

Instruction and operating manual
Continuous temperature measurement

CasTemp®

Document version: 1.13

Date of issue: 18 June 2019

© 2014 Heraeus Electro-Nite

This manual is copyrighted by Heraeus Electro-Nite. You cannot copy any part of this document or send, transcribe or store it in any retrieval system, or translate it into any language without getting our written permission beforehand.

We do not guarantee the contents of this document and specifically any implied warranties of merchantability or fitness for any particular purpose.

We can change the specification of the product without giving notice to any person or organisation about these changes.

If we have added improvements or instrument changes after this document was printed, they will be on one or more pages enclosed at the end of this manual.

Trademarks: All brand names and product names included in this manual are trademarks, registered trademarks, or trade names of their holders.



1	Overview	1
1.1	Introduction	1
1.2	Benefits of use	1
1.3	Measuring with CasTemp.....	2
1.4	CasTemp retaining system.....	3
2	Converting the tundish	4
2.1	Steps.....	4
2.2	Positioning the hole	4
2.2.1	Where to place the sensor	5
2.3	Making a hole in the tundish.....	7
2.4	Welding the base plate to the tundish	8
2.5	Compact application set	9
2.6	Fitting the CasTemp block.....	10
2.6.1	Fitting the CasTemp block in a new permanent lining.....	10
2.6.2	Fitting the CasTemp block mid campaign	13
3	Exchanging a CasTemp block.....	15
3.1	When to replace?	15
3.2	Procedure.....	16
4	Fitting the sensor.....	22
4.1	Safety notices.....	22
4.2	Steps	22
4.3	Preparing for fitting	23
4.4	Applying CasTemp mortar to the sensor	24
4.5	Pushing the sensor through the base plate	25
4.6	Securing the retaining plate.....	26
4.7	Checking for continuity	28
4.8	Lining the tundish	29
4.8.1	Applying spray gunning to the tundish	29
4.8.2	Applying a dry vibe lining to the tundish	30
5	Measuring with CasTemp.....	32
5.1	Before preheating.....	32
5.2	Selecting the connection cable.....	33
5.3	After preheating.....	34
5.4	Removing the CasTemp.....	34
5.5	Inserting the safety plug	35
6	Thermocouple technical information.....	36
6.1	PARTS LIST.....	36
7	Parts.....	37
8	CasTemp rapid start (RS).....	38
9	CasTemp long-life sensor.....	38
10	Troubleshooting	39
10.1	Checking the 460mm sensor	39
10.2	Checking the hardware.....	40
10.3	Fault finding flow chart.....	41
11	Safe system of work.....	42
12	CasTemp approval form	44



Revisions:

1.00	02 Feb 12	New manual
1.01	21 May 12	Included amendments due to various site issues around the world
1.02	04 Dec 12	Some diagrams improved, some text changed, new Troubleshooting section added
1.03	21 May 13	New section added on exchanging a CasTemp block
1.04	18 Mar 14	New warnings in sections 2.2.1 and 4.3, new information about the long-life sensor, new commissioning approval form on the back page
1.05	20 Mar 15	Updated information on protecting sensor from spray 4.8.1 Dimensions given for connection head clearances 2.2.1
1.06	22 Feb 16	Some text changed (plain English), information about RS sensor.
1.07	14 July 17	CasTemp weld plate spec added 2.4
	22 Feb 18	Sign off sheet includes CTW
1.10	08 Mar 18	Updated components and procedure
	08 Mar 18	Re-crystal marked (plain English)
1.11	08 Mar 18	Translation to Chinese
1.12	22 May 19	Safe system of work added (11)
	22 May 19	Fault flow chart & edits to fault finding (8.3)
1.13	18 Jun 19	Key word links to parts list



1 Overview

1.1 Introduction

CasTemp is a sensor containing a type-B thermocouple housed in a robust graphite-alumina sheath. It is used to continuously measure the temperature of liquid steel in the tundish in the continuous casting plant. The CasTemp sensor is inserted through the sidewall of the tundish close to the outlet nozzle between the steel impact and outlet.

Because the sensor is fully submerged, it gives an accurate temperature as soon as casting starts and also avoids the problem of corrosive slag. CasTemp is a 'fit and forget' sensor that does not need any manipulators or handling.

CasTemp can be connected

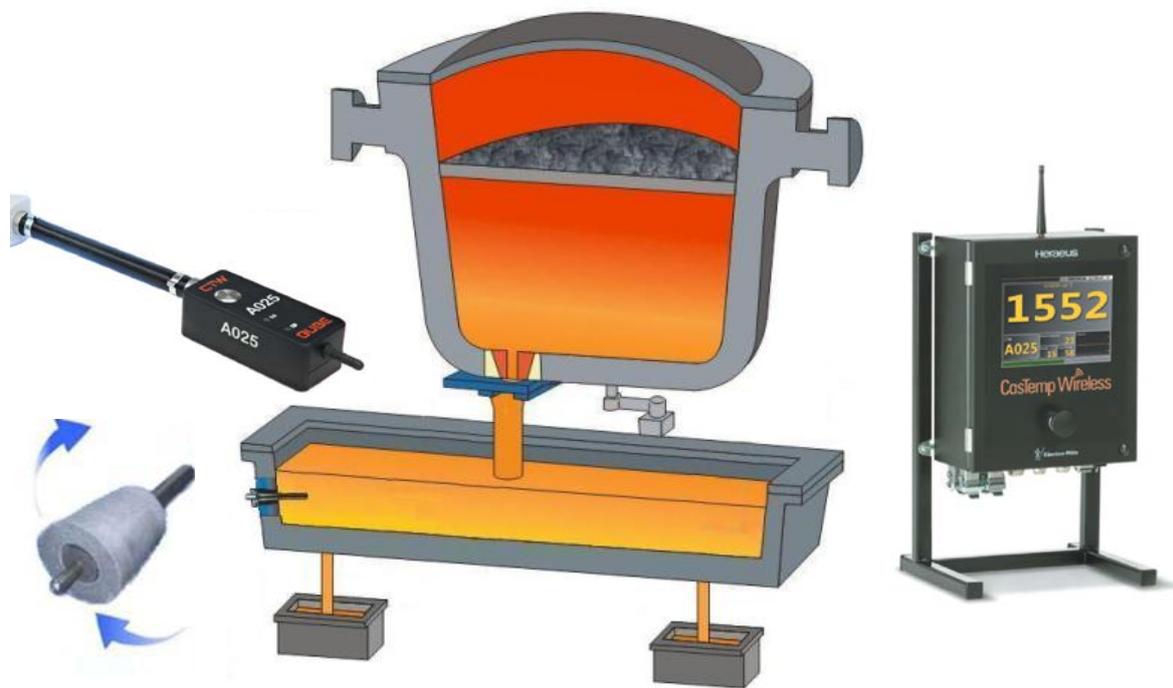


Figure 1 Overview of CasTemp system

1.2 Benefits of use

The CasTemp system provides:

- temperature readings throughout the whole casting sequence;
- a fast response, because the sensor is fully submerged in liquid steel;
- maximised sensor life, because the sensor is submerged below any corrosive slag;
- measurements during ladle changes;
- measurements taken close to the steel outlet (the most critical point); and
- measurements during pre-heat

Potential benefits for the plant are:

- faster production, as the casting speed is increased by using closed-loop control;

- fewer temperature-related breakouts;
- fewer temperature-related freeze-offs; and
- improved safety by reducing operators' exposure to liquid steel.

1.3 Measuring with CasTemp

CasTemp continuously measures the casting temperature throughout a complete sequence. It is not affected by the level of the liquid steel, any slag, or machine operations.

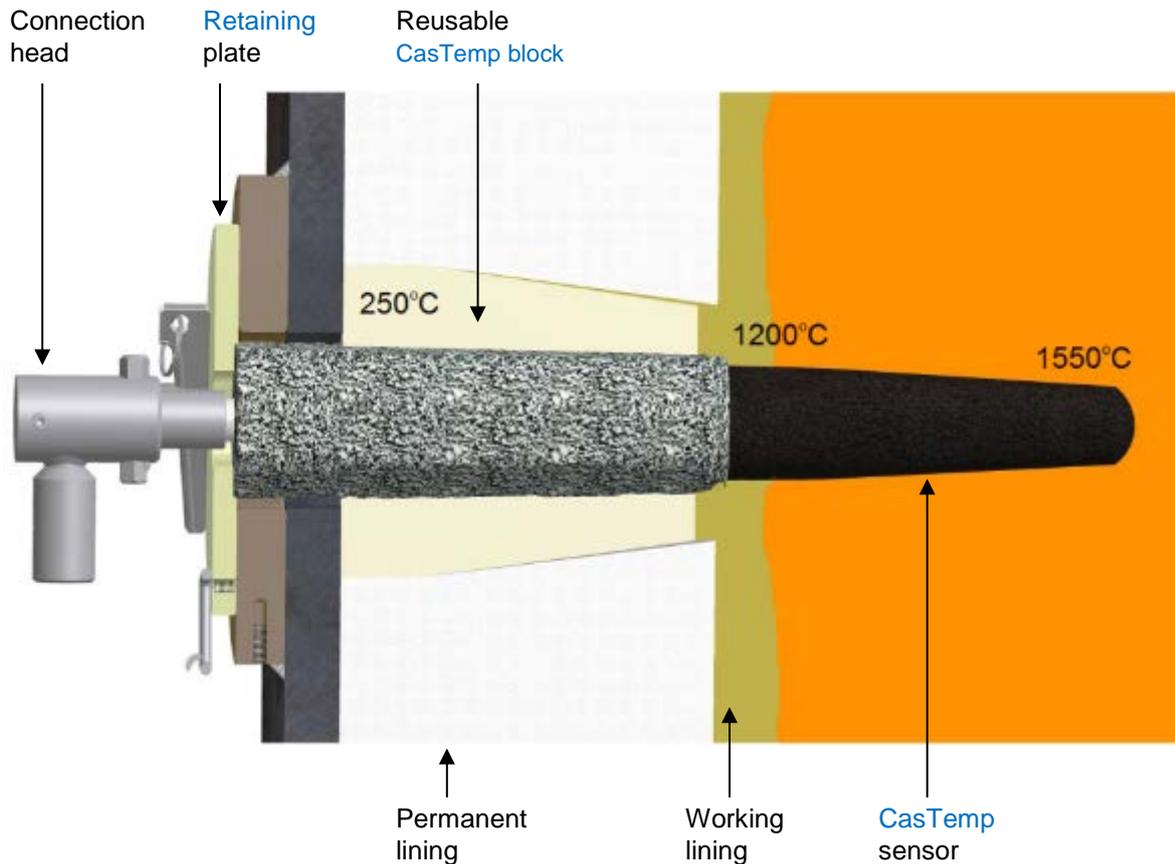


Figure 2 Cross section of CasTemp system with thermal gradient

The signal connection is designed to be used in high temperatures. See section 5.2 for more details.



1.4 CasTemp retaining system

The CasTemp retaining system keeps the CasTemp in place throughout the casting sequence. The retaining system is reusable. It is made up of the parts shown in the following diagram.

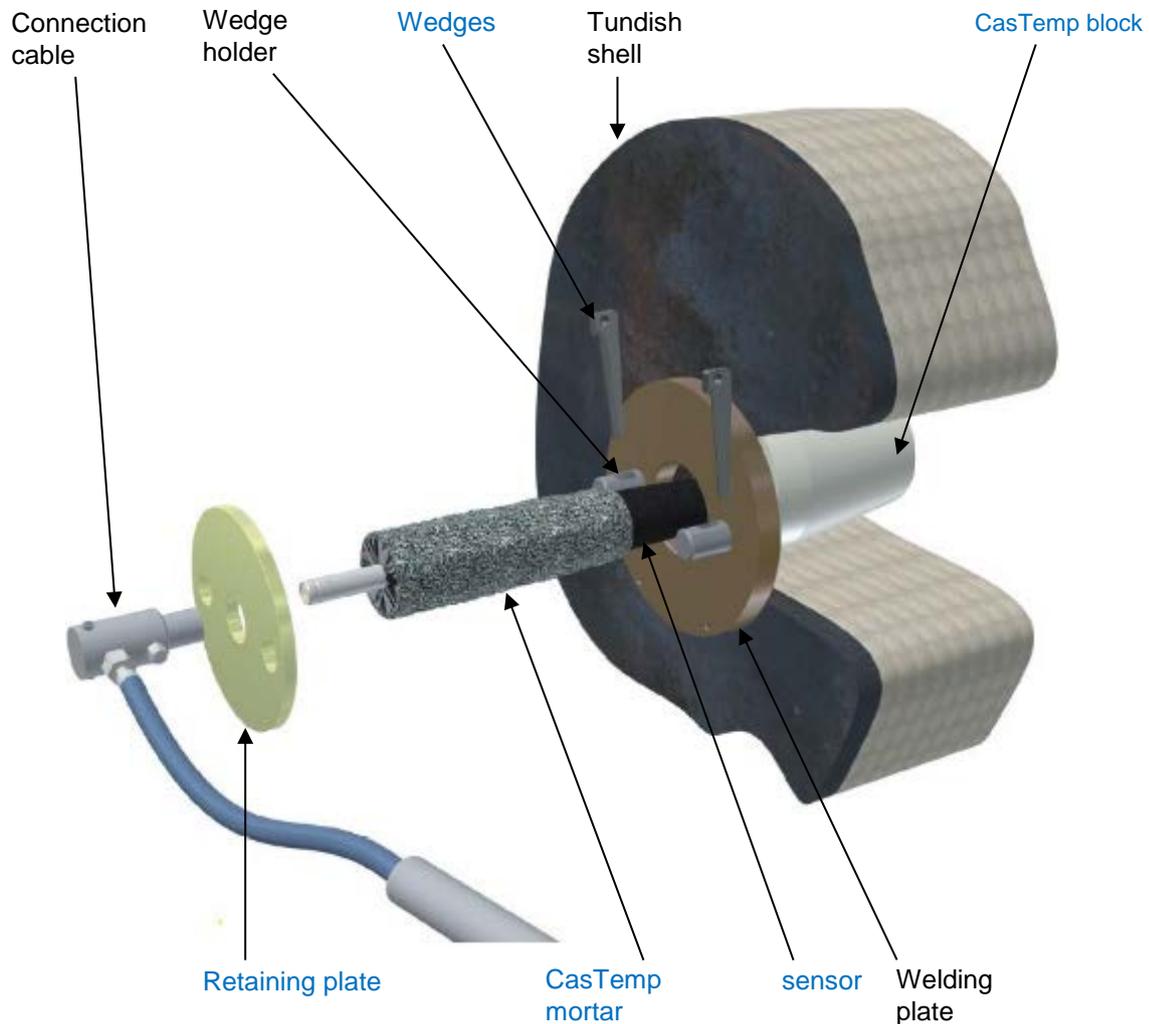


Figure 3 Various parts of the CasTemp system

Make sure that all parts of the CasTemp retaining system are not damaged and are not worn. For a list of spares see **6.1**.

Safety notice: The CasTemp **must** be fitted correctly to make sure the seal is working.

2 Converting the tundish

2.1 Steps

The steps involved in preparing a tundish for fitting a **new** CasTemp are:

1. position the hole;
2. make the hole;
3. weld the base plate; and
4. fit the [CasTemp block](#).

