though it should normally be adequate simply to save, as a new paqfile, the data already received.

Data Analysis

Before starting full analysis of the downloaded data (p. 77), it may be advisable to:

- Specify the **oven start** position in the data (see below).
- **Align data from the probes** with respect to time (*Insight EasyTrack Professional only*; see p. 74).
- Apply a **process file**, if not already done (*Insight EasyTrack Professional only*; see p. 74).
- Record any **notes** specific to the profile run (see p. 44).

Other techniques useful during analysis are:

- Examining specific section of the data by **zooming** in to it (see p. 87).
- Comparing temperature profiles by **overlaying** them on one graph (see p. 88).

Specifying Oven Start and Process End

By specifying the start and end of the useful temperature data, as described below, you can use the process zoom (p. 87) to exclude from the analysis and from the printed report any unwanted data at the start and end of the temperature profile.

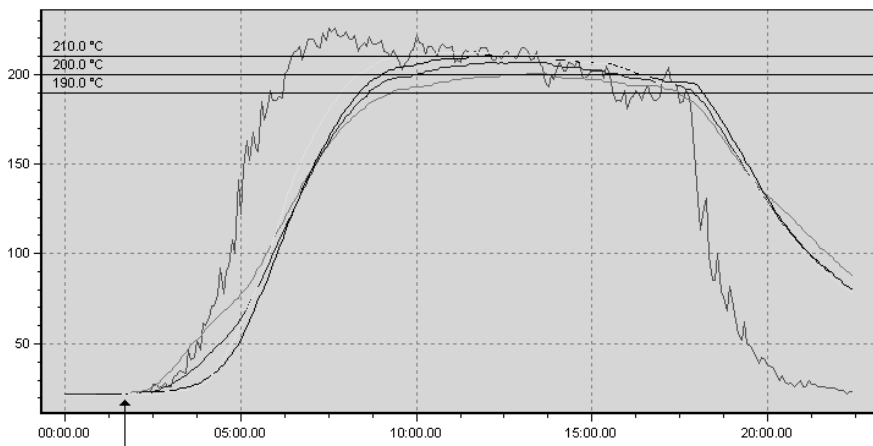
Oven Start

There will often be a delay between the time at which the logger commences recording data, and the start of the actual process, i.e. the point from which time and temperature records are actually required. It is thus useful to set a standardized **oven start position** in the recorded data. Once this has been done:

- The temperature profile will be displayed correctly relative to the oven length and (*in Insight EasyTrack Professional only*) to the positions of the oven zones (p. 74).
- Different paqfiles, i.e. data from different temperature profile runs, can be compared more easily with each other.

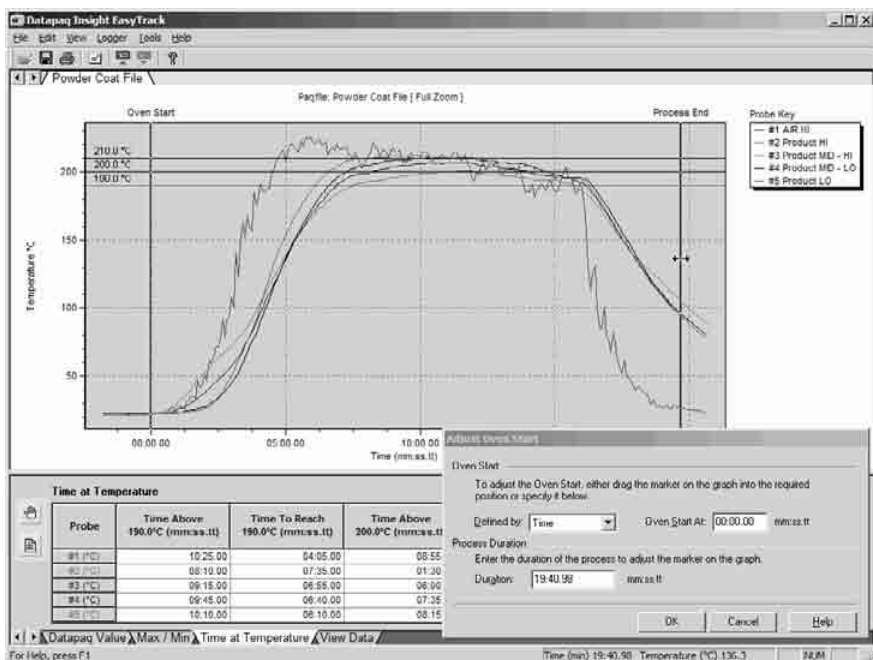
The example paqfile shown here includes a delay, from time zero to the actual start of the process (indicated by the arrow in the picture), of about 90 seconds. Correct this as follows.

1. Select Edit > Adjust Oven Start, or right-click on the graph and select Adjust Oven Start from the popup menu.



Paqfile showing delay before the actual process start (arrowed).

2. The Adjust Oven Start dialog opens and the current oven start position is shown as a vertical heavy black line on the graph.



Paqfile with the Adjust Oven Start dialog open, and showing oven-start and process-end markers on the graph.

3. With the dialog still open, click on the black line and drag it to the position which you think will give the best position for the oven start. To increase the accuracy of this procedure, you can zoom the graph (see p. 87). Once positioned, click OK to set the new oven start.

Rather than setting the oven start by dragging the marker, you may set it instead by entering data in the Adjust Oven Start dialog. Select the appropriate option under 'Defined By' as follows.

- Fix the oven start at a specified **time** or (*Insight EasyTrack Professional only*) a specified **distance** from the start of the data.

Or,

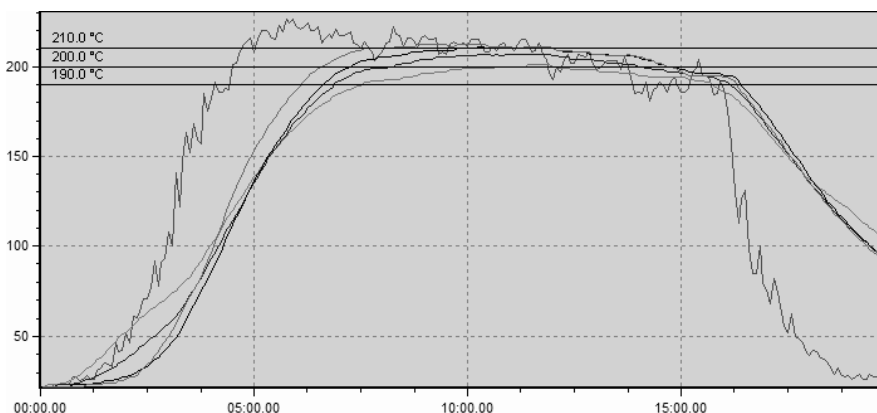
- Choose **temperature** to set oven start as the point at which the temperature – of any probe – rises above a temperature which you specify.

