Heraeus

CasTemp® Superheat

Dynamic Control of Tundish Superheat

Electro-Nite

Introduction

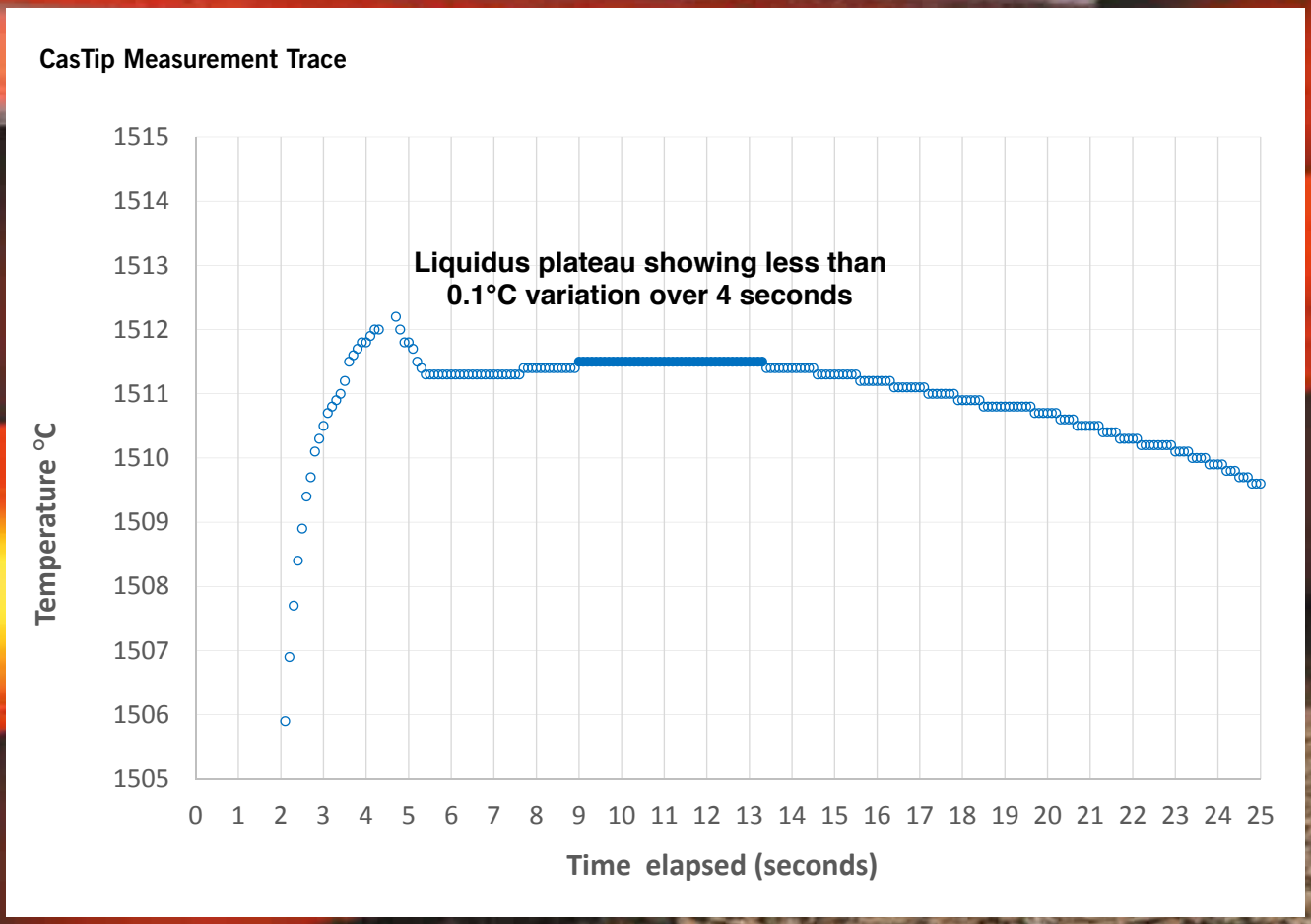
Dynamic superheat control is essential for optimising the continuous casting process, requiring knowledge of the tundish temperature above liquidus.

Good control of superheat will help ensure high quality production and productivity. Liquid steel temperature is obtained using the CasTemp “through the wall” continuous temperature measurement, which is optimally sited near the tundish outlets. Therefore the liquidus has to be accurately and consistently measured to ensure a viable dynamic superheat for casting operations, and future enhancements such as automated speed control. Liquidus is measured by the direct reading CasTip liquidus sensor.