Only the first three steps apply when converting a tundish **mid campaign** (see section 2.6.2). The fourth step is then to fix the [CasTemp block](#) in place then hold it with [mouldable](#) refractory.

2.2 Positioning the hole

Mark on the outside of the tundish side wall where the [CasTemp sensor](#) will be fitted. While choosing the position, keep in mind that the hole should be 90 to 100mm in diameter.

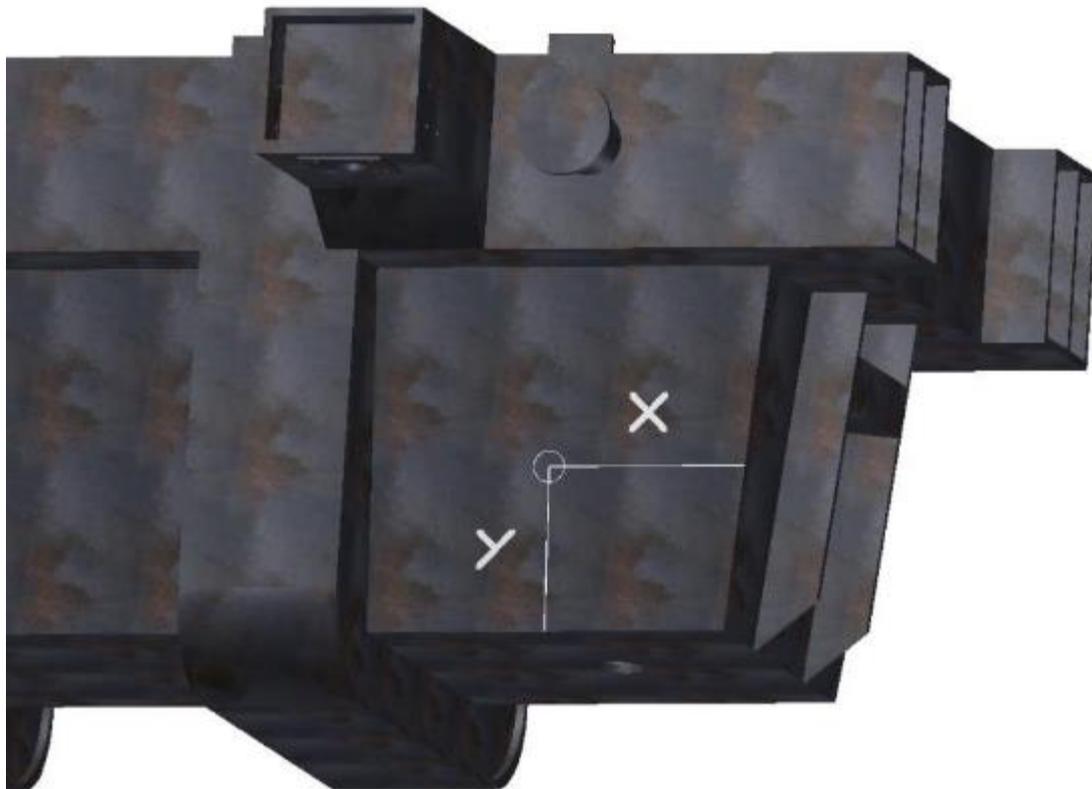


Figure 4 Marking out the CasTemp position

2.2.1 Where to place the sensor

Where you put the **CasTemp sensor** depends on the type of tundish.

Tundish with monobloc-stopper

- The CasTemp should not be too close to the stopper to prevent it being hit and broken when mounting the stopper.

Tundish with sliding gate

- Operating the tundish sliding gate can result in the need for oxygen lancing, usually at the start of casting. Direct oxygen lancing to the **CasTemp sensor** could significantly reduce the sensor life or cause it to fail much earlier than it should.

Important

- **The sensor should never be positioned in an area of steel impact.** The ideal location is close to the area of steel outlet, but avoiding any steel impact.
- **The sensor should be positioned to avoid direct contact from the preheat flame,** otherwise this could lead to the sensor decarburizing during preheat.

To get an accurate temperature reading:

- the tip of the sensor should be at least 150mm from the side and bottom of the tundish wall;
- the sensor should be more than 150mm from dams and other protrusions;
- there should be at least 150mm of the sensor exposed to liquid steel; and
- in a multi-strand tundish, the sensor should be positioned near one of the outer strands.

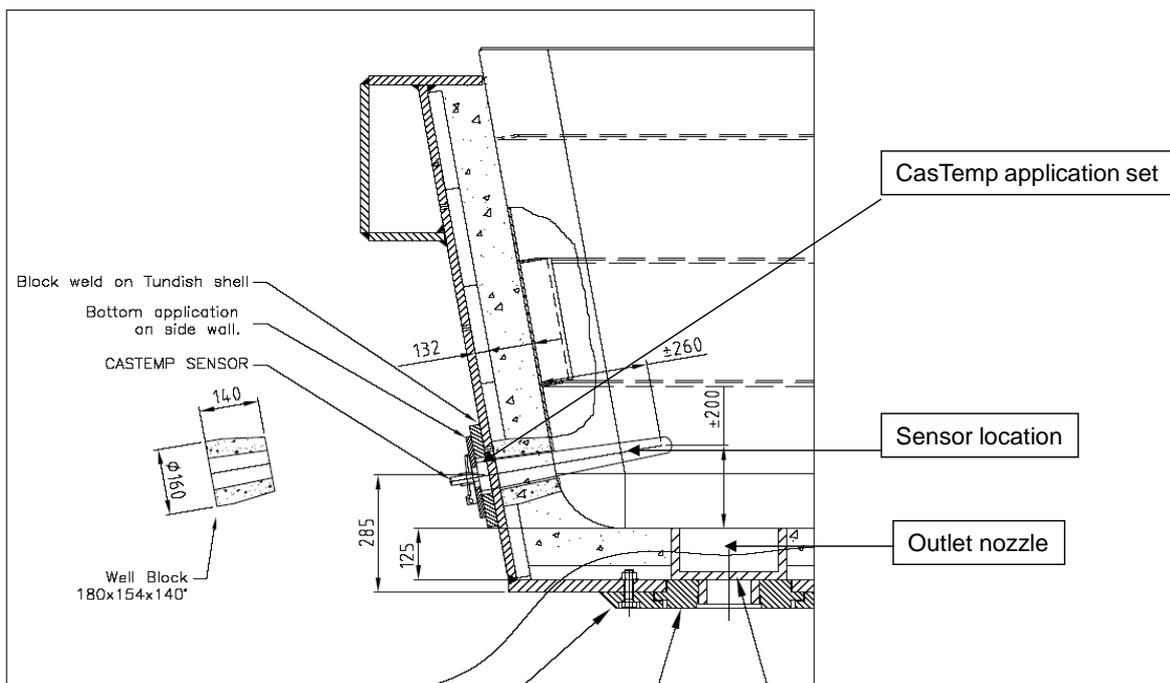


Figure 5 Typical schematic showing position of the sensor

You need to carefully consider reinforcing the structure of the tundish before deciding where the sensor will go. If you are going to make any changes, consult a structural engineer.

Connection cable clearance

As shown below, the connection cable head needs to be 250mm clear of the tundish shell. You need to make sure that this clearance is available when you connect the sensor.

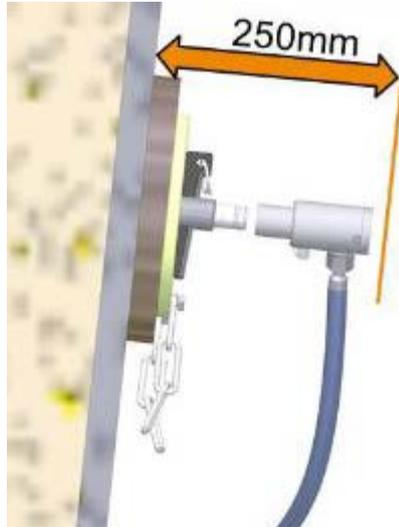


Figure 6 Clearance needed for CasTemp connection

2.3 Making a hole in the tundish

Burn a 90 to 100mm hole into the tundish steel in the centre of the mark-up.

Figure 7 Mark out the outer circumference (250mm) and the inner circumference (90 to 100mm):



Figure 8 Cut the hole (90 to 100mm):

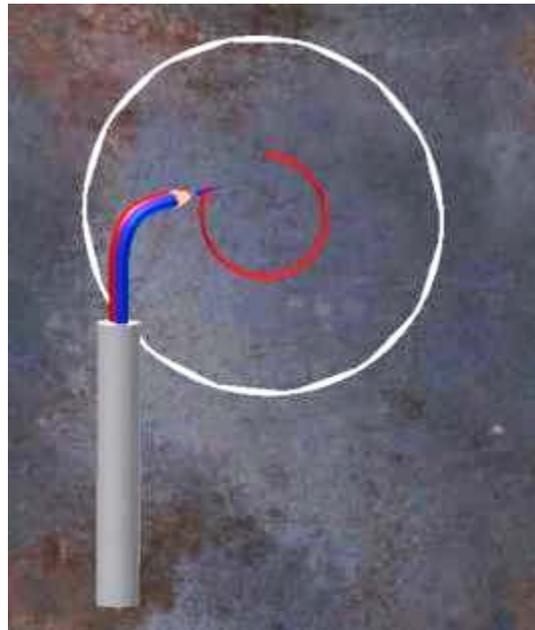


Figure 9 Inner hole complete:



2.4 Welding the base plate to the tundish

Figure 10 Grind the surface clean.



CasTemp weld-plate specification: DIN 17100 ST 52-3 N
[HIGH TENSILE PLATE or NEAREST EQUIVALENT] : BS4360 Gr50, ASTM A572-50JIS, G3106 SM50
(Low carbon high-tensile structural steel suitable for welding to other weldable steels.)

Figure 11 Before welding, consider the best position for the wedges and weld the posts in the appropriate positions.



Figure 12 Tack weld the plate against the surface you have ground down, making sure the centre of the plate lines up with the hole. Weld the plate to the tundish (one complete weld plus at least two more complete welds on top of the first one).



2.5 Compact application set

If there is limited room, a compact application set is available.

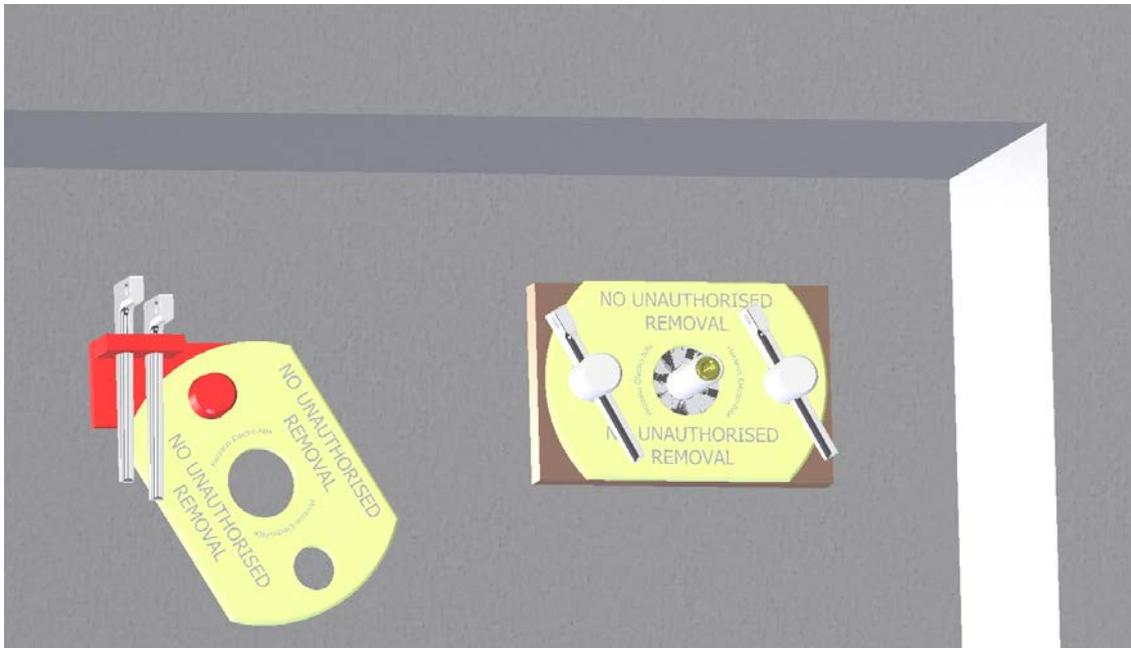


Figure 13 Compact application set and CasTemp wedge and plate holder

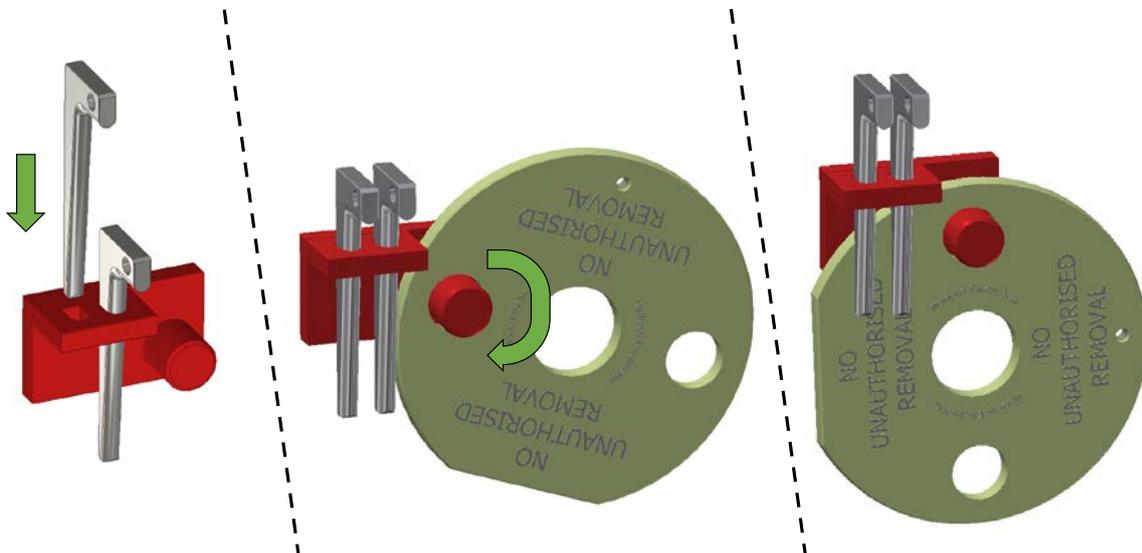


Figure 14 The CasTemp wedge and plate holder can be used on all types of plate and wedge.