In *Insight EasyTrack Professional*, you may instead:

- Click **Automatic** to set oven start automatically, based on the point at which the temperature starts to rise rapidly as it enters the oven.

Process End

By entering a **process duration** (timed from the oven start position), you effectively define a process end, which is then marked on the graph. Alternatively, click on the process end marker on the graph and drag it into position. NB Process end cannot be set in *Insight EasyTrack Professional*: instead, the end of the process is defined by setting oven zones (see p. 76).



The paqfile after oven start and process end have been set up. Process zoom view (p. 87) has been selected, so that the profile is shown only from oven start to process end.

Aligning Probe Data

Due to the different positions of the thermocouple probes on the product, they may pass through a given point in the oven at slightly different times, and data from the probes may thus be slightly misaligned one with another. *In Insight EasyTrack Professional only*, when the temperature probe data have been collected and are displayed graphically, compensation can be made for the time delays between probes, i.e. the probe data can be aligned.

Open the **Adjust Probe Alignment** dialog to adjust the relative positions of the different probe traces for the current paqfile: select Adjust Probe Alignment from the Process menu or from the graph right-click menu. Choose how probe alignment is to be done:


- **Probe** – Select the probe to be manually adjusted and click the arrow buttons to move that probe's trace to left or right by one data-point; hold Shift as you click to move the trace by 20 data-points.
- **Autocorrect** – Click to adjust positions of the probe traces automatically, according to their shape.

If the paqfile is saved after the change has been made, the **new alignment will be saved** with it.

Process Files

A **process file** (*available in Insight EasyTrack Professional only*) contains data on the product you are passing through the oven and the conditions to which it is subject while it is in the oven. It can also specify the analyses you wish Insight to perform on it.

All the information and options held in a process file can be applied individually to a paqfile, but – especially if the run is to be repeated with the same product and the same conditions – it is normally more convenient to hold all this information together, in a process file. It can then be applied to the paqfile in a single, simple step – and, during hardwired telemetry (p. 67), this allows you to see the temperature profile in relation to the oven zones (p. 76) as the profile appears on screen during the run.

A process file is **created**, or **edited**, using the Process Details dialog: click , or select Process > Process Details.

It will often be most convenient to **apply** an existing process file to a temperature profile as part of the logger download operation (p. 65), but it may also be applied (or a different process file may be applied) at any time after that by using the Process Details dialog or by selecting Process > Apply New Process.

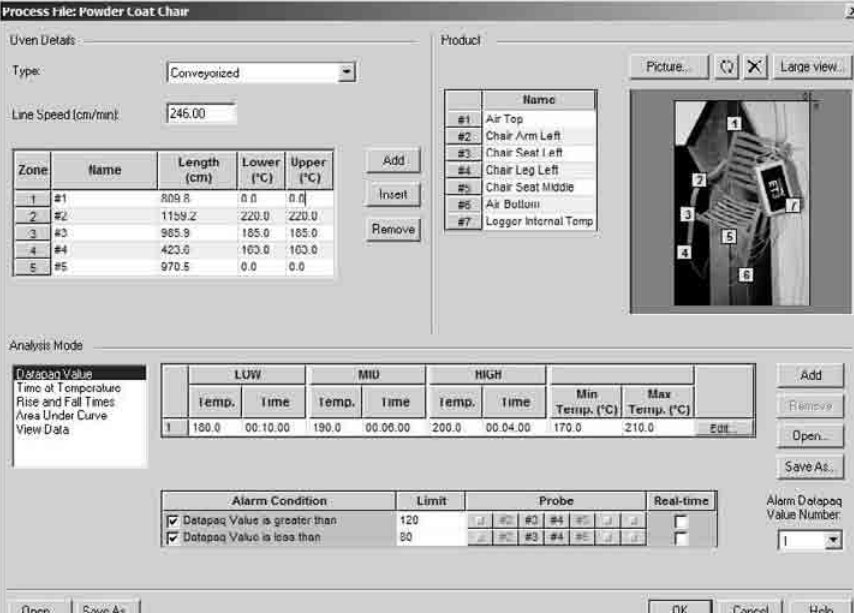
Process Details Dialog

The dialog provides you with a central location to:

- View and specify the process which is applied to the currently-viewed paqfile.
Changes are applied to the paqfile display by clicking OK.
- Edit and save the process details as a process file, whether or not they are applied to the currently viewed paqfile.
Files are saved by clicking Save As.

Reach the Process Details dialog directly by clicking  on the toolbar.

You can also reach the Process Details dialog by clicking Edit on the Paqfile Properties dialog (select File > Properties, or graph right-click menu).



Process File: Powder Loat Chair

Given Details:

Type:

Line Speed (cm/min):

Zone	Name	Length (cm)	Lower (°C)	Upper (°C)
1	#1	809.8	0.0	0.0
2	#2	1159.2	220.0	220.0
3	#3	965.9	185.0	185.0
4	#4	423.0	163.0	163.0
5	#5	970.5	0.0	0.0

Buttons: Add, Insert, Remove

Product:

Name
#1 Air Top
#2 Chair Arm Left
#3 Chair Seat Left
#4 Chair Leg Left
#5 Chair Seat Middle
#6 Air Bottom
#7 Logger Internal Temp

Buttons: Picture..., Large view...

Analysis Mode:

☒ Datapaq Value
☐ Time of Temperature Rise and Fall Times
☐ Area Under Curve
☐ View Data

	LOW		MID		HIGH			
	Temp.	Time	Temp.	Time	Temp.	Time	Min Temp. (°C)	Max Temp. (°C)
1	180.0	00:10.00	190.0	00:06.00	200.0	00:04.00	170.0	210.0

Buttons: Add, Remove, Open..., Save As..., Edit

Alarm Condition	Limit	Probe	Real-time
<input checked="" type="checkbox"/> Datapaq Value is greater than	120	<input type="checkbox"/> #1 <input type="checkbox"/> #2 <input type="checkbox"/> #3 <input type="checkbox"/> #4 <input type="checkbox"/> #5	<input type="checkbox"/>
<input checked="" type="checkbox"/> Datapaq Value is less than	80	<input type="checkbox"/> #1 <input type="checkbox"/> #2 <input type="checkbox"/> #3 <input type="checkbox"/> #4 <input type="checkbox"/> #5	<input type="checkbox"/>

Buttons: Open..., Save As...