CasTemp Superheat is a development of the established CasTemp Wireless system, and combines a QUBE CTW module and QUBE CasTip to deliver the CasTemp and CasTip measurements; providing an economical and reliable dynamic superheat value promising greater accuracy than existing methods.

The system is wireless and it is designed with a simple connection protocol to ensure robust synchronisation built on the existing CasTemp Wireless system protocol.

A configurable user interface (UI) can be easily adapted to provide a digital superheat display suitable for shop floor operation, or graphical trending for use in the control room.



Benefits

- Dynamic superheat through casting of the ladle
- In built trending package
- No cabling/connectors from the sensor to instrumentation
- Long-life battery technology
- Advisory knowledge of superheat to the end of the ladle using forward prediction
- Existing CasTemp Wireless users can benefit through a software upgrade
- Potential benefits that can be realized include:
  - Automated casting speed control can be implemented by users
  - Improved consistency of operator decisions offered through use of the trending and prediction package
  - Faster casting
  - Increased productivity
  - Improved steel product quality
  - Lower superheat in the ladle
  - Reduction in input energy costs

Liquidus Determination

A number of liquidus equations are in regular use and calculate the liquidus from the steel chemistry. As all equations start at the nominal melting point of pure iron, then error in liquidus temperature is magnified by incorrect coefficients as alloy content increases, in particular carbon. Equations also differ in the constant chosen to represent the melting point of iron, so there can be inconsistency in prediction even at lower carbon contents. Many plants choose to define a single value for liquidus for a casting sequence, based upon grade chemistry, whilst others use sample analysis.

Whilst the grade liquidus value is stable, its accuracy on a given ladle is dependent upon the deviation of the casting analysis from the grade chemistry used in the calculation.

Liquidus obtained from sample analysis is dynamic and relevant to the ladle in question, but is subject to uncertainties caused by analytical technique, delay, sample quality and, indeed, sample identity.

The accuracy of the liquidus is mainly determined by the selection of the equation, and its precision mainly by the variation of the alloy content values used in the calculation from the actual chemistry in the tundish.

CasTip is a direct reading liquidus sensor which records the liquidus arrest plateau during solidification of a captured sample. It is optimized for use in the tundish, and will deliver a stable plateau using thermocouple technology for interpretation by the CasTemp Wireless measurement instrument.

System Components

1. CasTip sensor: immersion sensor for liquidus determination
2. CasTip sensor holder: attached to a standard pole and connected to the QUBE CasTip by an internal signal cable
3. QUBE CasTip: battery-powered unit transmits CasTip liquidus measurement data to the CasTemp wireless instrument
4. CasTemp Wireless instrument
5. CasTemp “through the wall” continuous measurement sensor
6. QUBE CTW: battery-powered unit transmits CasTemp continuous temperature measurement data to the CasTemp Wireless instrument

Continuous Temperature Measurement

Obtaining an accurate liquid steel temperature trend is fundamental to the CasTemp Superheat system. Measurement of this by CasTemp via the QUBE CTW module is described in the CasTemp Wireless brochure.