2.6 Fitting the CasTemp block

2.6.1 Fitting the CasTemp block in a new permanent lining

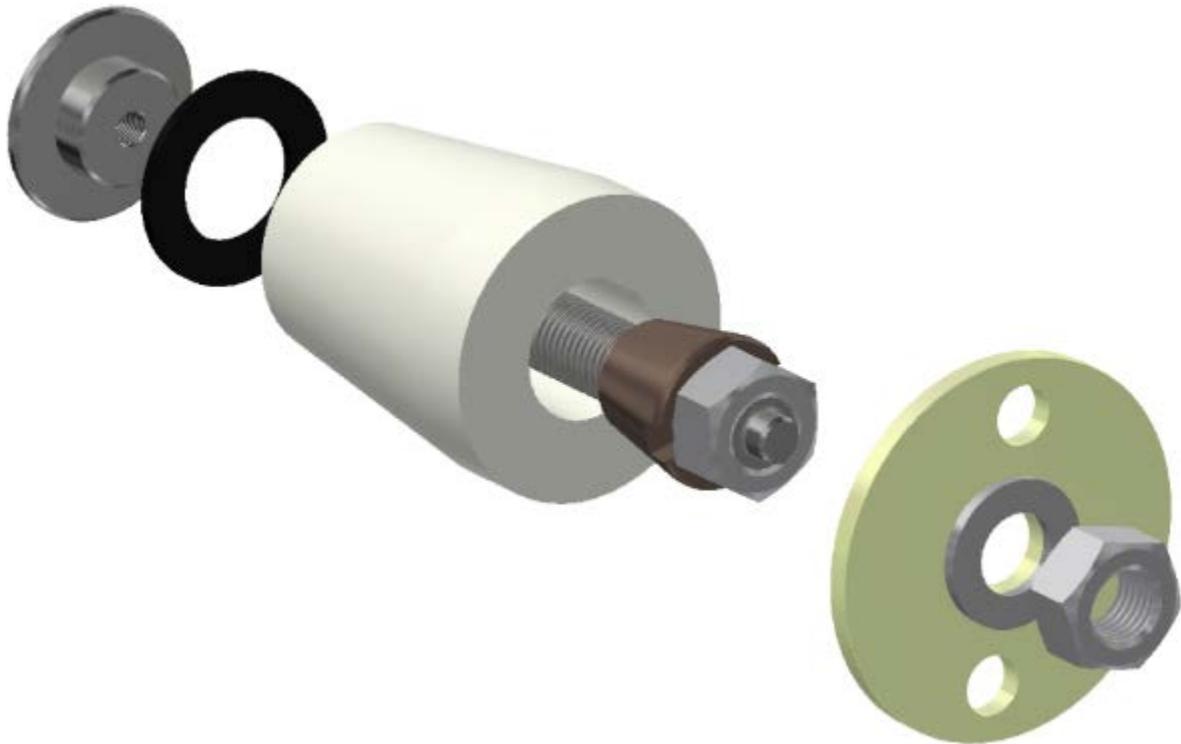


Figure 15 The CasTemp block is clamped and lined up with the conical nut of the embedding tool.

We recommend you use the embedding tool and make sure the CasTemp block is securely placed in the correct position. This will make sure the sensor fits correctly.

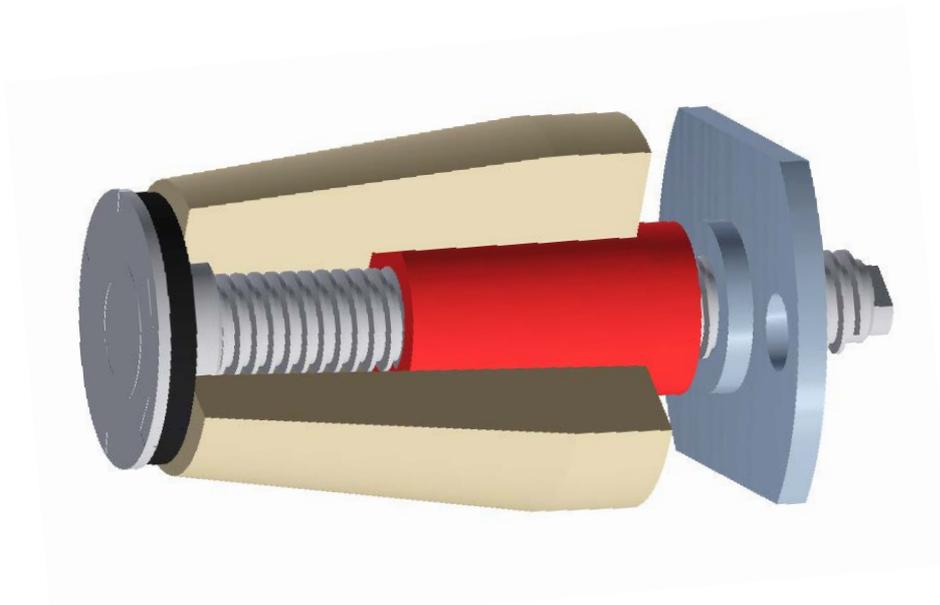


Figure 16 Nylon embedding tool with conical sleeve



Figure 17 You can use the adjustment tool to comfortably open and close the [embedding tool](#) from the outside of the tundish

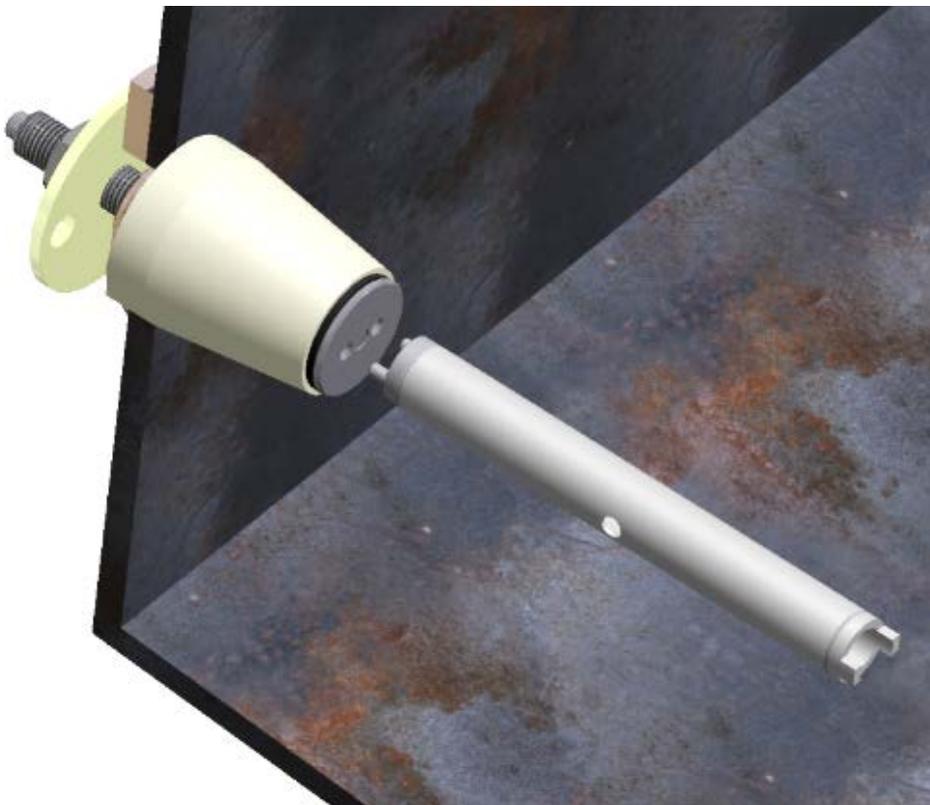


Figure 18 Or you can use the adjustment tool to open and close the [embedding tool](#) from the inside of the tundish.

When properly clamped, the [CasTemp block](#) stays in position when a concrete template (called the former) is used to set the permanent, monolithic tundish lining.

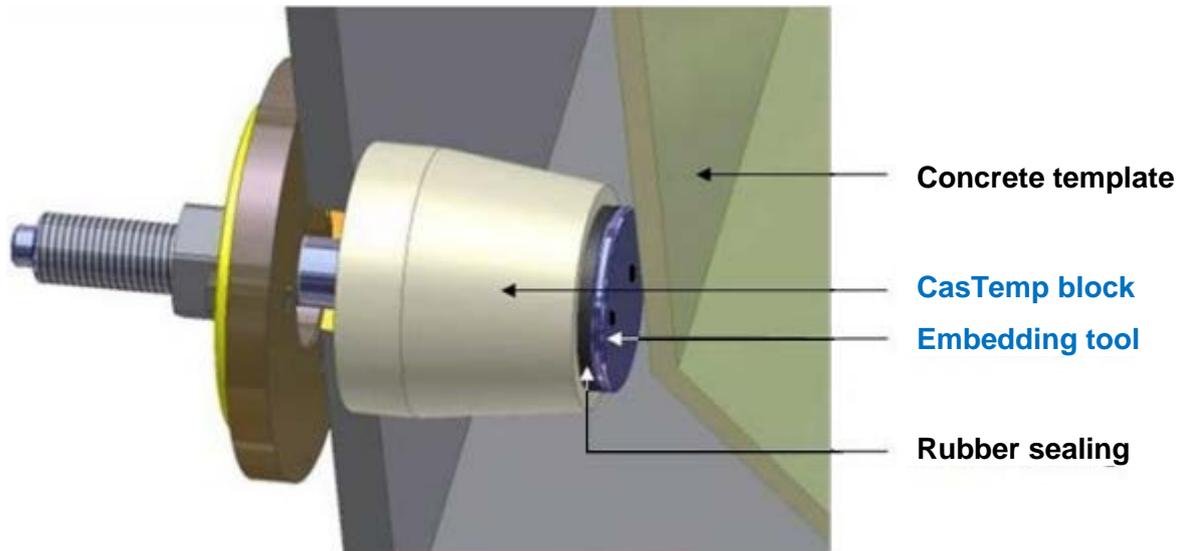


Figure 19 [CasTemp block](#) fixed in position against former

Tape over the holes on the [embedding tool](#) end plate before casting to avoid concrete getting into it. Always remove the [embedding tool](#) after air drying, but before heated drying.



2.6.2 Fitting the CasTemp block mid campaign

Figure 20 From the outside of the tundish, drill a central hole through to the inside.

X-Y is the location you have set after considering what we say in section 2.2.1.
(Always consult our representative before cutting holes.)

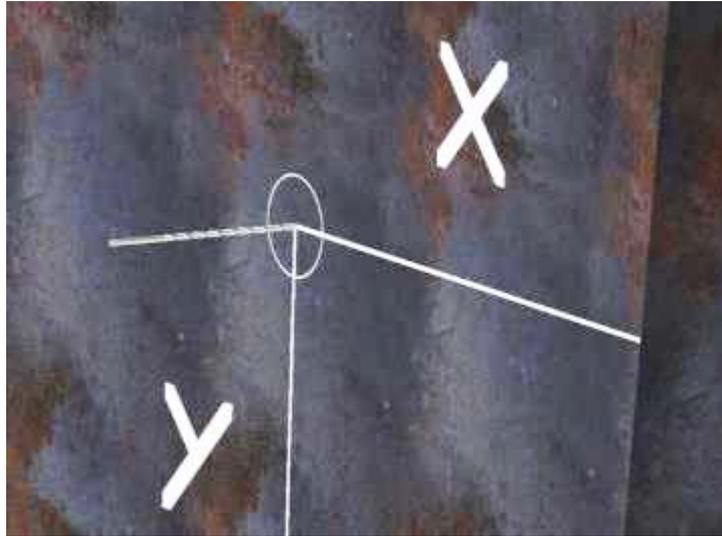


Figure 21 In the refractory lining, mark out a circle which is about 100mm in diameter larger than the CasTemp block to give enough clearance for the pneumatic hammer. Drill a series of holes with a masonry drill bit to make sure the hole won't be too big.

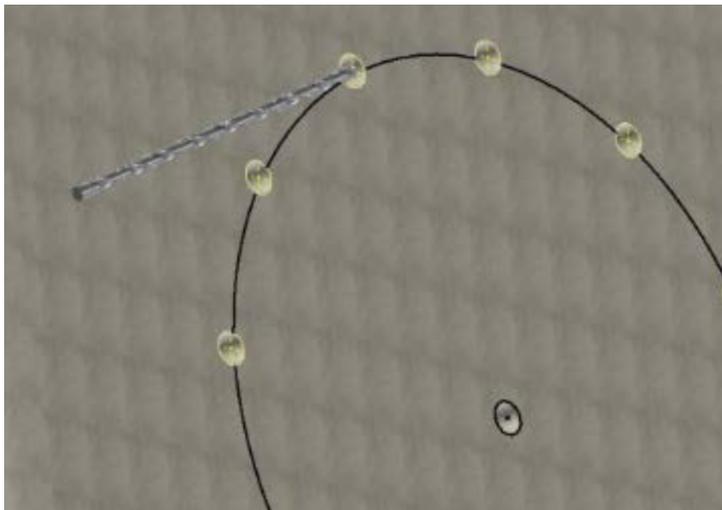


Figure 22 The resulting hole is approximately 100mm larger than the CasTemp block diameter.

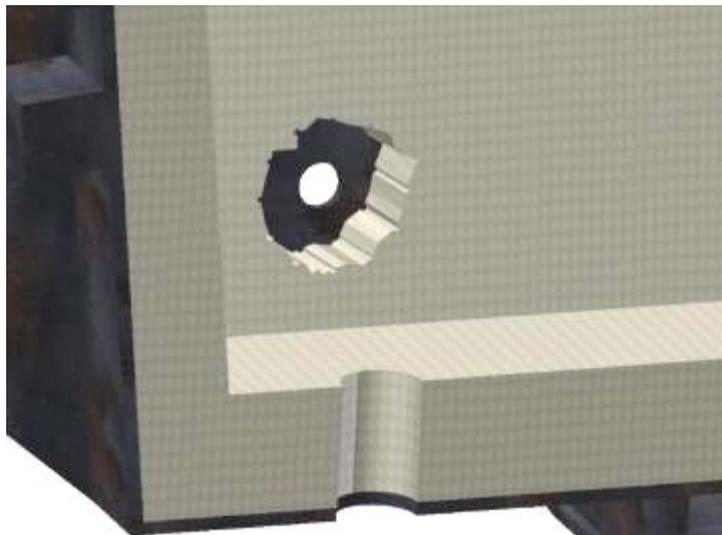


Figure 23 Position the CasTemp block in the hole. Leave the embedding tool in the CasTemp block during fixing.

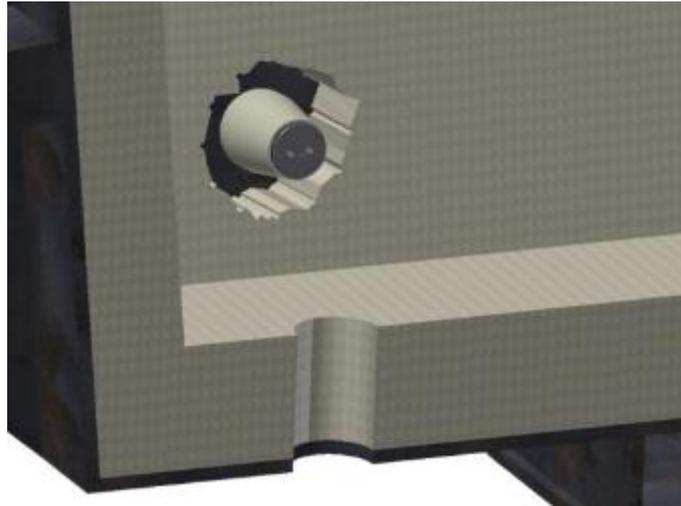
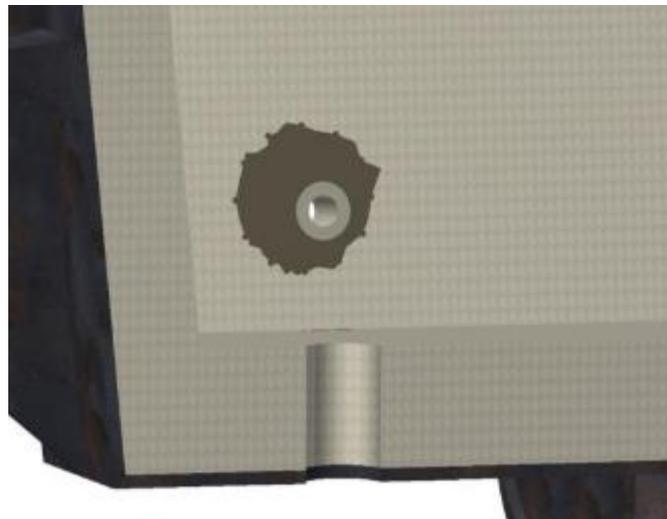


Figure 24 Shows the CasTemp block fixed in place with the embedding tool removed.