Alarm Datapaq Value Number:

Buttons: OK, Cancel, Help

The Process Details dialog (Insight EasyTrack Professional only), showing information on oven zones, probes, the product and analyses.

The following sections and controls are available in the dialog.

Open button – Allows you to open an existing process file. That process file's details are then displayed in the Process Details dialog but are not applied to the currently viewed paqfile until you click OK.

Save As button – Use this to save, as a process file, all the details currently displayed in the Process Details dialog. The filename will be saved with a .PRO extension. All process details displayed in the Process Details dialog will be saved with the currently displayed paqfile when the paqfile is saved, but they will not form part of a separate process file unless they are saved here.

OK button – Clicking OK will apply the process details shown in the dialog to the currently-viewed paqfile. If you do not wish them to be applied (e.g. because you have edited the process details in order to save them as a new process file for later use), close the dialog by clicking Cancel instead.

Oven Details

In this section of the dialog, specify the number and lengths of oven zones, and the settings to be used for line speed and heaters.

Specify the **type** of oven – conveyORIZED or batch. These differ in the way that oven zone lengths are defined; see below.

For a conveyORIZED oven, enter the oven's **line speed** (the rate at which the product moves through the oven), so that the results analysis can display the temperature profile correctly relative to the oven length and to the positions of the oven zones.

Oven zones are fixed sections of the oven which are defined primarily by the location of heaters, but also by elements such as fans and baffles which have a specific effect on the environment within the oven. Click the **Add** button until you have specified the total number of zones (maximum six), then enter the **length** of each zone – as a distance for a conveyORIZED oven, or as a time for a batch oven. Enter the temperatures that you wish to use for the **lower** and **upper** heaters of each zone. You can enter **names** for the oven zones if you wish. (Ignore any dead zones, i.e. those in which the product is removed from the oven for a time and then returned.)



To insert a zone within those already created, click in the grid immediately below the position of the new zone, and then click **Insert**. To remove a zone, click on its name or length in the grid and then click **Remove**.

Product

In this section of the dialog, specify a product picture and probe positions.

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

If you have a **picture** of the product – in BMP, JPG, GIF or PNG format – you can insert it here. This can either be simply for identification and reference, or it can help you to locate the positions of the thermocouple probes on it in order that you can compensate for the time delays between different probes passing through the oven (see p. 74). The picture should be to scale, from above or to the side of the product.

If you have included a picture of your product, you can click  to **rotate** it (clockwise, 90° at a time) so that the edge which enters the oven first is to the right. To **remove** a picture, click .

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.


Analysis Mode

In this section of the dialog, specify options for the analyses performed on the temperature-profile data.

Analyses can be performed on the profile data you gather, and, as part of this, alarms can be set up to highlight data which are outside specified limits. For most of the analysis modes, you can specify various parameters and set which alarms are to be operational and what their alarm conditions are to be (by default, all alarms are off).

In the list, select the analysis mode whose parameters/alarms you wish to change, and select options and/or enter values (see the references below for details of each mode):

- Datapaq Value – p. 78
- Maximum/Minimum – p. 80
- Time at Temperature – p. 81
- Rise and Fall Times – p. 81
- Peak Difference – p. 82
- Area Under Curve – p. 83

Options set here can also be applied to paqfiles individually using the Analysis Options dialog for the relevant analysis (after selecting the analysis tab at the bottom of the screen, click  or select View > Analysis Options). However, if you will be applying the same options to a number of paqfiles, it is quicker and more convenient to do this by making them part of a process file.

Analysis Modes

The Analysis Window, below the graph, shows the numeric values calculated for each probe's data using one of several analysis modes (see below).

Use the **tabs** at the bottom of the Analysis Window to switch between different analysis modes.

The following buttons are shown in the Analysis Window.



Analysis Options – Opens the Analysis Options dialog for the current analysis mode, where you may specify various **parameters for that analysis**. In *Insight EasyTrack Professional* only, you may also set here which **alarms** are to be operational and what their alarm conditions are to be (by default, all alarms are off): temperature profile data which are outside specified limits are then highlighted automatically in order to alert you to a potential problem. See information on individual modes, below. The options can also be reached by selecting View > Analysis Options. Note that this button is not available in View Data mode (p. 83).





Probe Names – Displays a dialog where you may enter names for the individual probes. Can also be reached by selecting Edit > Probe Names.



or



Change Sort Order – Visible only when another temperature profile is overlaid on the graph (p. 88). Switches the way data from probes are grouped in the analysis grid: clicking  causes the results for each probe to be listed by file (all data for each file are together);  groups them by probe number (all data for each probe number are together).

If you will be applying the same analysis options and/or probe names to a number of paqfiles, it is quicker and more convenient to do this by making them part of a process file (Insight EasyTrack Professional only; see p. 74).

Datapaq Value

Datapaq Value – a statistic developed and copyrighted by Datapaq – provides a unique indication of **cure quality** during a particular coating process, and can aid in optimizing product throughput. Insight compares the coating manufacturer's recommended curing time/temperature with the actual time/temperature values experienced by the product and, for each probe location, generates a number – the Datapaq Value – which indicates the degree of compliance. Datapaq Values are as follows:

Datapaq Value	Description	Meaning
<100	Time/temperature experienced did not achieve manufacturer's recommendations.	There was under-curing.
100	Time/temperature experienced complied with manufacturer's recommendations.	Curing was correct.
>100	Time/temperature experienced exceeded manufacturer's recommendations.	There was over-curing.

As with other temperature-profile data, Datapaq Value should be used in conjunction with complementary quality-assurance tests. By carrying out proven

tests (e.g. adhesion, salt spray, impact resistance) and comparing results from these with the corresponding Datapaq Values obtained, it is possible to establish an acceptance band of Datapaq Values (e.g. 80–120) which can then be used during day-to-day process control to prove that the coating is being cured to specification.

Datapaq Value is not linear, i.e. a value of 200 does not imply that the rate at which the product moves through the oven can be doubled, or that the oven temperature can be halved. Instead, it is necessary to make small adjustments to either line speed or temperature and monitor the resulting change in Datapaq Value to optimize product quality and throughput.