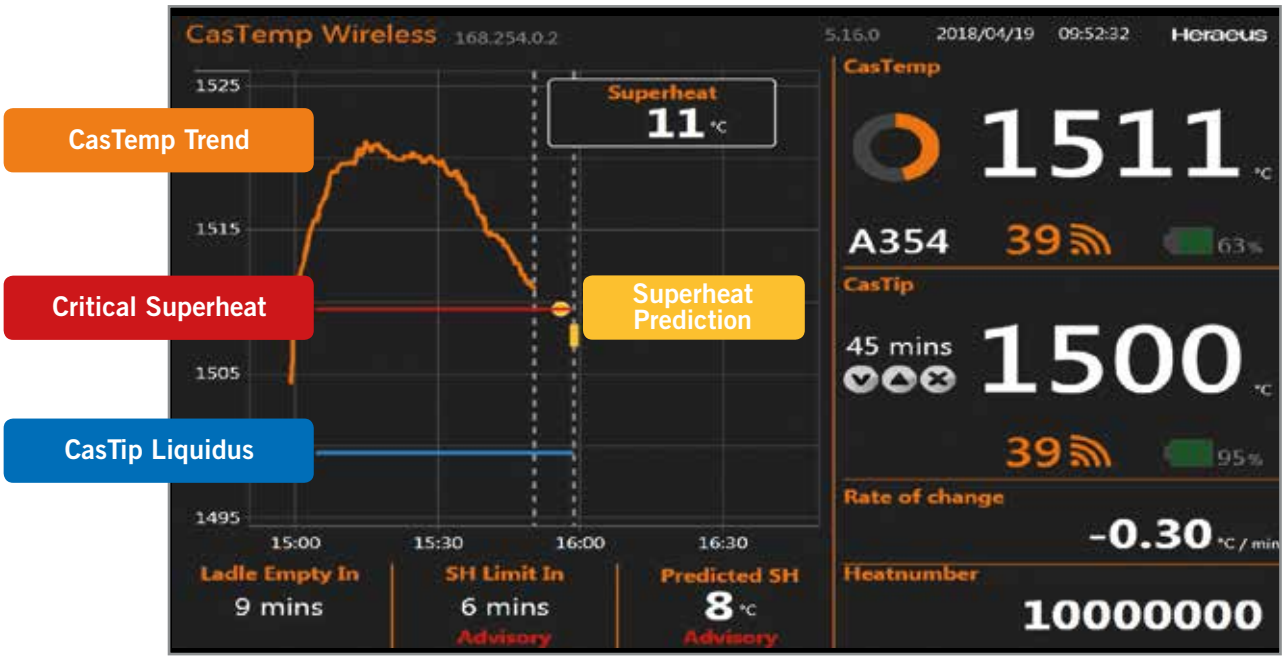
Liquidus Measurement

Measurement of liquidus by CasTip uses manual measurement techniques familiar to virtually all caster operations:

1. Connect the CasTip Liquidus sensor to the pole and obtain green light on the QUBE CasTip
2. Immerse the sensor quickly through the slag layer and into the melt for approximately 4-6 seconds to capture the sample
3. Remove the sensor from the melt and allow up to 20 seconds for the liquidus arrest to complete
4. Once completed it will show on the CasTemp Wireless screen
5. All measurement operations are indicated by the signalization LED on the QUBE CasTip, and will be displayed on the CasTemp Wireless screen or Remote Viewer facility

User Interface and trending

In CasTemp Superheat mode, the CasTemp Wireless instrument indicates the status of the respective QUBE measurement modules and their latest recorded temperature values. The screen can be configured to display either digital values, for easy reference on the caster floor, or a graphical interface. Both displays can be duplicated on a PC based Remote Viewer facility located in the control room. The graphical interface displays the movement of the CasTemp tundish temperature over time and displays the liquidus recorded by CasTip. A critical superheat limit can be user defined, and the system will monitor the progress of the trend towards this limit and on to end of cast, offering both an advisory prediction of superheat at end of cast and also an advisory time when the critical limit will be reached if within the expected casting time. This provides operators with an early warning of potential problems, and can be used to encourage consistency of decision making. The advisory forward prediction is automatically enabled on taking a CasTip liquidus measurement.



System Requirements

CasTemp Superheat requires connection to level 1 or level 2 systems for optimal operation, though its benefits can be demonstrated without such connection.

Data Requirement

The following parameters are required to enable a dynamic superheat measurement.

Measurement parameter	Data Origin	Measurement method
Tundish Temperature	CasTemp sensor	QUBE CTW module
Tundish Liquidus	CasTip sensor	QUBE CasTip module
CasTip Signalization (ready/measure/ complete LED indication)	Interpretation of the CasTip measurement	Interpretation within CasTemp Wireless
Dynamic Superheat	(CasTemp value - CasTip value)	Calculation within CasTemp Wireless
System Time	Plant level 1/2	Parameters sent by plant systems to enable calculation within CasTemp Wireless. I/O options: TCP/IP Ethernet I/P Profibus
Ready to Cast		
Heat Number		
Ladle End Time		
Critical Superheat Limit	User defined parameter delivered via plant level 1/2	
Advisory Forward Prediction	CasTemp Superheat	Calculation using the input parameters defined above

Hardware Requirement

Hardware, Software or connection	Function
CasTemp Wireless Instrument	Primary control instrument
QUBE CTW	Wireless CasTemp temperature measurement
QUBE CasTip	Wireless CasTip liquidus measurement
Control room PC and Display	Operation of Remote Viewer software
Remote Viewer software	Additional software delivering a configurable UI; of particular benefit in the control room
TCP-IP interface 1 (required) NOTE: Connection can be made via an established network or by a direct peer to peer link	Enable connection between the CasTemp Wireless instrument and control room PC or any additional HMI running Remote Viewer NOTE: The control room PC can be used to buffer information between level 1/2 and CasTemp Wireless if other comms protocols are not readily available
One of the following level 1/2 connections must be made	
TCP-IP interface 2 OR	– If using Ethernet I/P interface connection to level1/2 OR – If using direct TCP/IP interface connection to level 1/2
Profibus interface OR	If using Profibus interface connection to level1/2