Allow the mouldable refractory to dry according to the manufacturer's recommendation.

Notes

- The hole to fix the CasTemp block in should be approximately 100mm larger than the block diameter.
- The CasTemp block must never stick out further forward than the permanent tundish lining – see the examples below.
- There should be no more than 50mm of permanent lining over the end of the CasTemp block – see below.
- You can cut the CasTemp block to suit linings, but these should not be less than 120mm



long.

Figure 25 CasTemp block position



3 Exchanging a CasTemp block

A CasTemp block cast into a permanent lining might not last for the whole life of the permanent lining. In this case, the CasTemp block needs to be replaced. This section includes information on removing a used CasTemp block and fitting a new one.

3.1 When to replace?

You might need to replace a CasTemp block at any time due to damage or when the material of the block becomes worn.

Checks for damage to the CasTemp block

- You should replace CasTemp block with open cracks across one or two faces (you will need to keep an eye on surface and hairline cracks).
- You should replace CasTemp block with metal penetration (unless removing the metal leaves the block in an acceptable condition).
- You should replace a CasTemp block if it loses 20% of length 'A' (as fitted).
- The internal diameters should be within 2mm of the drawing specification.

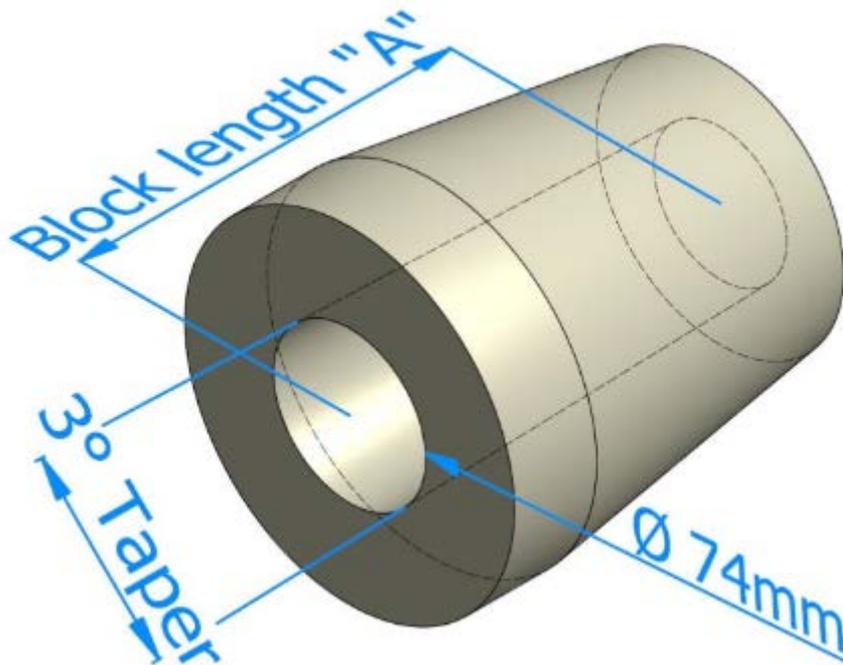


Figure 26

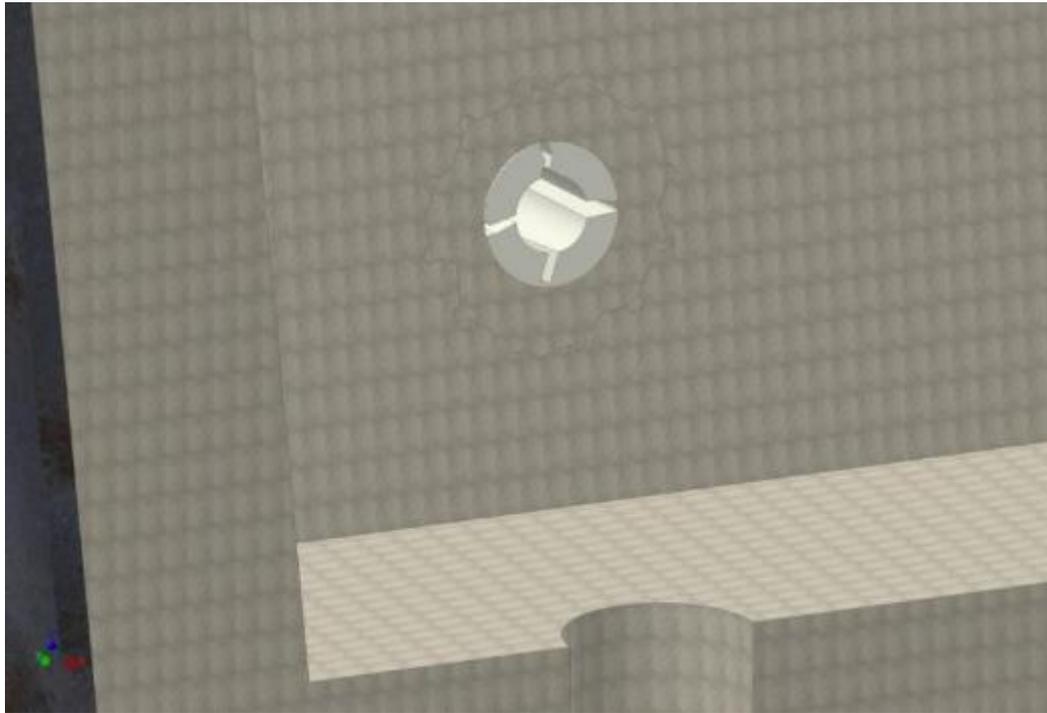


Figure 27 After the tundish skull is removed, you can remove the damaged [CasTemp block](#).

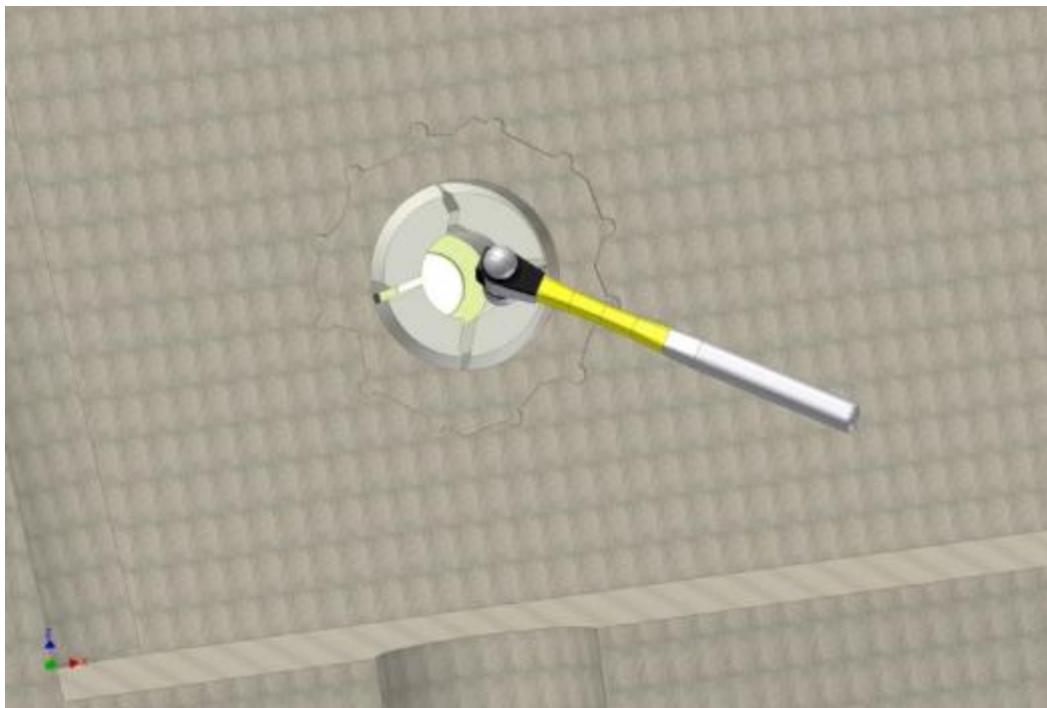


Figure 28 Depending on the damage, the [CasTemp block](#) may be removed with hand tools.



Figure 29 If the block leaves a neat hole, you must open this to accommodate the mouldable refractory.

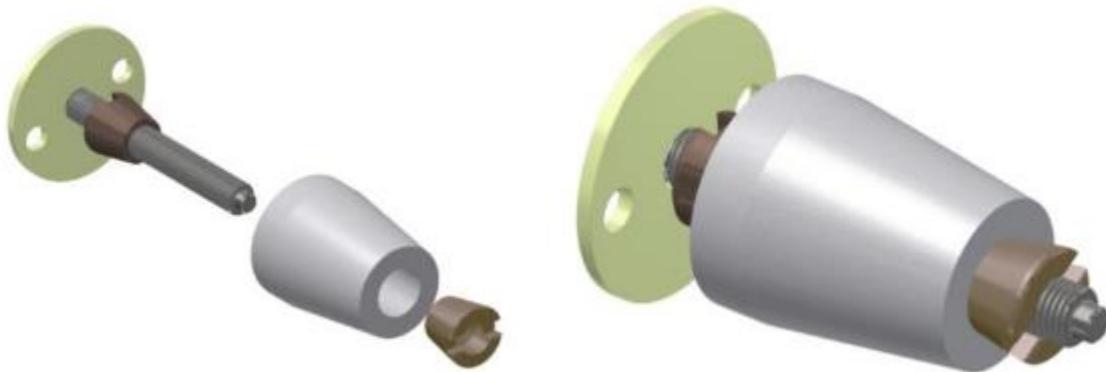


Figure 30 The assembly of the CasTemp block in the embedding tool.

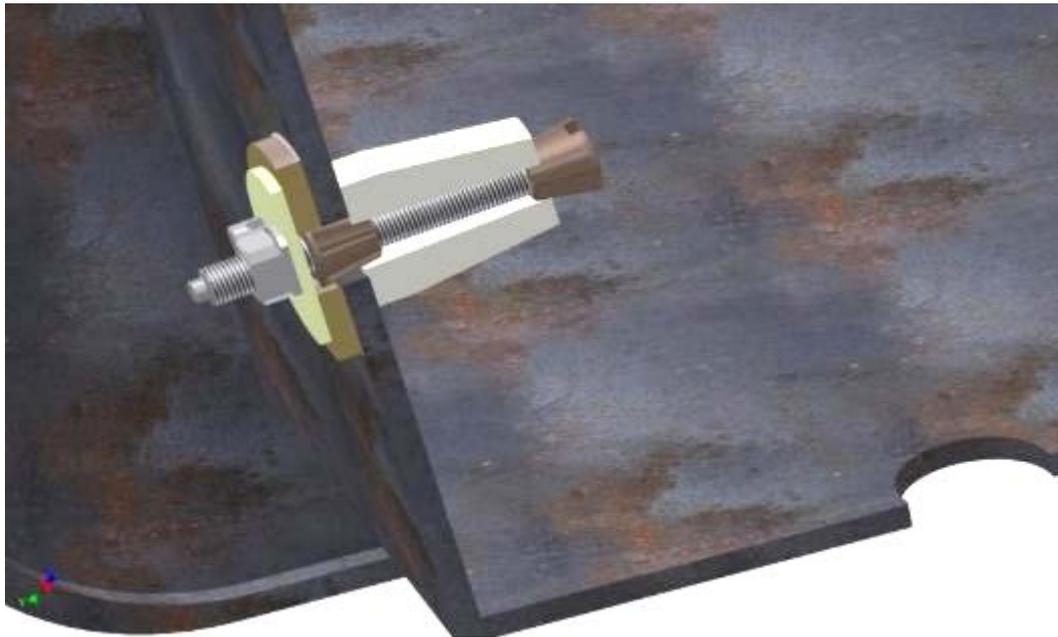


Figure 31 How the [embedding tool](#) holds the block in place.

Once you have made the space for a new block, fix the replacement block in place with the embedding tool. The length of the block should be just short of the lining thickness (not more than the thickness).

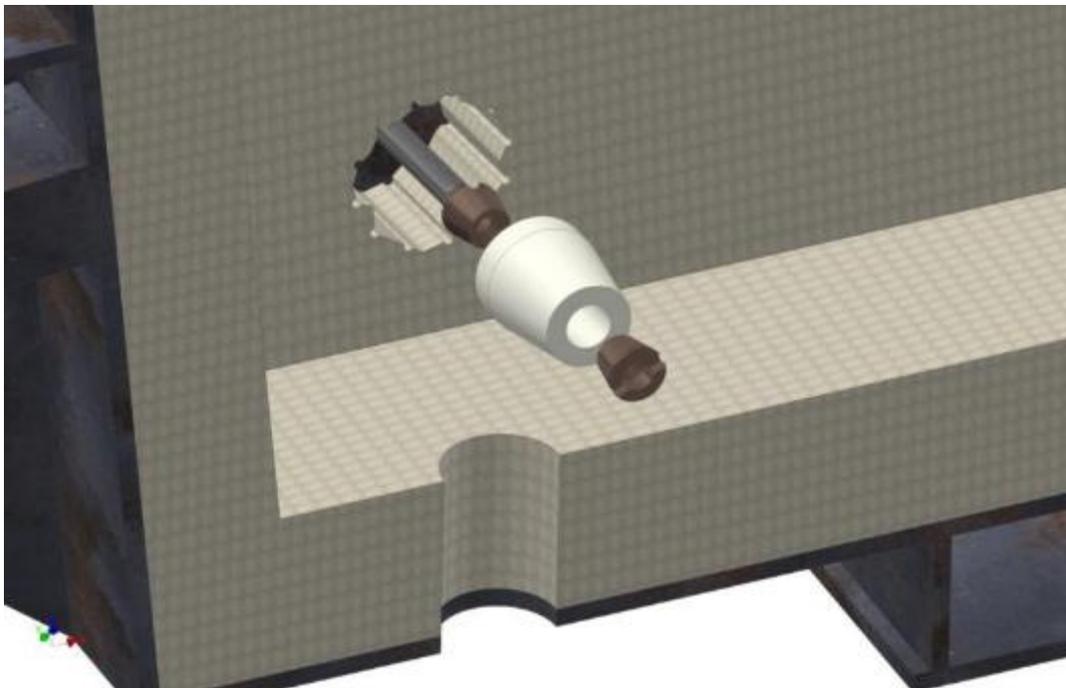


Figure 32



Make sure the block is centralised on the conical nuts. This holds the block in the correct position during fixing.