Parameters

A given **cure schedule** recommended by a coating manufacturer normally includes three cure options:

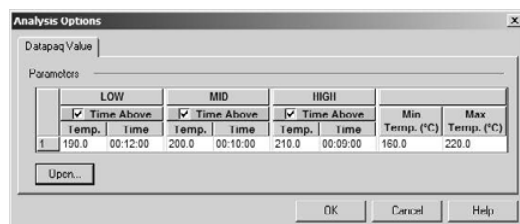
- Mid threshold temperature and time.
- Low threshold temperature over a longer time.
- High threshold temperature over a shorter time.

Also defined by the manufacturer for each cure schedule are:

- Minimum temperature, below which curing does not take place.
- Maximum temperature, above which the coating is damaged.

These values are entered as parameters in the Datapaq Value Analysis Options dialog (click  or select View > Analysis Options).


In *Insight EasyTrack*, results can be calculated for one cure schedule at a time. If you have been provided with cure-schedule data in a Datapaq Value file, click **Open** to load that data.



The Analysis Options dialog for Datapaq Value in Insight EasyTrack.

In *Insight EasyTrack Professional*, you may:

- Have three cure schedules loaded simultaneously: click the additional **Add** or **Remove** buttons as necessary.
- Click **Edit** to change graphically the values of a cure schedule's low, mid and high options: drag the data points as required; the values are reflected in the cure schedule data grid.

- Use the **Datapaq Value Wizard** to create a Datapaq Value file containing all the details of a cure schedule (click  or select Tools > Wizards or select Wizards from the graph right-click menu). Thus, different cure schedules can easily be stored and then loaded when required (click **Open** in the Analysis Options dialog).

To display results for a given cure option, select its **Time Above** checkbox. The Datapaq Value calculated is always displayed in the results.

Click **OK** and the results are displayed in the Analysis Window:


- **Time Above** – time spent above each threshold temperature
- **Datapaq Value** – indicating the cure quality (see above).

*In Insight EasyTrack Professional only, within this dialog you may set **alarms** to warn of any out-of-tolerance data (see p. 78 and, for full details, Insight's online Help system).*

A pass/fail result including Datapaq Value, immediately after the profile run is completed, can be achieved using SmartPaq; see p. 85.

Maximum/Minimum

This analysis mode displays **maximum and minimum recorded temperatures** and the times at which they occurred.

To **choose the data** you wish to display, click  (or select View > Analysis Options) to open the Analysis Options dialog. The results which can be displayed in the Analysis Window are as follows. Select the ones you wish to appear:


- **Maximum** – Highest temperature reading from a given probe. Useful for indicating when the product reaches too high a temperature.
- **Max. Reached** – The time after the start of the profile run at which a given probe's maximum temperature was recorded.
- **Minimum** – Lowest temperature reading from a given probe. Useful for indicating when the product does not exceed a required minimum temperature during certain stages of the process.
- **Min. Reached** – The time after the start of the profile run at which a given probe's minimum temperature was recorded.

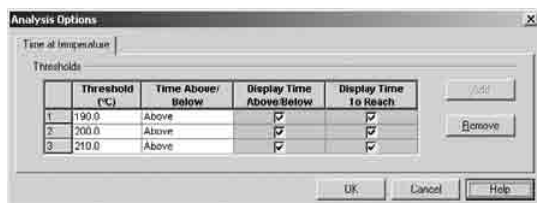
*In Insight EasyTrack Professional only, within this dialog you may set **alarms** to warn of any out-of-tolerance data (see p. 78 and, for full details, Insight's online Help system).*

A pass/fail result including maximum temperature, immediately after the profile run is completed, can be achieved using SmartPaq; see p. 85.

Time at Temperature

This analysis mode calculates the **time taken to reach user-selected temperatures** and the **time spent above or below** each of these thresholds.

To **define the thresholds**, click  (or select View > Analysis Options) to open the Analysis Options dialog.



The Analysis Options dialog for Time at Temperature mode.

Define the threshold temperatures (maximum three) which you wish to use and whether you wish to display time spent above or below these thresholds. Select also whether or not these results – and the time taken to reach the thresholds – are to be displayed in the Analysis Window.

The results displayed in the Analysis Window for this analysis mode are:


- **Time Above/Below** – The time spent above or below each threshold.
- **Time to Reach** – For time above, this is the time into the run at which the threshold temperature was reached. For time below, this is the time into the run at which the temperature fell below the threshold value.

In Insight EasyTrack Professional only, within this dialog you may set **alarms** to warn of any out-of-tolerance data (see p. 78 and, for full details, Insight's online Help system).

A pass/fail result including time at temperature data, immediately after the profile run is completed, can be achieved using SmartPaq; see p. 85.

Rise and Fall Times

This analysis mode (*Insight EasyTrack Professional only*) calculates the **rates of heating and cooling** for each probe over user-defined temperature ranges, and the time the temperature is within each range.

To **define the temperature ranges**, click  (or select View > Analysis Options) to open the Analysis Options dialog. The results which can be displayed in the Analysis Window are as follows. Select the ones you wish to appear:

- **Rise Time** – Time taken for the temperature to rise from the lower to the upper value within the range specified.
- **Rising Slope** – Average rate at which the temperature increases, calculated over the range specified.
- **Fall Time** – Time taken for the temperature to cool from the upper to the lower value within the range specified.
- **Falling Slope** – Average rate at which the temperature falls, calculated over the range specified.
- **Time Between** – Total time which the probe has spent within each specified temperature range (actually calculated as the sum of the Rise Time and the Fall Time, though this will normally be the same thing – unless the probe temperature has varied erratically, e.g. if it was recording air temperature).

If the upper temperature of the specified range has not been reached, times and slopes will be calculated up to the peak value achieved. Such values are marked with an asterisk * in the analysis grid.

Within this dialog you may set **alarms** to warn of any out-of-tolerance data (see p. 78 and, for full details, Insight's online Help system).


Peak Difference

This analysis mode (*Insight EasyTrack Professional only*) identifies the **two probes which recorded temperatures with the biggest difference at any single point in the profile**. It gives the value of the difference and the time in the profile at which it occurred. Thus it can be used to identify where the worst instances of unevenness of heating are occurring on the product.

The analysis grid shows a **link between the two identified probes**, and their temperatures.

By default, the analysis will consider the profile as a whole, but you can force it to consider:

- Only certain probes (e.g. to give you the magnitude and timing of the peak temperature difference between any two probes), and/or
- Only a certain part of the profile.

To **select the probes and the region of the profile** which you wish to include in the calculation, click  (or select View > Analysis Options) to open the Analysis Options dialog.