Input and Output Data Link Requirements for CasTemp Superheat

Caster PLC
I/O modules

Shroud Platform
QUBE CasTip

PLC I/O: Options
Profibus
Ethernet IP
TCP/IP

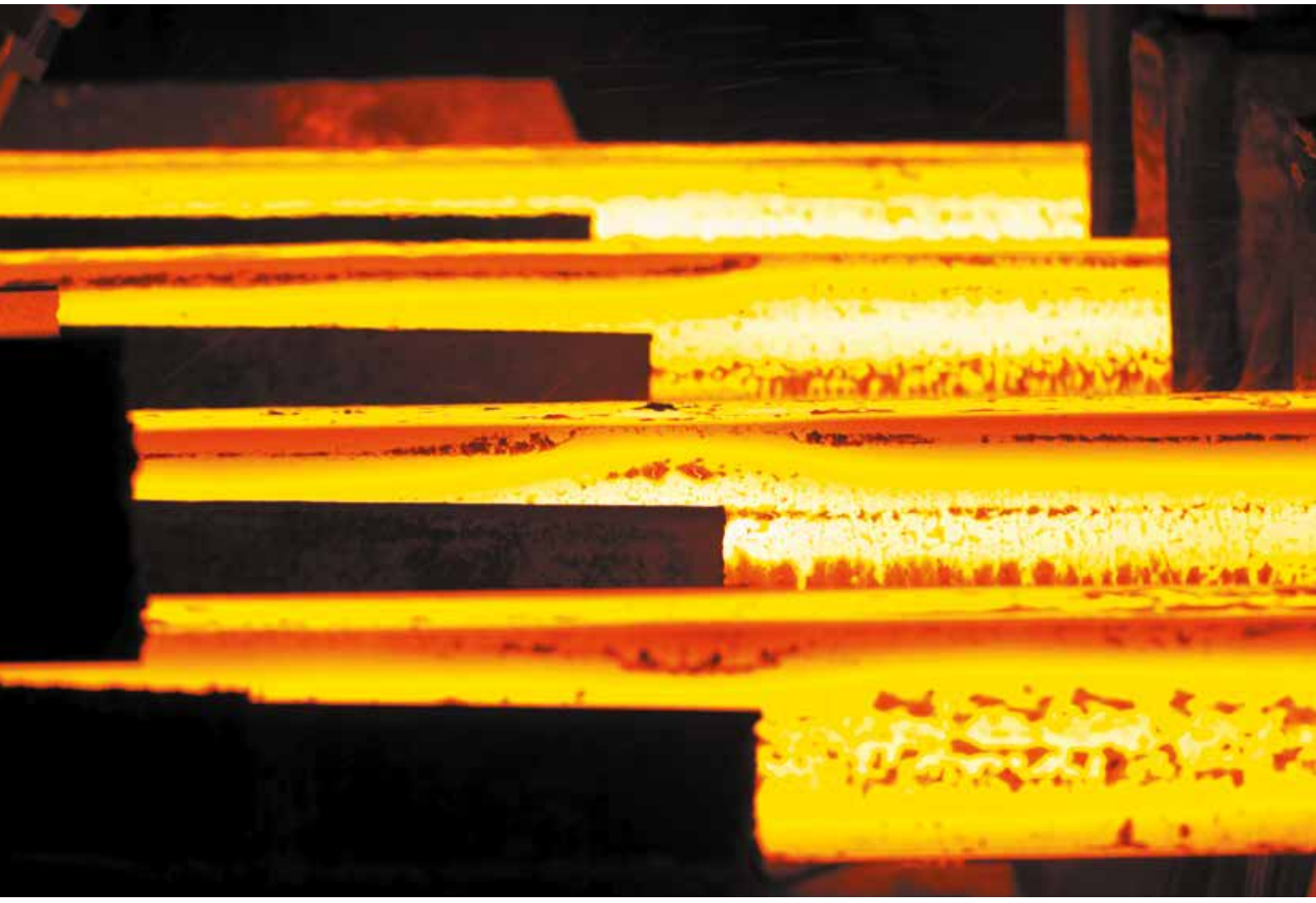
Wireless Data Link
QUBE CasTip
QUBE CTW

Tundish Car
QUBE CTW

Control Room
Remote Viewer

TCP/IP
Remote Viewer
I/O PLC to PC (trials)

Control Room PC
Remote Viewer
Manual I/O via PC (trials)
Temporary data connection with PLC (trials)



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