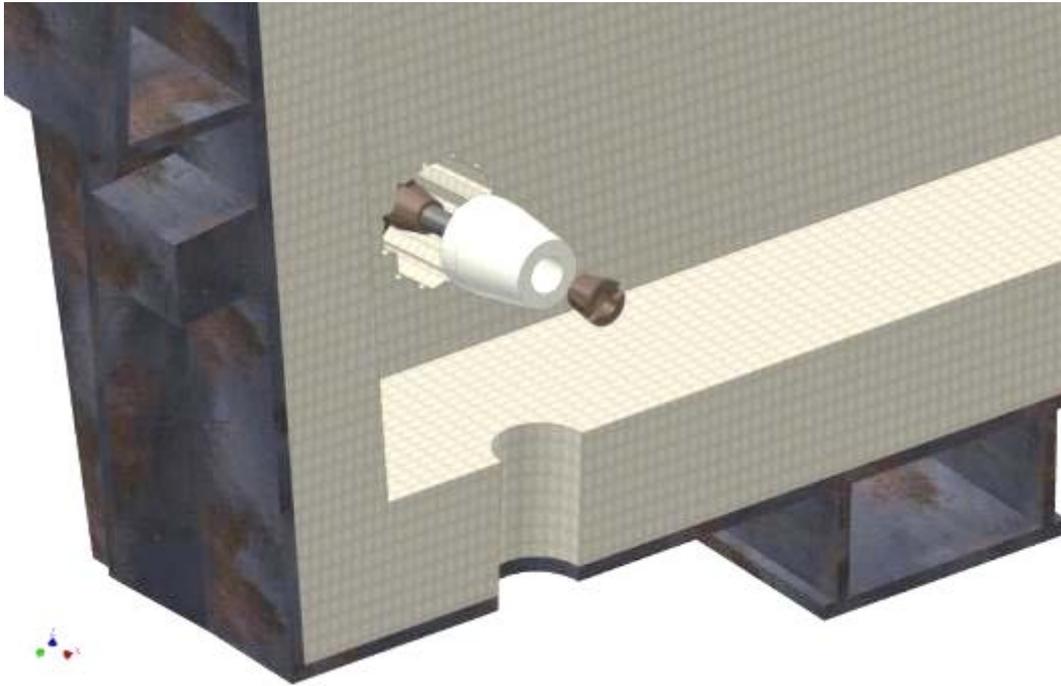


Figure 33

Do not tighten the conical nuts too much as this will split the block. Just tighten them enough to hold the block securely.

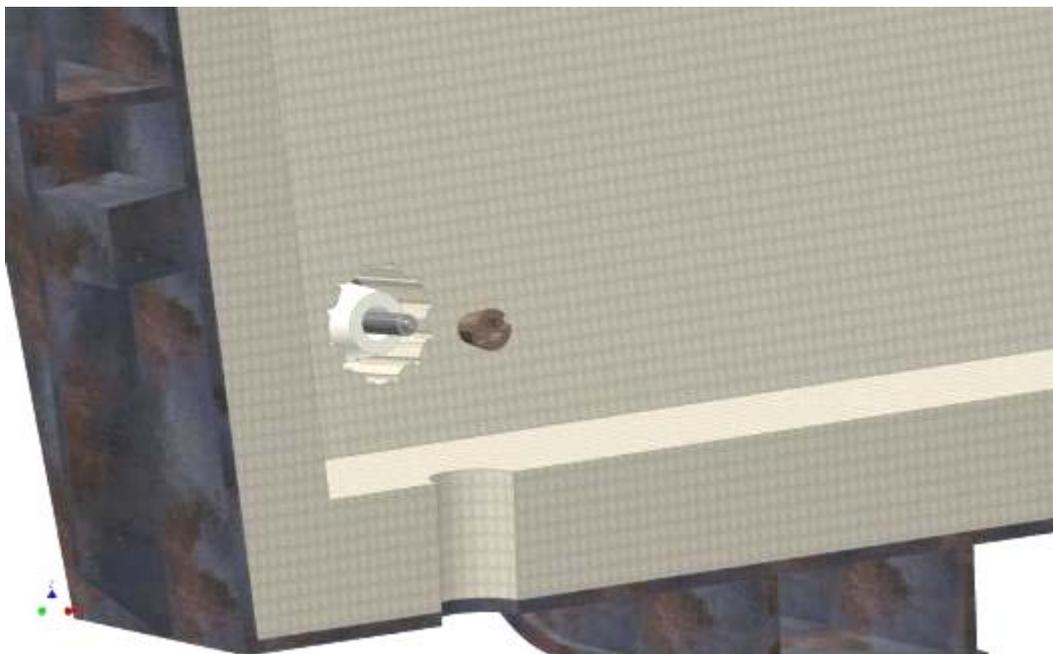


Figure 34

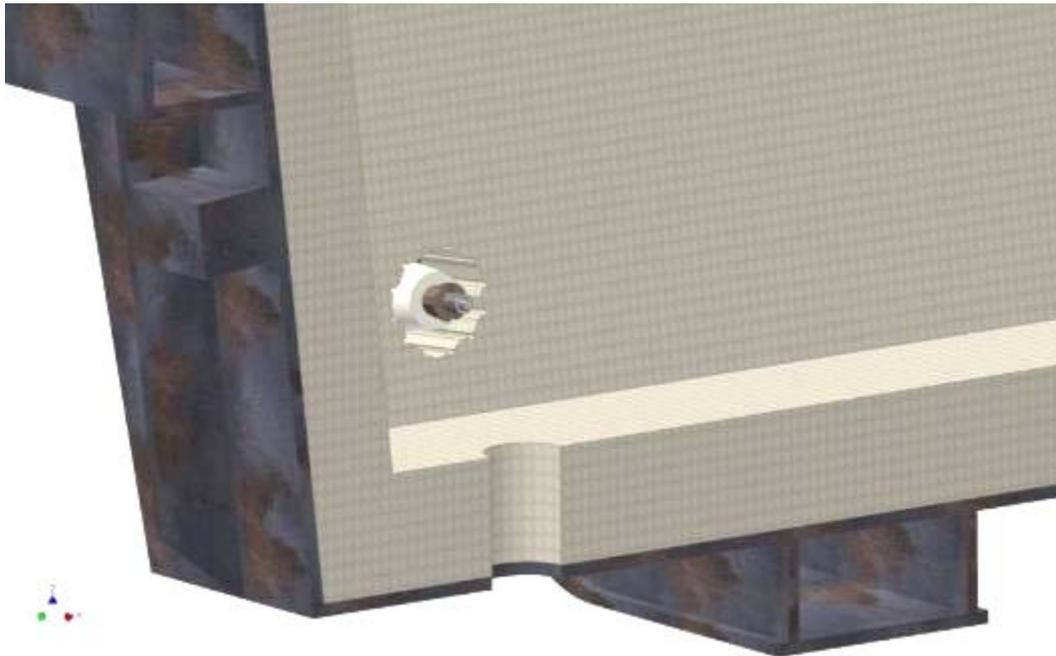


Figure 35 Apply the [mouldable](#) refractory once the block is in place.



Figure 36 Use a pneumatic hammer to pack the [mouldable](#) refractory around the block, filling all gaps.



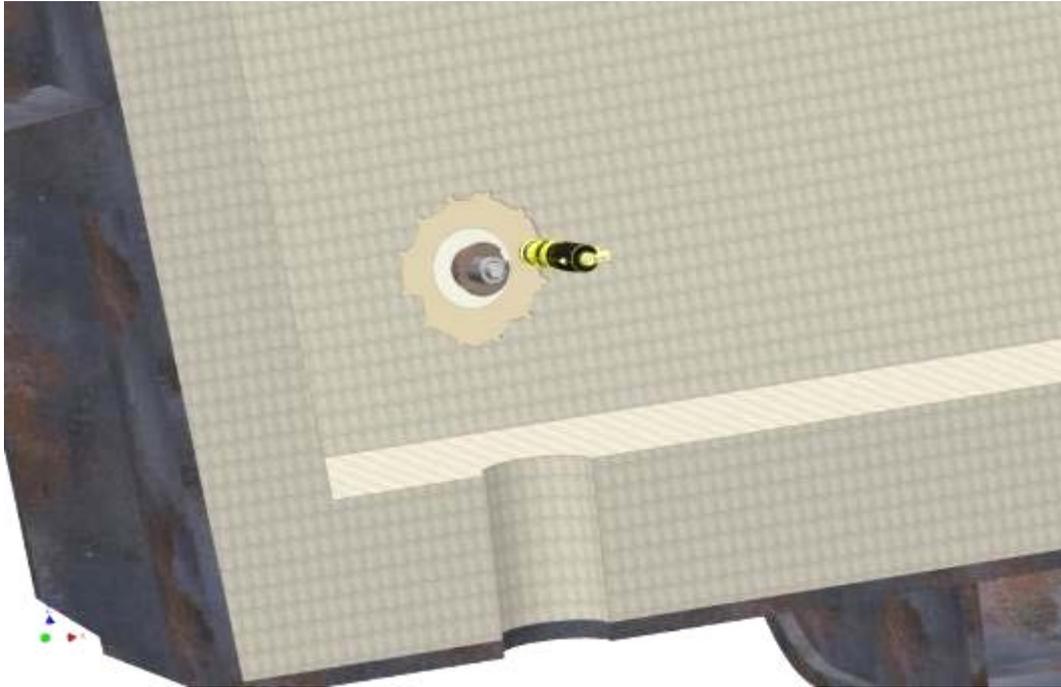


Figure 37 Once the mouldable refractory is level with the block, you can remove the embedding tool and dry the mouldable refractory.

4 Fitting the sensor

4.1 Safety notices

Only competent personnel should fit the [CasTemp sensor](#) in the tundish.

- When you remove the CasTemp from the crate, if the packaging is not sealed, do not use it. Contact the supplier.
- If any product is damaged when you remove the packaging, do not use it. Contact the supplier.
- CasTemp is not reusable and you must dispose of it according to local regulations.
- To guarantee the system will work correctly, only use Heraeus Electro-Nite sensors, parts and consumables (see section 6).
- The [CasTemp sensor](#) is fitted with a cap to protect the connector from dust and obstruction. Remove the cap before the tundish goes on preheat.
- Using a [sensor checker](#), check if the sensor gives a green light before fitting. If not, do not use it. Contact the supplier.

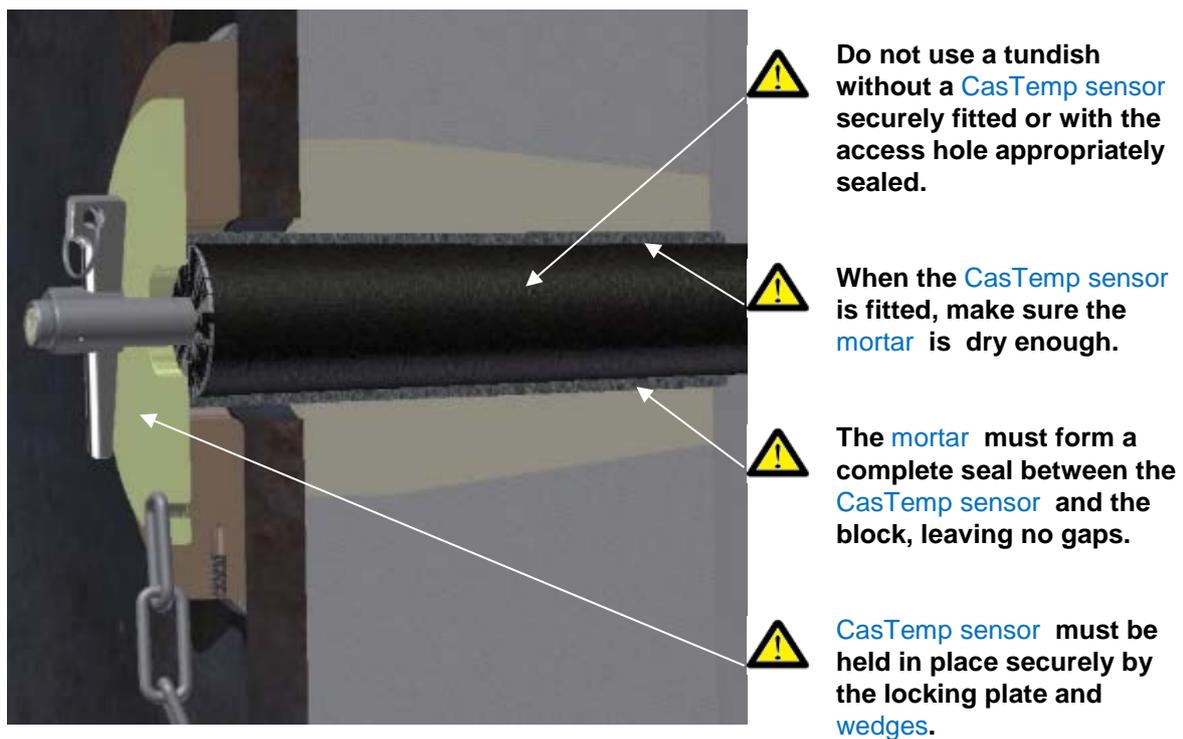


Figure 38 Important checks when fitting the [CasTemp sensor](#)

4.2 Steps

The steps involved in fitting a [CasTemp sensor](#) are:

1. remove the used [CasTemp sensor](#) without damaging the [CasTemp block](#);
2. clean the inner surface of the [CasTemp block](#) ;
3. clean the welded plate and [retaining plate](#) surfaces;
4. fit the [CasTemp sensor](#) using plenty of [mortar](#) and rotate the sensor during insertion;
5. use the insertion of [wedges](#) to push the [CasTemp sensor](#) into the final position;



6. use [BOTH] [wedges](#) to secure the [retaining plate](#);
7. check the continuity of the [CasTemp sensor](#) using the [sensor checker](#);
8. seal or spray (or both) the front face to the [CasTemp sensor](#) ;
9. check the sensor and seal visually; and
10. keep the work area clean replacing relevant tools and consumables in the agreed location.

4.3 Preparing for fitting

Before fitting the [CasTemp sensor](#) , make sure the block is in good condition and clear of [mortar](#) . Clean it out if necessary.