Excluding Probes – To turn probes off, click on the probe buttons in the analysis grid or in the Analysis Options dialog. The analysis will then apply only to those that remain.


Analyzing Only Part of the Profile – Either:

- **Zoom** into your chosen part of the graph by dragging out a rectangle (from top left to bottom right) over the selected area (p. 87). Data shown in the Analysis Window then apply only to the region of the graph that has been selected for zoom. Return to the normal view – and restore analysis of the whole profile – by double-clicking on the graph. Or...
- Restrict the analysis by **oven zone**.

Within this dialog you may set **alarms** to warn of any out-of-tolerance data (see p. 78 and, for full details, Insight's online Help system).

Area Under Curve

This analysis mode (*Insight EasyTrack Professional only*) calculates the area under the temperature profile curve, i.e. the **area which lies below the curve but above a threshold temperature**. A start and end time for the area can be defined.

To **define the thresholds** you wish to use, click  (or select View > Analysis Options) to open the Analysis Options dialog. Time limits can also be set by **dragging the vertical markers** on the graph; click **Expand/Contract** to make the dialog smaller to assist this.

If an area of the graph is selected by **zooming** (p. 87), the Analysis Window shows both the calculated area under the whole profile curve and, in an additional column, the part of that area which is visible in the current zoom.

In Insight EasyTrack Professional only, within this dialog you may set **alarms** to warn of any out-of-tolerance data; click **Expand/Contract** as necessary (see p. 78 and, for full details, Insight's online Help system).

View Data

This analysis mode shows the **raw time and temperature data** for each probe, as gathered by the logger.

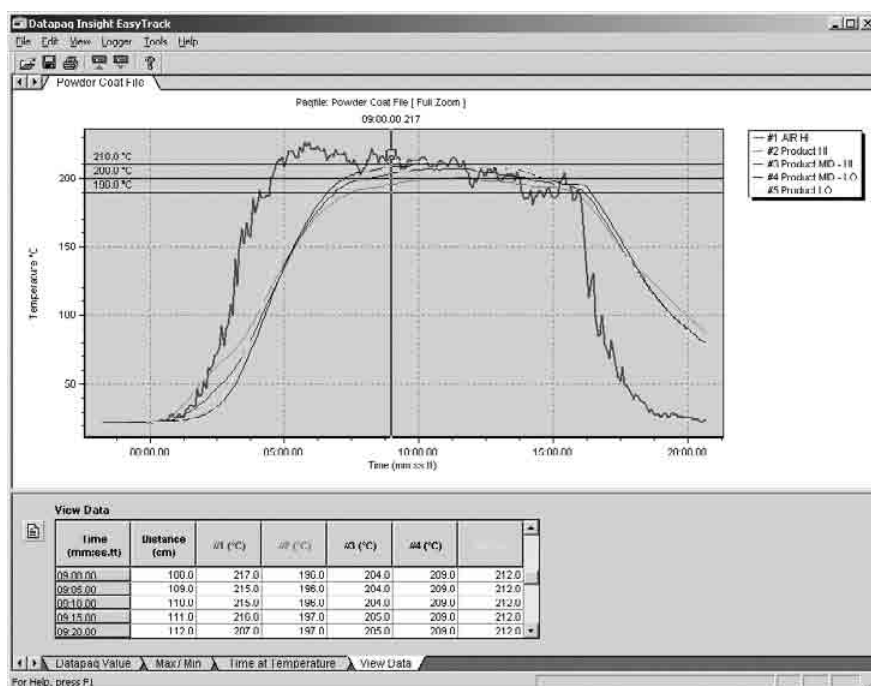
The probe profile which is currently selected is thickened on the graph and on the Probe Key to the right of the graph. To select a different probe profile, click on it on the graph.

Drag the cursor bar across the graph to obtain precise time and temperature data for a specific probe. These are shown numerically:

- On the graph above the top of the cursor bar

- In the data grid in the Analysis Window. The grid scrolls as the cursor is moved, with the top line of data in the grid corresponding to the current cursor position.

Similarly, scrolling the data table moves the cursor across the graph.



View Data analysis mode.

Zooming into a region of the graph (drag out a rectangle from top left to bottom right, p. 87) re-locates the cursor to the center of the zoomed region. Return to the normal view by double-clicking on the graph, right-clicking and selecting Show Full Zoom, selecting View > Show Full Zoom, or pressing F5.

Values at the start of the data may be negative. This is because the oven start (p. 71) occurs after the logger started recording data.

SmartPaq

In *Insight EasyTrack Professional*, SmartPaq provides instant pass/fail quality assurance on removal of the system from the oven. There are two simple stages:

1. As part of the reset procedure (p. 57), **pre-program the logger** with your process's pass/fail criteria (see below).
2. While the run is in progress, the logger continually calculates the pass/fail result on the data gathered so far; thus, the **SmartPaq LED** starts red and may change as the run progresses. When the run is stopped (by pressing and holding the logger's red stop button, p. 63), the LED shows the final outcome for the whole run: **green** for pass, **red** for fail.



The SmartPaq LED.

SmartPaq calculations will be performed on data from **all the thermocouples** that are specified in the SmartPaq setup (see p. 87).

The SmartPaq result will be a **fail** if:

- **One or more of the chosen parameters** (see below) is outside the limits specified for any of the thermocouples.
- **Any one of the selected analyses** (see below) produces a fail on its own.
- Data from any of the specified thermocouples contains **invalid data** (e.g. open circuit, see p. 94).

SmartPaq Setup

Parameters for the SmartPaq calculations are programmed into the logger as part of the reset procedure (p. 57). In the Logger Reset dialog, click the SmartPaq button to open the **SmartPaq Setup dialog**, and there specify or edit your parameters and limits for any combination of:

- Time at Temperature; see p. 81.
- Maximum Temperature; see p. 80.
- Datapaq Value; see p. 78.

Select which of these three analyses you wish to form part of the SmartPaq calculation.

Time at Temperature

Enter data for the **temperature threshold** (one threshold value only) and whether to test the times spent above those temperatures against **minimum and/or maximum permitted times**. By default, the threshold temperature will be the value setup for the mid cure option in Datapaq Value.

Maximum Temperature

Enter a **maximum permitted temperature**. By default, the value will be the maximum temperature entered for Datapaq Value calculations.

Datapaq Value

Enter **cure-schedule data** (for one cure schedule only) to suit your process, as recommended by your coating manufacturer:

- Temperature and time data for **three cure options**.
- **Minimum and maximum** permitted temperatures for successful cure.