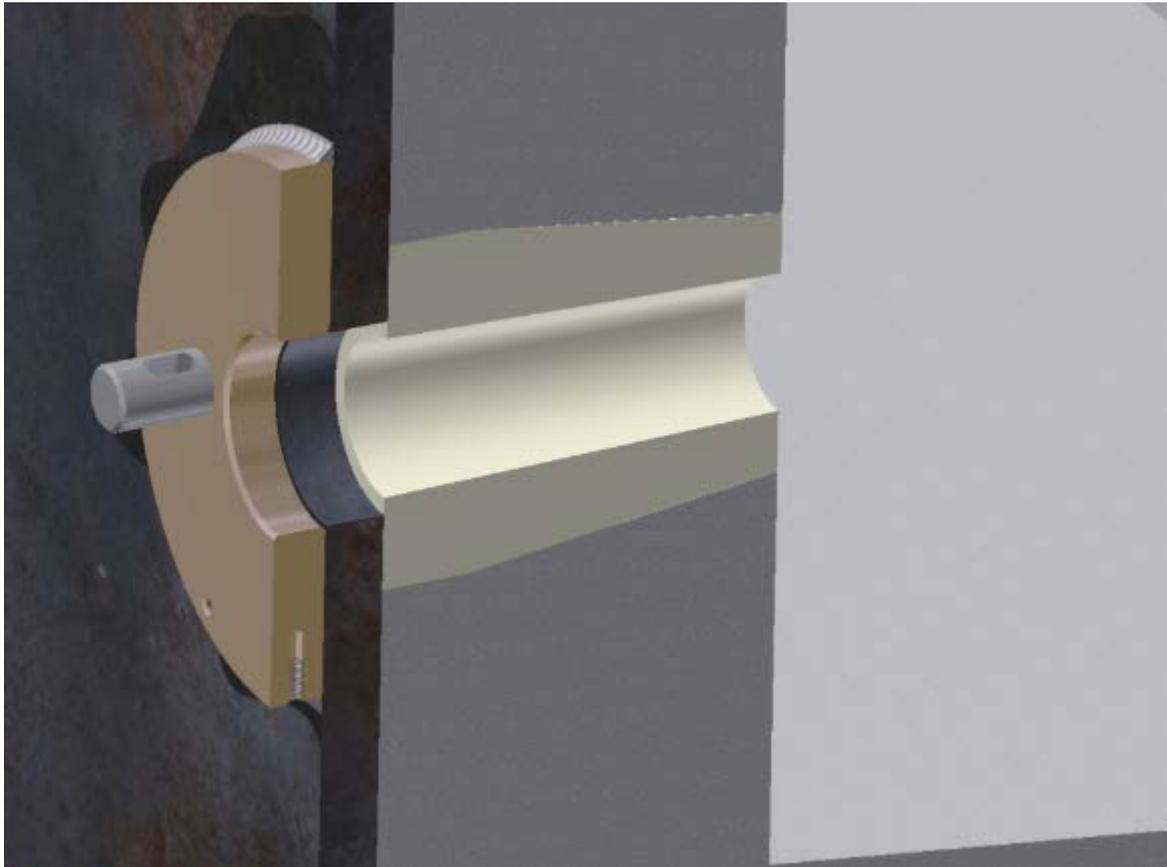


Figure 39 [CasTemp block](#) ready for fitting the sensor

4.4 Applying CasTemp mortar to the sensor

Apply about 20mm of CasTemp mortar to halfway up its length as shown below. If you do not use the insertion tool, keep the connection tube free of mortar and leave the cap on to prevent mortar getting into the tube. Make sure the mortar is of the correct consistency before you use it.



Figure 40 Applying CasTemp mortar to the sensor



4.5 Pushing the sensor through the base plate

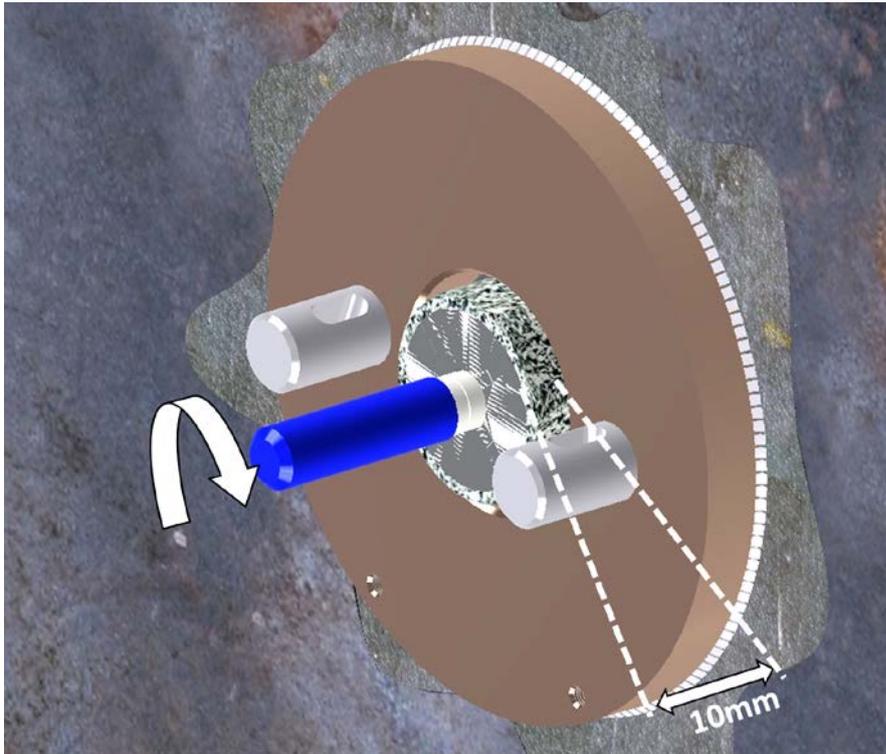


Figure 41 Pushing the sensor through the base plate

Push the sensor through the base plate and turn it slowly once around its axis to distribute the **mortar** evenly.

Leave a 10mm gap, so the sensor has a good, tight fit when **wedges** are fixed.

Leave the protective cap on during fitting to keep the connector clean. Remove the cap to test the continuity.



Figure 42 Protective blue cap to be removed for the continuity check

4.6 Securing the retaining plate

Secure the retaining plate to the base plate making sure the wedges are facing down. Hammer in the wedges for a tight fit.

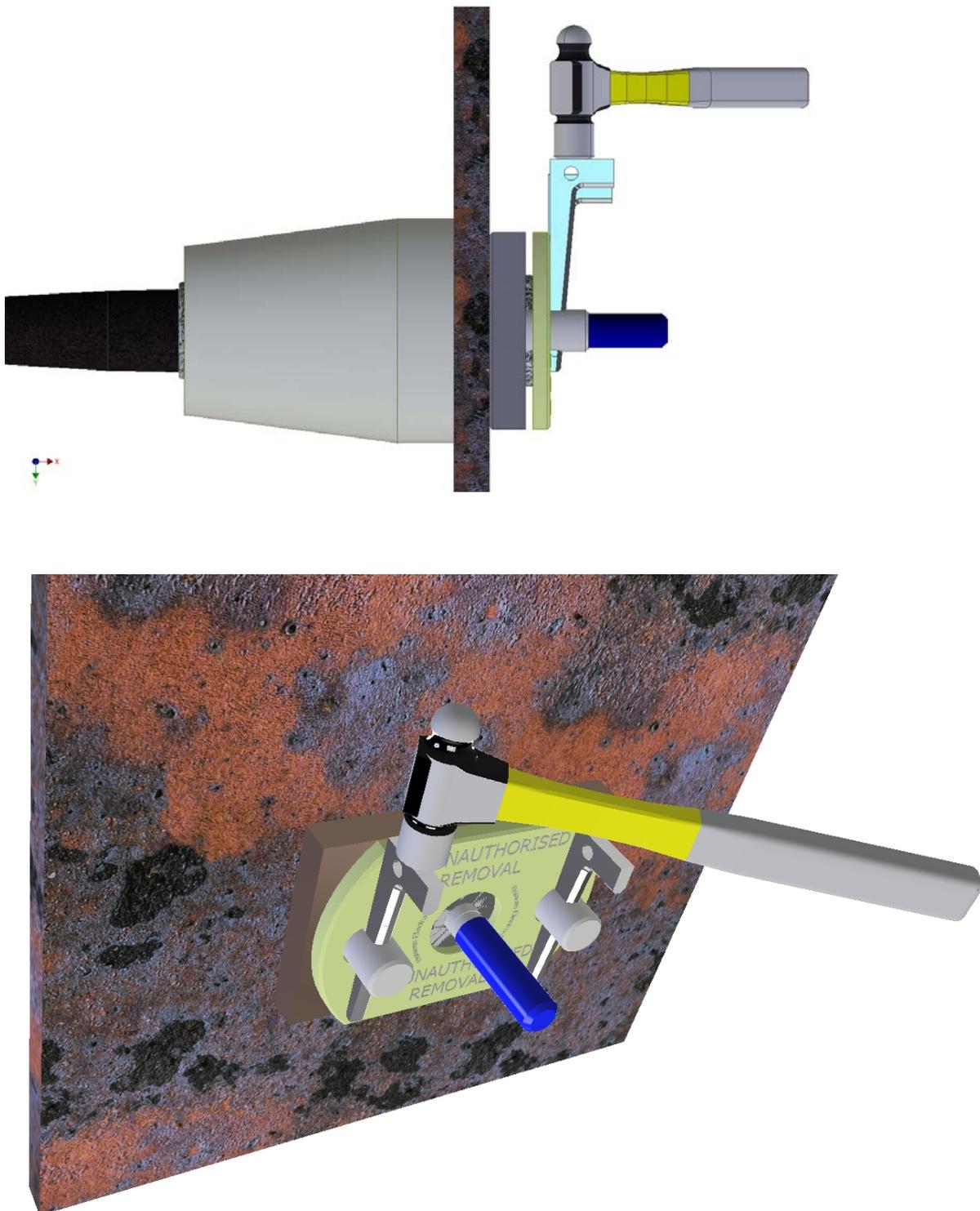


Figure 43 wedges must ensure a secure fit



Before sending the tundish for drying, check there is no gap between the **CasTemp sensor** and the **retaining plate**. If you find a gap, refit the sensor.

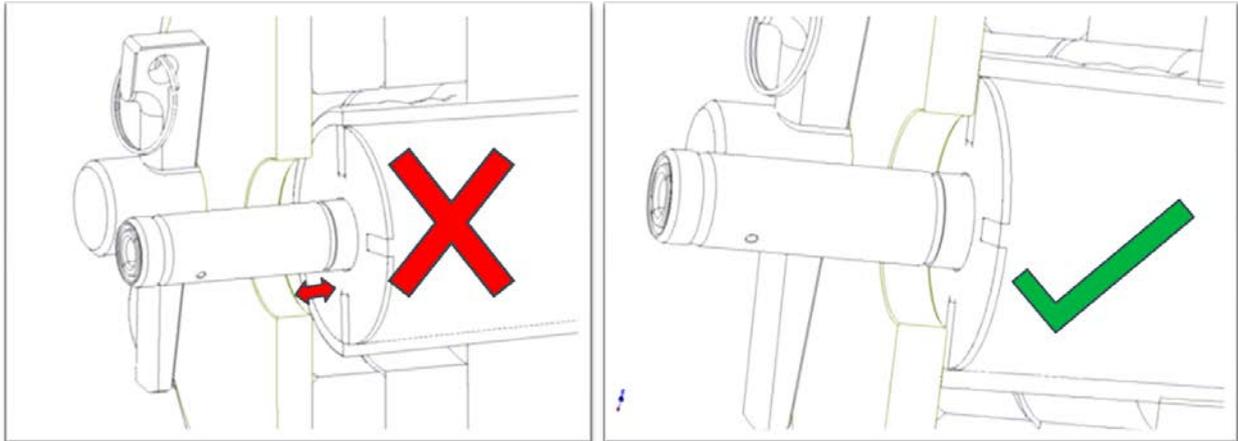


Figure 44 Important check after fitting the **CasTemp sensor**

4.7 Checking for continuity



Figure 45 Push the [sensor checker](#) onto the sensor



Figure 46 A green light means that the tundish can now be lined.



If the [sensor checker](#) doesn't light up, fit a new sensor. (Make sure the [sensor checker](#) is working) Engaging the [sensor checker](#) means the connection head will fit. This must be done before releasing the tundish for use.



4.8 Lining the tundish

There are two types of lining that can be applied on top of the permanent tundish lining.

- Spray gunning
- Dry vibrate forming

4.8.1 Applying spray gunning to the tundish

Spray gunning can be applied before or after fitting the sensor. In this example, it is applied afterwards when the sensor is already fitted and mortared in (as described in sections 4.3 to 4.7). Before gunning, to protect against spray gunning mass and humidity, cover the part of the sensor that sticks out using the bag in which the sensor was delivered. If you don't do this, it will result in inaccurate measurements of the temperature. Remove the bag after gunning.

Figure 47 When using the sensor bag, make sure that 30mm of sensor is exposed for the spray material to seal.

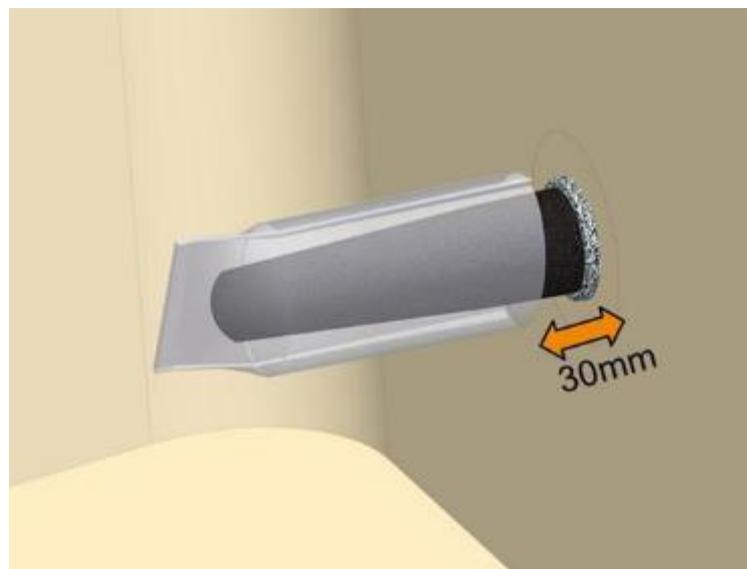
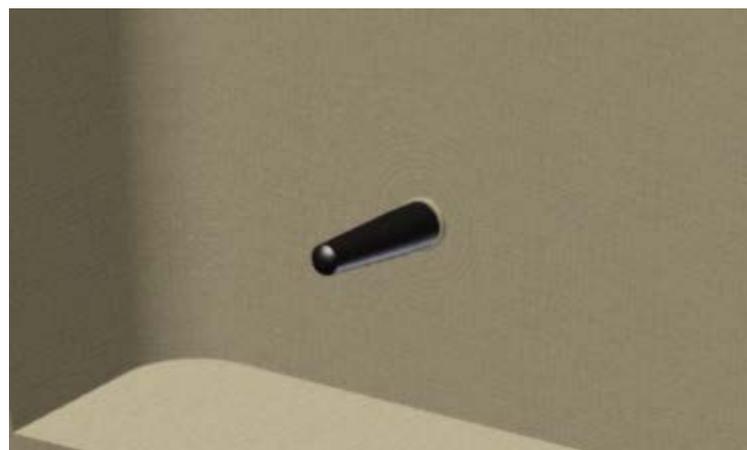


Figure 48 The front face must then be sealed with gunning mass.



If spray gunning is done before the CasTemp sensor is fitted, similarly protect the CasTemp block hole.

4.8.2 Applying a dry vibe lining to the tundish

Figure 49 The [embedding tool](#) protects the access hole when a dry vibe lining former is inserted into the tundish. Remember to tape over the holes in the [embedding tool](#) to prevent lining material from getting into it.