Select whether to test the calculated Datapaq Value against **minimum and/or maximum values**, and enter those values (see p. 78).

The SmartPaq Setup dialog box is titled "SmartPaq Setup" and contains a sub-header "Select the analysis calculations and limits that your logger will perform to give a pass/fail result:". It has three main sections, each with a checkbox and a title:

- Time at Temperature** (checked):
 - Threshold (°C): 200.0
 - Pass/Fail Limits (hh:mm:ss) table:

Minimum		Maximum	
Check	Limit	Check	Limit
<input checked="" type="checkbox"/>	00:00:00	<input checked="" type="checkbox"/>	00:00:00
 - Buttons: Add, Remove
 - Buttons: #1, #2, #3, #4, #5, #6
- Maximum Temperature** (checked):
 - Pass/Fail Limits (°C): 220.0
 - Buttons: #1, #2, #3, #4, #5, #6
- Datapaq Value** (checked):
 - Table with columns: LOW, MID, HIGH, Min Temp. (°C), Max Temp. (°C), Pass/Fail Limits.

LOW		MID		HIGH				Pass/Fail Limits	
Temp.	Time	Temp.	Time	Temp.	Time	Min Temp. (°C)	Max Temp. (°C)	<input checked="" type="checkbox"/> Check Minimum	<input checked="" type="checkbox"/> Check Maximum
190.0	00:12:00	200.0	00:10:00	210.0	00:09:00	160.0	220.0	0	0
 - Buttons: #1, #2, #3, #4, #5, #6

At the bottom, there is an unchecked checkbox: "For multiple runs, calculate pass/fail for first run only (If this is deselected, a pass/fail result will be calculated for all runs using the parameters set-up above)".

Buttons: OK, Cancel, Help

The SmartPaq Setup dialog. All three possible analyses are selected, and details of all three are therefore shown.

Probe Selection

Probe selections can be set separately for each of the SmartPaq analyses. Click on individual **probe numbers** to exclude them from the SmartPaq calculations.

Multiple Runs

If the logger is to be used in multiple-run mode (p. 60), select whether the SmartPaq pass/fail calculation will be carried out for all runs or for only the first run.

Working with the Graph

Zooming

Sections of the graph of particular interest can be expanded (zoomed), to provide a magnified view of that part of the graph.

While the graph is zoomed, the numerical data and calculations shown in the Analysis Window are restricted to that part of the data lying within the time range of the zoomed area.

Zooming is done with the mouse:

- Drag out a rectangle (from top left to bottom right) over the selected area. After zooming once, you may repeat this to zoom in further.
- Double-clicking the graph (or dragging a rectangle from bottom right to top left) returns the view to either Full Zoom, Process Zoom or a Saved Zoom (see below), depending on which was last selected (except during a hardwired telemetry run; see p. 68).

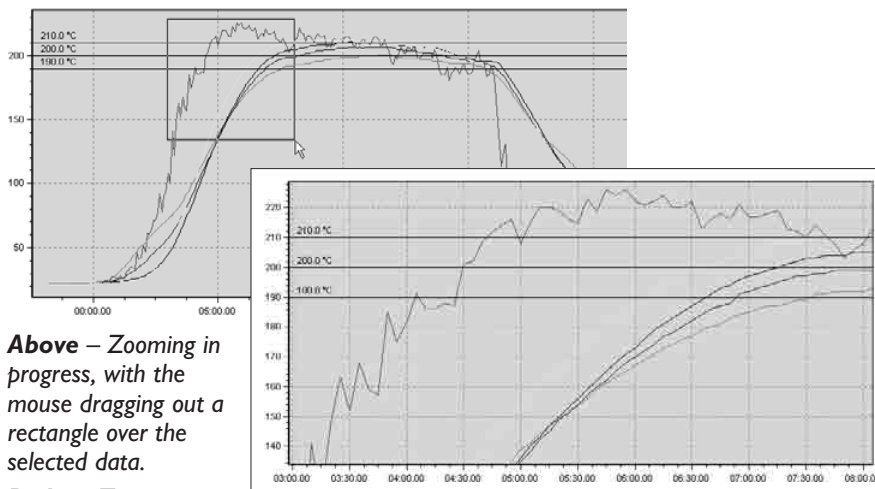
Other **zoom modes** can be selected from the View menu or from the graph right-click menu or with function keys, as follows.

Show Full Zoom – FUNCTION KEY F5 – Returns the view to the full view of the paqfile's data, i.e. from the first to the last data-point.

In Insight EasyTrack Professional only, to ensure that the view includes the set oven-zone temperatures (which may exceed the maximum recorded temperature, see p. 76), check Use Recipe Settings for Full Zoom Calculation on the Profile Options tab of the Graph Options dialog (from View menu or right-click menu).

Show Process Zoom – FUNCTION KEY F6 – Zooms the view to the area of the process only, i.e. from oven start to the end of the process (see p. 71).

Real Time Zoom – During hardwired telemetry (p. 68), zooms the view to only the most recently received portion of the data on the scrolling graph.



Above – Zooming in progress, with the mouse dragging out a rectangle over the selected data.

Right – Zooming after the mouse is released: the selected data fills the whole Graph Window.

Saved Zooms (*Insight EasyTrack Professional only, but not available during hardwired telemetry*) – Allows Insight to remember a series of specific zoomed areas of the graph and return to them quickly.

Show Saved Zoom – Select from the list the saved zoom view you require. The currently selected zoom is shown checked.

Saved Zoom(s) – View images of the saved zooms: an outline on the full graph shows the area that will form the zoomed view. Click OK, or double-click on the selected zoom image.

Add To Saved Zoom(s) – Adds the zoom view currently on screen to the saved zooms.

The zoom mode currently in use is shown above the graph.

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

Overlaying Another Temperature Profile


Overlaying another temperature profile on your graph is useful for purposes of comparison, and to check that individual profiles fall within specified limits.

- To select and overlay another profile, select View > Overlay from the main menu, or select Overlay from the graph right-click menu.

- To select curves to be overlaid, click **Add** and browse to the required files. Turn the display of each curve on or off with the **Show** checkbox. Click **Browse** next to a selected file to replace it with another.

In order that the overlay be meaningful, it is essential that the oven start position (p. 71) is exactly the same for all curves.

One paqfile at a time (or up to three in *Insight EasyTrack Professional*) can be overlaid on the current paqfile.