Figure 50 This shows the [CasTemp block](#) hole after the [embedding tool](#) has been removed.



Now follow the steps described in sections 4.3 to 4.7.



June 20, 2019

CasTemp®

page 31 of 41

Figure 51 This shows the CasTemp sensor seated inside the tundish.



Figure 52 Once the sensor is fitted, seal the hot face with Phosphate bonded alumina mortar .



5 Measuring with CasTemp

5.1 Before preheating

- Check the [CasTemp sensor](#) with a [sensor checker](#).
- When the tundish is positioned in the tundish car, connect the connection cable to the sensor.

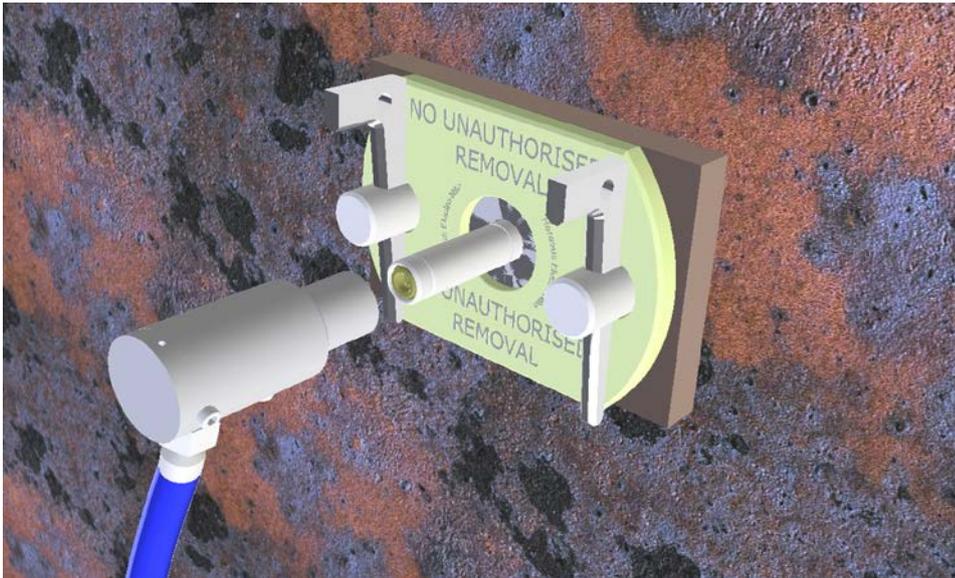


Figure 53



Figure 54

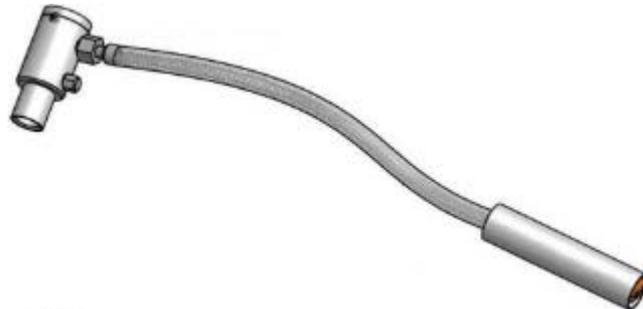
5.2 Selecting the connection cable

There are different types of connection systems, designed to connect the [CasTemp sensor](#) to the instrument.

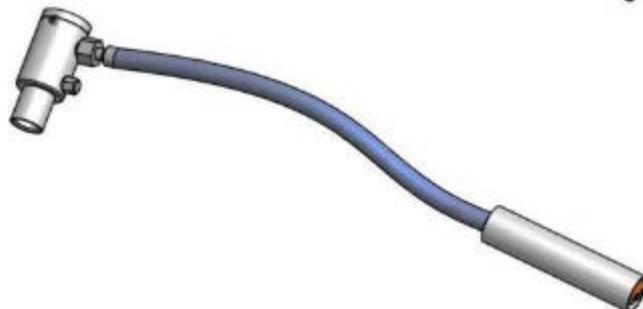
CTW Qube module paired to a CasTemp wireless instrument is the preferred connection as it gets rid of the need for plant wiring and multiple connections.



Cables using platinum wire in a braided steel hose designed for the harshest conditions.



Cables using compensation cable in a fireproof rubber hose designed for most applications.



Cables using compensation cable designed to offer fast and economical repair.



5.3 After preheating

- The CasTemp system is designed to work without air cooling. However, if radiant heat pushes temperatures above 250°C, you should ask our representative about shielding or cooling. During casting, keep the connection free of any insulation material so it can be ventilated naturally by air.
- If the tundish lid is placed on the tundish, make sure that no refractory parts fall into the tundish and damage the sensor. If there is a chance of this, protect the sensor.
- Do not throw covering powder into the tundish before the sensor is immersed totally in the liquid steel.



Never use a tundish without a sensor or safety plug fitted.

Recommended best practice – in a **preheated tundish**, link the preheat output from the sensor to the plant's 'ready to cast' machine-locking system. Doing this would mean a threshold temperature above 500°C would have to be reached as part of the 'ready to cast' sequence needed to start the machine. This forces the check at the start of every cast. With **cold tundish** practice, you can use continuity. However, continuity does not guarantee that a working sensor is fitted.



Never remove the CasTemp or any of the retaining system before de-skulling. If you do this, there is a danger liquid steel will leak out.

5.4 Removing the CasTemp

When the cast is finished, disconnect the connection cable. When the tundish skull is solid and removed, release the [wedges](#) and remove the [retaining plate](#). After the tundish has been emptied, knock out the used sensor using the CasTemp [removal tool](#), taking care not to injure yourself or damage the [CasTemp block](#). After removing the used sensor, clean the inner surface of the block of any [mortar](#) which is sticking to it, inspect the block for damage, and replace it if necessary.

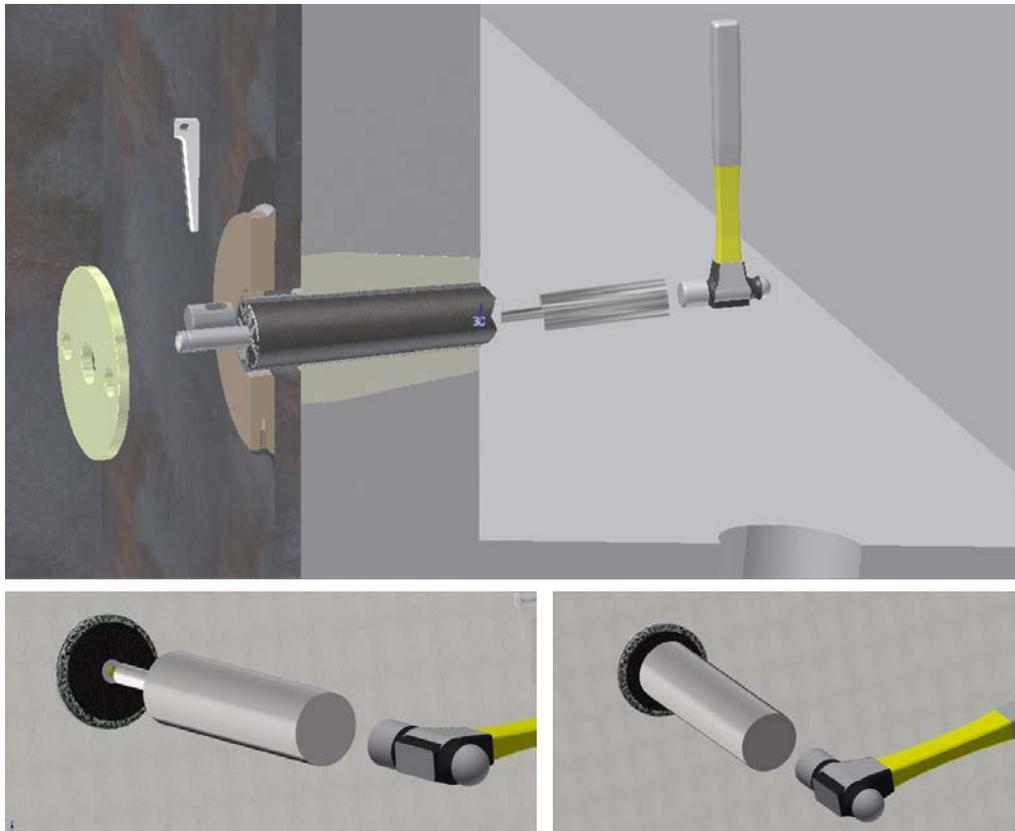


Figure 55 Removing the used sensor with the CasTemp [removal tool](#)



5.5 Inserting the safety plug

The safety plug is used:

1. as a substitute for the [CasTemp sensor](#) when casting without a sensor is needed; or
2. as a temporary plug during spray gunning.

The [safety plug](#) must be inserted with CasTemp [mortar](#) to make sure it can be removed easily.

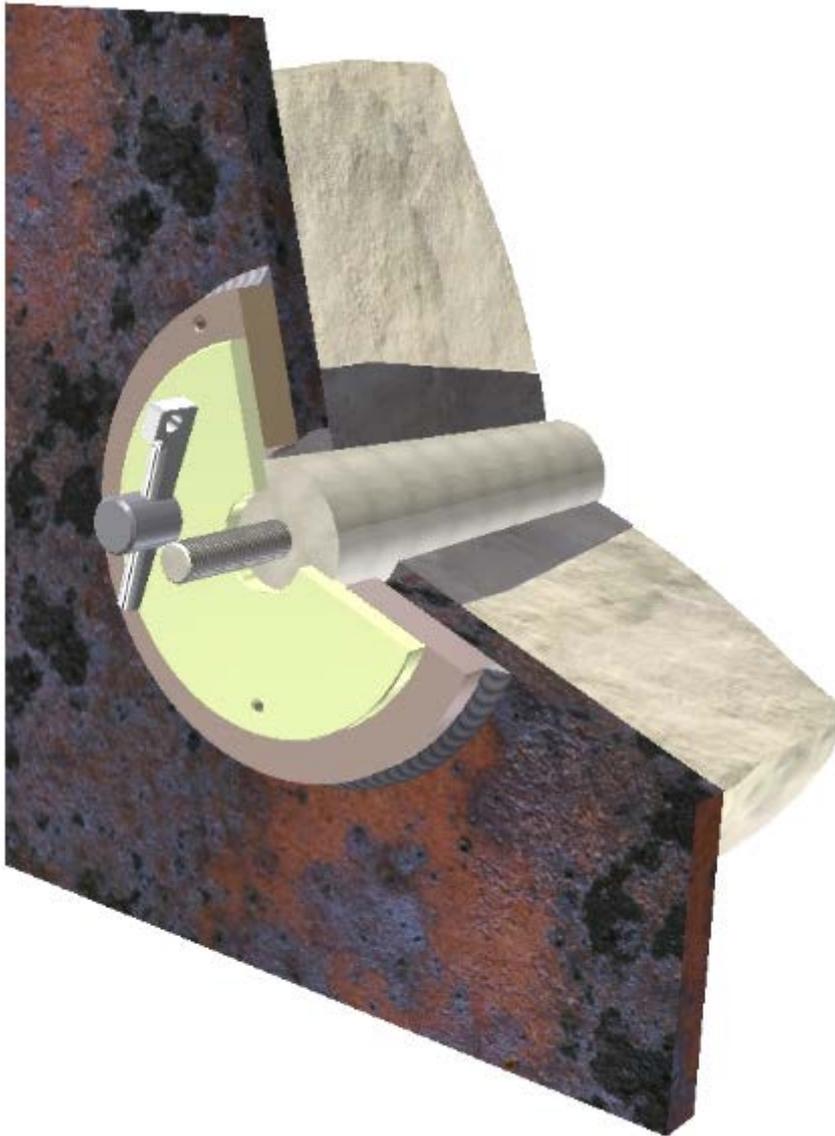


Figure 56

6 Thermocouple technical information

CasTemp uses type-B, Pt30%Rh/Pt6%Rh thermocouple wire according to international standards IEC584, DIN43710, NBS125, JIS1981, AFNOR, and BS4937 based on the ITS 90 temperature scale.

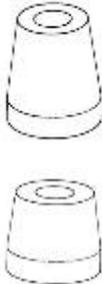
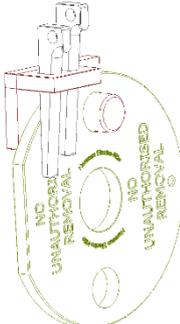
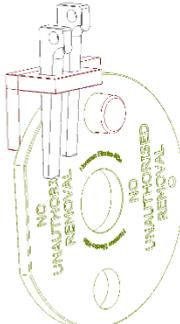
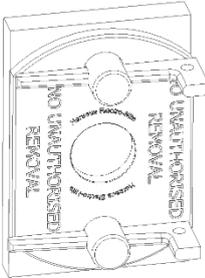
The wire has an accuracy of -1 to +1°C at the melting point of palladium 1554°C.

6.1 PARTS LIST

Name	UCS
CASTEMP PHOSPHATE BONDED MOULDABLE	13829111
CASTEMP MORTAR MIXED	23808711
CASTEMP EMBEDDING TOOL COMPACT P1	10869861
CASTEMP BLOCK RS16.14 P1	21822061
CASTEMP NARROW APPLICATION SETP1	10869961
CASTEMP safety plug P4	21820661
CASTEMP REMOVAL TOOL	23926821
CT-SENSOR CHECKER P1	10848463
CASTEMP 460 P50	20024074
CASTEMP WEDGE & PLATE HOLDER	13973071
CLAMPING WEDGE LONG	11825061
CASTEMP NARROW RETAINING PLATE	13971851



7 Parts

<p>CASTEMP 460</p>	<p>CASTEMP 600</p>	<p>CASTEMP SAFETY PLUG</p>	<p>CasTemp block</p>
			
<p>CASTEMP EMBEDDING TOOL</p>	<p>CASTEMP WEDGES & PLATE HOLDER</p>	<p>CASTEMP NARROW RETAINING PLATE. CLAMPING WEDGE LONG.</p>	<p>CASTEMP REMOVAL TOOL</p>
			
<p>CT-sensor checker</p>	<p>Connection cable</p>	<p>CASTEMP MORTAR (mixed or unmixed)</p>	<p>CASTEMP NARROW application set</p>
			

You can ask us for supporting documents and part numbers. See your local Heraeus Electro-Nite representative.

8 CasTemp rapid start (RS)

The CasTemp RS sensor is designed for applications where a fast response time is important. The sheath has a thinner tip for a reduced response time so that temperature monitoring can start at the beginning of a casting sequence.

Due to the thinner tip, the probe will not last as long as the standard sensor and is not recommended for long sequence or corrosive environments.