Probe numbers and **probe names** in the overlaid paqfiles are maintained unchanged: they are shown in the Probe Key beside the graph, and can be viewed and edited in the Edit Probe Names dialog (click  in the Analysis Window). The traces for all probes of a given probe number are shown in the same color but in a different tint of that color.

*In Insight EasyTrack Professional, you may also overlay a **tolerance curve** on the current paqfile (from the Tolerance Curves tab of the Overlay dialog). These provide an envelope of acceptability against which to compare your temperature profile. For details of the creation and use of tolerance curves, see Insight's online Help system.*

Using Memos

Memos allow you to annotate your results directly on the graph. There are two types:

- **Box memo** – Text is permanently visible in a box, with an arrow showing the point of interest on the graph.
- **Vertical-line memo** – A 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.

Creating Memos

1. **Right-click** on the graph at the point where you wish the memo to appear.
2. Select **Add Memo** from the popup menu.
3. Enter your **text**.
4. Select a **color**.
5. Select **vertical-line memo** if you wish it to be one.
6. Click **OK**.

The Add Memo dialog is also available by selecting Edit > Memos and clicking Add. The memo you create will then appear on the graph in the middle of the current view and may be moved as described below.

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**.

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 – Click and drag on the marker line.

Removing Memos

Either:

- Right-click on the memo on the graph, and select 'Remove', or
- On the main menu select Edit > Memos, then
Click in the text of the memo you wish to remove, and click 'Remove'.

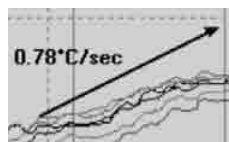
Printing

When the graph is printed, box memos appear as they do on screen. Vertical-line memos appear with their text displayed.

Using Slope Markers

Slope markers allow you to annotate your results directly on the graph by indicating desirable or actual slopes at different parts of the temperature profile.

The marker consists of an arrow, whose angle can be changed; the slope of the arrow is shown automatically next to it.



Creating Slope Markers

1. **Right-click** on the graph at the point where you wish the marker to appear.
2. Select **Add Slope Marker** from the popup menu.

Altering Slope Markers




Hold Control as you click and drag the marker's arrowhead to change the **angle** of the marker.

Hold Control as you click and drag the other end of the marker to **move** the whole marker.

To **remove a slope marker**, right-click on the marker and select 'Remove'.

*During hardwired telemetry, you may also add **event markers** while the run is in progress. See p. 69.*

3D Graph and Thermograph Views

In *Insight EasyTrack Professional* only, alternative views of the profile data can help to visualize and highlight certain aspects. Click  or  (or select from View menu or the graph right-click menu). To return to the default view, click  (or View > 2D Graph, or select from the graph right-click menu). See p. 42, and – for full details – Insight's online Help system.

Troubleshooting

Logger Download Error Messages

Error Message	Action
There are insufficient readings in the logger	Check trigger set point (temperature). Check logger's battery for charge. Check date/time settings on computer. Check probes and their connections. Reset logger, and test thermocouples (see below).
Logger stopped due to going over temperature	The logger's maximum-permitted internal temperature has been exceeded and it may have suffered serious damage: contact Datapaq for advice.
Logger stopped due to low battery	Replace the battery, then repeat the profile run.
Logger memory full	Data collection may have stopped before the run was completed: check the data collection period and sample interval before resetting the logger for another run (p. 57).

Logger Communications Problems

Typical sources of problems with establishing communication:

- **Communications lead not fully inserted** – Check correct sockets are being used.
- **Damaged communications lead or connectors** – Check for breaks and other damage. Replace the lead.

In addition:

- **Check the logger and battery status from the LEDs** – See p. 13.
- **Try restarting the logger** (any data present in the logger's memory is retained):
 1. Disconnect communications lead from logger.
 2. Turn logger off (press green and red buttons together, and hold for 5 seconds); all four LEDs flash together, once.
 3. Reconnect communications lead to logger.
 4. Red logger-status LED will flash five times to confirm connection.

To minimize communications problems:

- **Connect the lead first to the PC** and then to the logger.
- **Always use the same USB port** – the one which was first used to set up communications (p. 38).

In case of communications problems, the user may easily download and **email key diagnostic information** to Datapaq:

1. Connect the logger to the PC with Insight running.
2. Select Logger > Setup > Advanced, or Help > Service.
3. Select a name and location for the downloaded file, and a destination for the email.

The file created is accessible to Datapaq but is not designed to be opened by the user.

Checking the Data

If you suspect that invalid data may have been introduced into your temperature profile (paqfile), perhaps by damaged thermocouples (see below), select the View Data tab in Insight's Analysis Window to view the raw data as downloaded from the logger. The various types of invalid data which may be contained in a paqfile are shown in the analysis grid as follows.

- *OC* Open circuit. (May be recorded when trigger mode is set to auto start; see p. 59.)
- *NA* Telemetry data not received.
- *LO* Temperature measured was below the range of the logger.
- *HI* Temperature measured was above the range of the logger.
- *** Calculation cannot be performed (not necessarily because the data are invalid). Does not appear in View Data analysis mode.

Probes with an intermittent open circuit may produce spiky, erratic profiles. Note that spikes are inevitable when probes are disconnected from a running data logger. Typical causes of invalid or interrupted data are:

- Thermocouple becoming detached from the logger.
- Faulty connection.

Readings which are inconsistent with those of other probes may be caused by a short circuit (see below). The probe concerned must be replaced.

Testing the Logger and Thermocouples

Although thermocouples are generally robust, they can be damaged during handling. Use the following procedure to confirm the operation of logger and thermocouples after installation. Note that this test is not an alternative to calibration (p. 19), but will highlight a malfunctioning logger or faulty probes and thus avoid a wasted profile run.

Do one of the following:

- With a full set of thermocouples attached to the logger, and the logger connected to a PC running Insight, open the Logger Reset dialog (p. 57)

or the Diagnostic section of the Communications Setup dialog (p. 39); this shows current probe temperatures – *or...*

- Set up the system as if to monitor a profile run using hardwired telemetry (see p. 67 for details), and note the temperatures registered by the thermocouples as they are displayed in Insight – *or...*
- To test the thermocouples alone, use a digital thermometer (of a type to match the thermocouple type) and attach it to each thermocouple in turn.

Proceed as follows.

1. Note readings first at ambient temperature: thermocouples registering no data in Insight, or an open circuit with a digital thermometer (*OC* in the Communications Setup dialog), may be broken. Inconsistent readings may indicate an intermittent short circuit.
2. If a satisfactory ambient reading is recorded, apply heat to the thermocouple-tip via fingers or other heat source. An increased temperature should register:
 - If the reading does not change, the thermocouple is short circuit and must be replaced.
 - If the probe measures air temperature, the cable may have damage which has created a new hot junction.
 - If the thermometer shows a decrease, the thermocouple connections are reversed.
3. Confirm correct operation at 100°C/212°F by placing the thermocouple-tip in freshly-boiled water.
4. Replace any damaged cables.

Printing Problems

- Check correct printer selected: on menu bar, select File > Printer Setup.
- Check printer cable connections.

Datapaq Service Department

If you cannot resolve your problem, please contact the Service Department at Datapaq. For contact details, see back page or www.datapaq.com – or email as follows:

UK service@datapaq.co.uk

Germany service@datapaq.de

China service@datapaq.com.cn

USA auto-rma-us@fluke.com

To **generate an email containing important diagnostic information** about your system and the logger's recent performance, see p. 94.

INDEX

Major entries are shown in bold.

Battery. See Data logger.

Calibration. See Data logger.

Communication between data logger and computer. See Data logger.

Computer specification. See Insight.

Data

- aligning 74

- analysis 71

- analysis in SmartPaq 85

- analysis modes 77

 - Area Under Curve 83

 - Datapaq Value 78

 - Maximum/Minimum 80

 - Peak Difference 82

 - Rise and Fall Times 81

 - Time at Temperature 81

 - View Data 83

- Analysis Options dialog 78

- capacity. See Data logger.

- checking 94

- copy to clipboard 51

- downloading from logger 64

- export 51

- import from file 51

- import from spreadsheet 50

- invalid 94

- pre-trigger **52**, 60

- raw 94

- real-time display 68

- SmartPaq 85

 - LED 14

- sort order, probe 78

- start collection 62

- stop collection 63

- View Data mode 94

Data logger

- accuracy 12

- alarm, run 54

- auto-detection 57

- battery 15

 - charge level 13, 17

 - disposal 19

 - LEDs 11, **13**

 - life 16

 - replacing 16

 - status 13, 58

- buttons, stop/start 15

- calibration 19, 52

- charging. See Battery.

- communication with computer problems 93

 - setup 38

- data capacity 12

- defaults 51

- disposal 19

- download error messages 93

- downloading data from 64

- email diagnostic information 94

- humidity range 12

- LEDs 11, **13**

- measurement range 12

- memory 12

- multiple runs **60**, 65

- multiple runs with SmartPaq 87

- power off 15

- power-off, auto 17

- pre-trigger data **52**, 60

- reset for hardwired telemetry run 67

- reset for non-telemetry run 57

- reset, warn/disable if logger too hot **53**, 58

- reset with previous options 61

- run mode 60

- sample interval **58**, 61

- servicing 95

- specifications 12

- stop 15

- temperature, internal **18**, 40, 53, 58

- temperature limits 12

- temperature, maximum 40, 43, 64

- testing 19, 94

- trigger mode 14, 43, **59**, 60, 61, 65, 93

- troubleshooting 93

- turn off 15

- USB setup and drivers 38

- USB specification 13

Downloading data. See Data logger.

Electricity supply, frequency 54

Emergency procedures 29

Error messages 58, 64, **93**

First-aid procedures 29

Insight 37

- 3D graph view 91

- alarm, run 54, 65

- analysis modes. See Data.

- analysis modes in process file 77

- autosave 70

- Clipboard Paste Wizard 50

- Communications Setup dialog 39

- computer specification 37

- copy data to clipboard 51

- customizing 48

- data analysis. See Data.
 - Datapaq Value. See Data, analysis modes.
 - EasyTrack Professional 9
 - email diagnostic information 94
 - email paqfile 42, **44**
 - export, data 51
 - file management 49
 - graph 87
 - event marker 69
 - memo 89
 - move 88
 - overlay 69, **88**
 - slope marker 90
 - zoom 45, 47, 68, 71, 83, 87
 - Help system 38
 - import data from file 51
 - import data from spreadsheet 50
 - installing 37
 - Logger Download Wizard 64
 - logger listen mode 69
 - Logger Reset Wizard 58
 - menu, main 43
 - menu, right-click (graph) 47
 - notes 50
 - oven details in process file 76
 - oven start 44, 46, 47, 69, **71**, 89
 - oven type 76
 - oven zone 46, 47, 68, 69, **76**, 83
 - paqfile 49, 65
 - password 68
 - printed report 49
 - printing problems 95
 - Process Details dialog 75
 - process end 73
 - process file 65, 68, **74**
 - removal 38
 - report, printing 49
 - save 65
 - shortcut keys 38, 40
 - SmartPaq. See Data.
 - start position, oven 44, 46, 47, 69, **71**, 89
 - thermograph view 91
 - tolerance curve 89
 - toolbar 42
 - upgrading 38
 - user interface 41
 - View Data 94
 - wizards 48
 - zoom 45, 47, 68, 71, 83, **87**
- LEDs. See Data logger.
- Logger. See Data logger.
- Memory. See Data logger.
- Multiple runs. See Data logger.
- Open circuit. See Thermocouple probe.
- Oven start, oven type, oven zone.
See Insight.
- Paqfile. See Insight.
- PC. See Computer specification.
- Power off. See Data logger.
- Printing. See Insight.
- Probe. See Thermocouple probe.
- Process file. See Insight.
- Product 76
- PTFE warning 28
- Resetting logger. See Data logger.
- Sample interval. See Data logger.
- Short circuit. See Thermocouple probe.
- SmartPaq. See Data.
- Start position, oven. See Insight.
- Telemetry, hardwired 67
 - data-collection, pause/resume/end 69
 - logger listen mode 69
 - real-time display 68
- Temperature, logger, internal. See Data logger.
- Temperature profile
 - erratic 94
 - running with hardwired telemetry 67
 - running without telemetry 57
- Thermal barrier **21**, 62, 63
 - care 24
 - first use 21
 - heatsink **21**, 62, 63
 - care 24
 - logger, fitting 62
 - moisture 21
 - selecting 24
- Thermocouple probe 27
 - aligning data 74
 - attachment 33
 - care 35
 - clamp 34
 - installation 34
 - insulation 28
 - location 32
 - names 78
 - open circuit 65, 94
 - PTFE 28
 - short circuit 94
 - sort order, data 78
 - specification 27
 - temperature, current 40, 61, 94
 - testing 35, **94**
 - types 29
- Trigger mode. See Data logger.
- Troubleshooting 93
 - email diagnostic information 94
- USB communications. See Data logger.

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