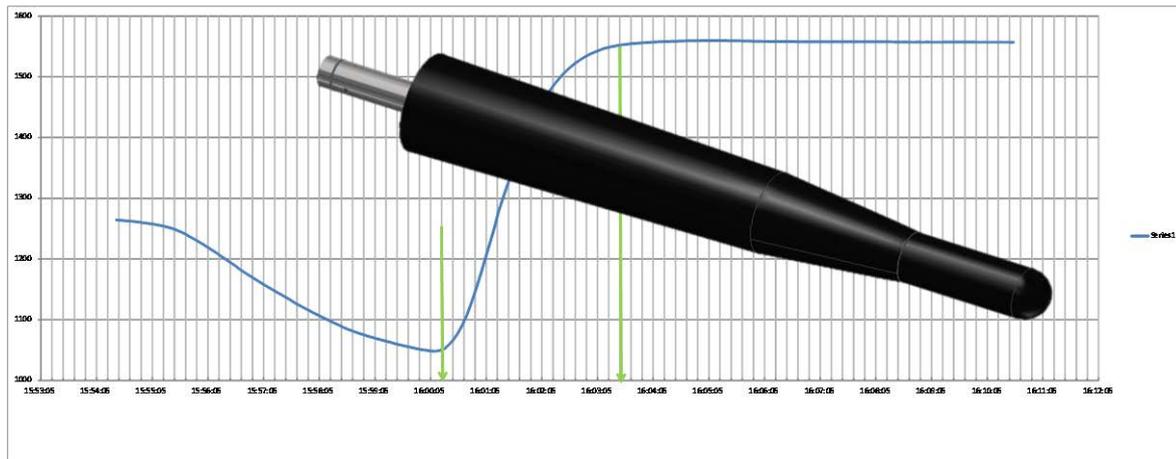


Figure 59

9 CasTemp long-life sensor

The CasTemp long-life sensor has a high-density sheath so it can be used in applications where there is likely to be extreme wearing.

The sheath has a thicker profile at the tip, but has an identical taper to the standard [CasTemp sensor](#) so it can be used in the same application.

The material is more sensitive to thermal shock and so we would advise you that if you do not use preheat, you should use a shock shield. You can get these from us and they will slow the response time down to prevent any risk of thermal shock. The shock shield will only last a few minutes in liquid steel so there should be no lasting effect on thermal response through the sequence.

If you reuse the long-life sensor material, there will be an increased risk of thermal shock and so we do not recommend this.



Figure 60



10 Troubleshooting

This section is for the service engineer and includes information on checking the [CasTemp sensor](#) and hardware.

10.1 Checking the 460mm sensor

Equipment needed: Multimeter and new contact block.



Figure 57

Even a sensor with a green light on continuity can be damaged – the [sensor checker](#) only registers a circuit. This could be a circuit formed by liquid steel on a broken sensor. To understand the exact nature of the failure, you must measure the resistance of the sensor with a new contact block and a multimeter.

- Cold [CasTemp sensor](#) should read within 1Ω of the stated value on the steel tube.
- Lower values indicate there is some sort of short circuit in the sensor.
- Higher values indicate a bad connection or internal wire breaks in the sensor.

- Hot 460mm standard CasTemp should read between 25 and 50Ω .
- Less than 25Ω shows there is some sort of short circuit in the sensor.
- More than 50Ω shows there is a bad connection or internal wire breaks in the sensor.

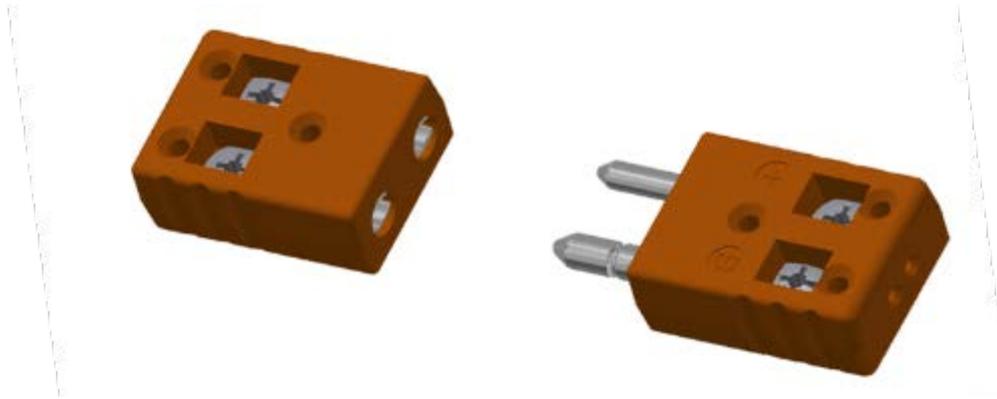
Questions

- Is the sensor connector clean and dry? Or does it have [mortar](#) in the connector?
- Can the umbilical head connect correctly with the sensor connector? Or is it obstructed?
- Is the new contact block loose in the CasTemp connector rings?

There are other possible further checks, but by now you should know if the sensor is fit for use. Once you know this, you can check the hardware for faults. You can check the hardware first, but you must be 100% sure that the hardware is faulty before you replace it.

10.2 Checking the hardware

Equipment needed: Megohmmeter (megger), allen keys, small flat screwdriver.



- The marlin plugs and sockets should always be positioned correctly for polarity (check the polarity is correct).
- Check the positive wire is connected to the positive contact on both plug and socket (and do the same check for negative).
- Check the plugs connect securely and are not loose, bent, corroded or squashed.
- Check the terminal screws are tight – regular checks will avoid possible problems.



- The connector should be an open circuit across the connection posts (shown yellow) [even at 250v with megohmmeter]. Make sure the screws are tight with this test.
- The open circuit should be maintained when pushing the positive pin (shown red) towards the negative pin (shown black). Using the audible continuity function of your meter will help here.
- The locking pin (shown purple) should be securely in place. If it is loose, the positive and negative pins may short together. (Check movement and circuit.)
- The terminal screws should be tightly screwed down to the connecting cable – regularly checking and tightening these screws can avoid possible errors caused by high resistance in the thermocouple circuit.
- The surfaces of the positive and negative pins should be clean and free from oxidation, debris or coating.
- The positive and negative pins should be reasonably secure (not loose) and concentric. If either pin is deformed, it will deform the contact ring in the sensor.



- The connector should plug securely to the sensor connector. It should not be loose or difficult to connect.
- The three bolts holding the connector into the umbilical head should also be secured, and you should regularly tighten them.

10.3 Fault finding flow chart

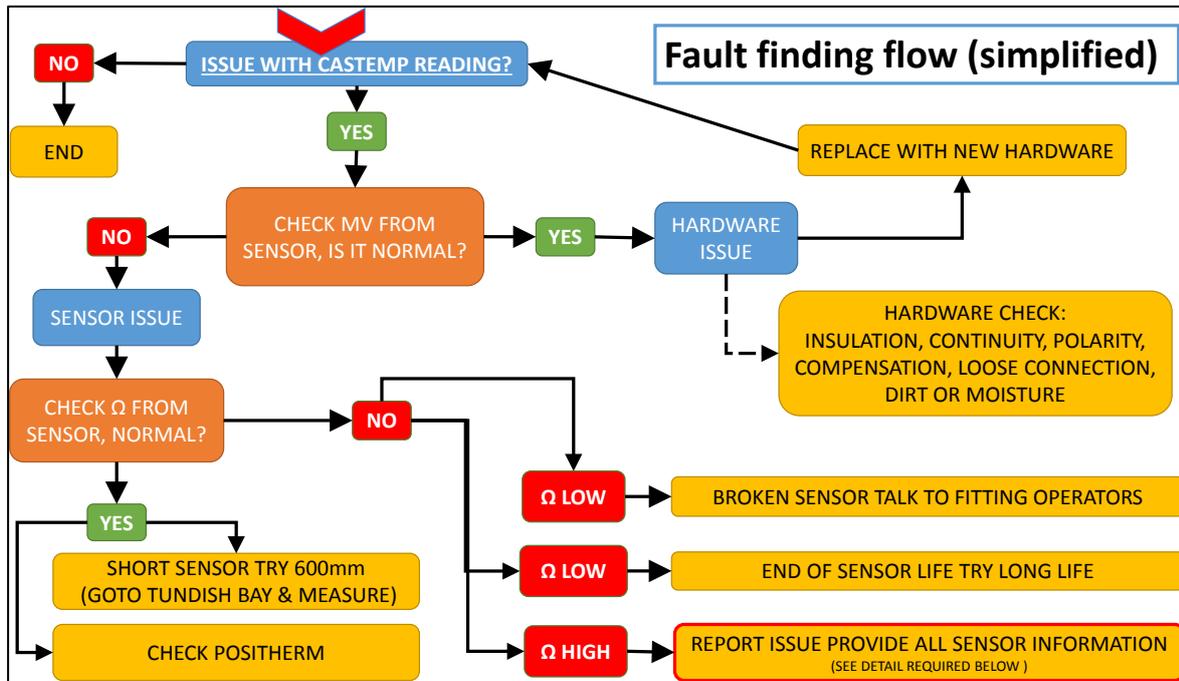


Figure 58

If your fault analysis brings you to the 'report issue' box (outlined in red), please collect the information below:

- Nature of issue:
 1. What went wrong (describe fault)
 2. When did it go wrong (how many hours into sequence)
 3. Ω & mv from sensor (important if you can't recover sensor)
- Batch detail (photo of stem, or crate label)
- CTW trace (or plant data with tundish weight & dips etc.)
- Plant detail:
 1. Pre-heat? (how long)
 2. Type of caster, sensor position, open pour, tundish lids, tundish furniture etc..
 3. Steel grade, ppm O, Oxy lancing
- Returning sensor isn't always possible but even the cold half of sensor can be useful.



11 Safe system of work.



Never use a tundish without a sensor or safety plug fitted.

Recommended best practice – in a **preheated tundish**, link the preheat output from the sensor to the plant's 'ready to cast' machine-locking system. Doing this would mean a threshold temperature above 500°C would have to be reached as part of the 'ready to cast' sequence needed to start the machine. This forces the check at the start of every cast. With **cold tundish** practice, you can use continuity. However, continuity does not guarantee that a working sensor is fitted. (see section 5.3)



Never remove the CasTemp or any of the retaining system before de-skulling. If you do this, there is a danger liquid steel will leak out. (see section 5.3)



If the **sensor checker** doesn't light up, fit a new sensor. (Make sure the **sensor checker** is working) Engaging the **sensor checker** means the connection head will fit. This must be done before releasing the tundish for use. (see section 4.7)



Before sending the tundish for drying, check there is no gap between the CasTemp sensor and the retaining plate. If you find a gap, refit the sensor. (See section 4.6)



Do not use a tundish without a CasTemp sensor securely fitted or with the access hole appropriately sealed. (see section 4.1)



When the CasTemp sensor is fitted, make sure the mortar is dry enough. (See section 4.1)



The mortar must form a complete seal between the CasTemp sensor and the block, leaving no gaps. (see section 4.1)



CasTemp sensor must be held in place securely by the locking plate and wedges. (see section 4.1)



Only use the specified CasTemp® components from Heraeus Electro-Nite to ensure the correct and safe operation. (see section 4.1)

Only competent personnel should fit the CasTemp in the tundish.

When you remove the CasTemp from the crate, if the packaging is not sealed, do not use it. Contact the supplier.

If any product is damaged when you remove the packaging, do not use it. Contact the supplier.

CasTemp is not reusable and you must dispose of it according to local regulations.

To guarantee the system will work correctly, only use Heraeus Electro-Nite sensors, parts and consumables (see section 7).

It is recommended that records of any training given are logged as shown below (Table 1)

Following the correct installation of the CasTemp system it is recommended to carry out periodic audits to ensure the safe system of work is being followed, see example below. (Table 2)



CasTemp fitting training, given by:			JOHN SMITH	<i>John Smith 28.5.18</i>		
CASTER 4	A SHIFT	DATE TRAINED	SIGNATURE	B SHIFT	DATE TRAINED2	SIGNATURE2
TEAM LEADER	DAVE STEEL	<i>22.5.18</i>	<i>Dave steel</i>	BOB IRON	<i>25.5.18</i>	<i>Bob Iron</i>
1	JOHN BULL	<i>22.5.18</i>	<i>John Bull</i>	FRED SMITH	<i>25.5.18</i>	<i>Fred smith</i>
2	JIM BELL	<i>22.5.18</i>	<i>Jim Bell</i>	TONY WING	<i>25.5.18</i>	<i>Tony Wing</i>

Table 1 Example of training records

Castemp fitting issues		0		
ISSUE	Consequences	Avoidance	Check	Count
Only 1 wedge fitted	No backup Possible to loosen CasTemp sensor when stopper fitting	Replace any missing parts	Fitting stand Pre-heat stand Casting position	0
Spray on connector	Bad contact to sensor Difficult to contact or check continuity	Take more care, or reposition	Fitting stand Pre-heat stand	
Too much cement on or around connector tube	Bad contact to sensor Difficult to contact or check continuity	Wipe clean	Fitting stand Pre-heat stand	
Spray over CasTemp tip	Slow response time of sensor Temperature differences during cast Incorrect temperatures during cast	Wipe clean or cover during spray	Fitting stand Pre-heat stand	
Removing closing plate prior to deskulling	Possible steel leak Difficult to remove probe	Closing plate only to be removed after deskulling		
Under spray or insufficient spray	Liquid metal gets to permanent lining welding probe in place Difficult to remove probe without damaging block	Even spray round probe Check during spraying	Spray station Pre-heat stand	
Bent plates	Possible insufficient closing of plate Difficult fitting	Replace with new	Fitting stand Pre-heat stand	
Wrong wedge type	Possible insufficient closing of plate Difficult fitting	Replace missing parts	Fitting stand Pre-heat stand	
Non concentric block	Difficult probe fitting Incorrectly fitted probes Difficulty making signal head connection	Appropriate tool Take care fitting blocks	Fitting stand	
Probe pushed in too far	Gap behind plate Possible to loosen probe when stopper fitting Loose probes are very difficult to remove without block damage	Use excess mortar Twist and push leaving probe 5mm proud	Fitting stand Pre-heat stand	
No CasTemp sensor fitted	Possible steel Leak	Review safe system of work	Fitting stand Pre-heat stand Casting position	

Table 2 Example of follow up audit

Whenever work is carried out on site it is important that you follow a safe system of work, complying with local requirements. Before work is started it is recommended that a risk assessment of the hazards is carried out followed by measures and actions to reduce risk of injury to yourself and others. You should follow an agreed safe working procedure, in addition to any required permits and signing in procedure. Some examples of hazards and corrective actions associated with working inside a tundish:

Hazard	Corrective action
Overhead crane movement	Flashing light, danger board, radio contact, second person to watch.
Dust & flying particles	Personal Protective Equipment
Pre-heater burner	Isolation, flashing light, Radio, second person to watch
Movement of tundish car	Isolation, flashing light, Radio, second person to watch
Hand Arm Vibration (power tools)	P.P.E , regular breaks, second person
Working alone	Inform others of your position, second person to watch
New or unexpected Hazard?	Carry out a short Point of Work Risk assessment!



12 CasTemp approval form

CasTemp installation

I confirm the CasTemp system has been installed and commissioned in line with the CasTemp installation manual.

CasTemp Wireless installation

I confirm the CasTemp Wireless system has been installed and commissioned in line with the CasTemp Wireless installation manual.

Instrument Serial Numbers

CasTemp Superheat Licence Approval

I confirm Heraeus Electro-Nite provides the 'CasTemp Superheat' System and the respective measurements (measurement of the superheat via CasTip, calculation of the superheat and the forward prediction of the superheat at the end of the cast) on an advisory basis and will not be liable for any inaccurate results.

Name:

Position:

Customer name:

Address:

Customer signature:

HEN signature:

Date:

Date:

