NIR-BORESCOPE-GLASS

THERMAL IMAGING SOLUTIONS

FOR **GLASS FURNACE APPLICATIONS**

1000 to 1800 °C / 1832 to 3272 °F

LAND

AMETEK®

PROCESS & ANALYTICAL INSTRUMENTS

QUALITY CUSTOMER SOLUTIONS

NIR-BORESCOPE-GLASS

THERMAL IMAGING SOLUTIONS

AMETEK LAND HAS BEEN MANUFACTURING PRECISION MEASURING EQUIPMENT SINCE 1947.

We are specialists in non-contact temperature measurement and combustion monitoring with our products finding applications across diverse industries such as steel and glass making, power generation, cement manufacture and hydrocarbon processing.

As part of AMETEK Process & Analytical Instruments Division since 2006, our customers benefit from the worldwide AMETEK sales and service team.

The NIR-Borescope (NIR-B) Glass range encompasses short-wavelength radiometric infrared borescope imaging cameras, designed to produce high definition thermal images, along with providing accurate temperature measurements from any selected points in the image. The camera measures temperatures in the range 1000 to 1800 °C (1832 to 3272 °F) and is suitable for float glass, container glass, borosilicate glass, and fibre glass melt furnaces.

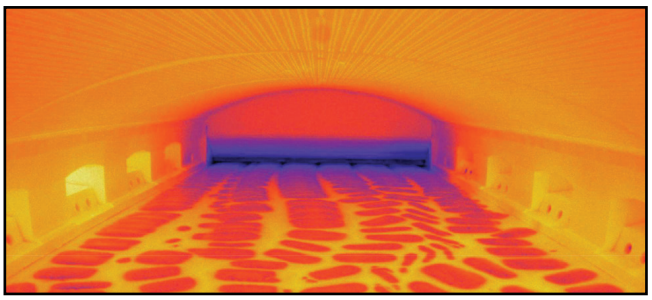
Models available:

- **NIR-B-656-Glass -** Standard resolution (656 x 494 pixels) gives over 300 thousand temperature points with a 90° lens.
- **NIR-B-2K-Glass -** High resolution (1968 x 1472 pixels) gives nearly 3 million temperature points with a 95° lens.

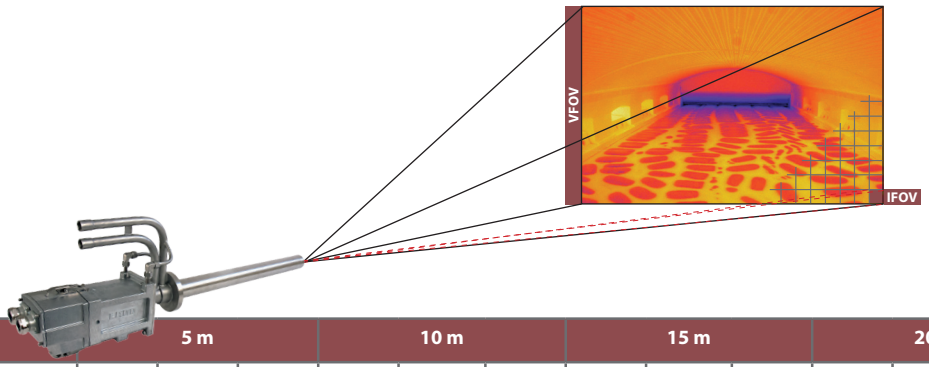
With the NIR-B-Glass, it is possible to accurately and continuously profile the temperature of the entire furnace, including glass, refractory walls and port arches, and the crown/roof, with only a small opening in the wall. Thermal imaging inside refractory-lined furnaces, boilers and glass melt tanks normally requires the plant operator to cut large openings in the refractory to enable viewing of the critical area. This can cause significant wasted energy from heat loss and can be difficult to keep the opening free from debris. The NIR-B Glass only requires a small diameter hole through the furnace casing and refractory to accommodate the wide-angle lens tip.

The NIR-Borescope-Glass offers significant advantages over the traditional methods of furnace monitoring. The NIR-B-Glass offers continuous, labour free monitoring whereas manual visual inspection can take hours to complete, is not continuous and unreliable due to user error. A visual camera does not provide a temperature reading, with the NIR-B-Glass you can see the process and measure the temperature at any point within the pixel image and set alarms to detect air and glass leaks affecting the temperature and efficiency of the furnace.

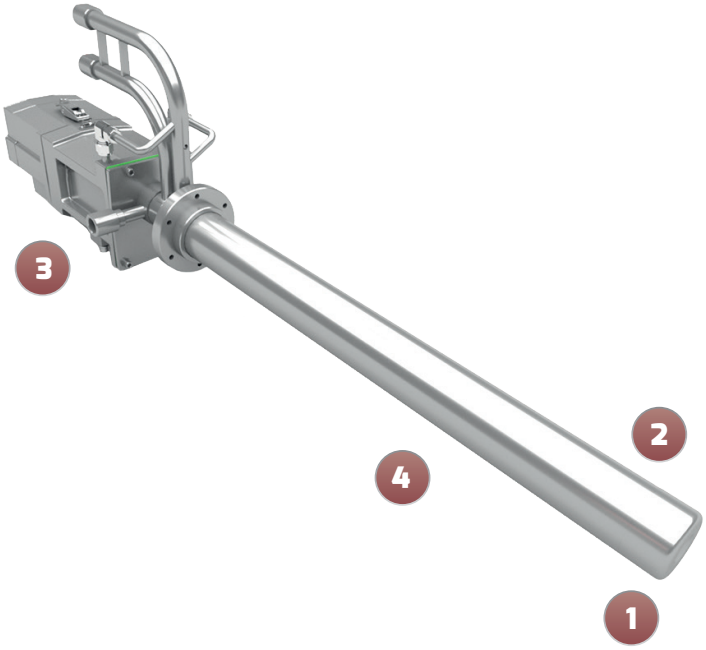
With the new IMAGEPro software it's region of interest (ROI) can be user-defined and trended, showing max, min, and average temperatures and by using the included Playback view you can replay events and stop at any frame to measure multiple temperatures at the same point in time, particularly useful if you are measuring port arch temperatures at the moment of reversal.

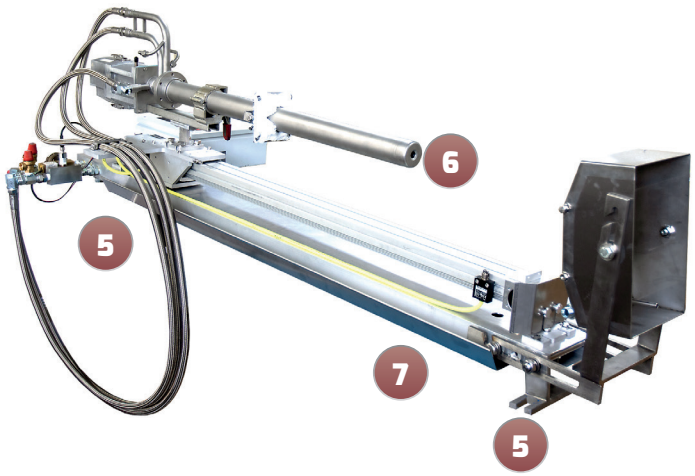


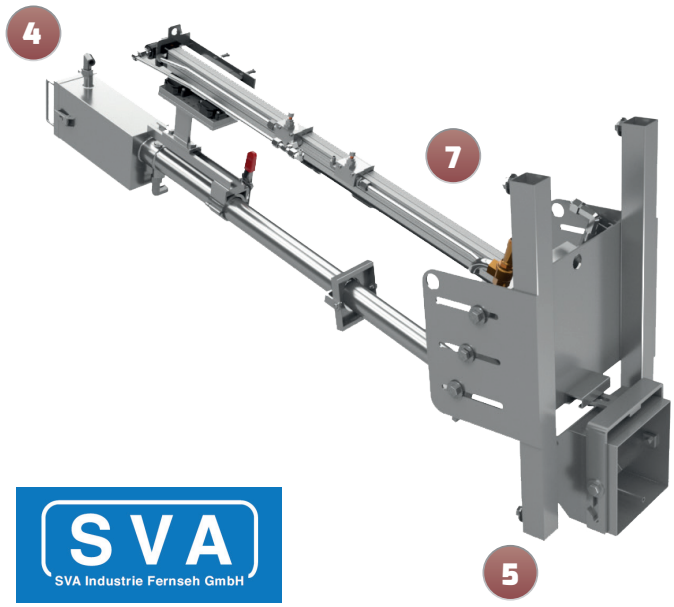
FIELD OF VIEW OPTICS



Distance	1 m			5 m			10 m			15 m			20 m		
	Width	Height	IFOV	Width	Height	IFOV	Width	Height	IFOV	Width	Height	IFOV	Width	Height	IFOV
NIR-B-656 90° x 67.5°	2.0 m	1.5 m	3 mm	10 m	7.53 m	15.2 mm	20 m	15.06 m	30.4 mm	30 m	22.59 m	45.7 mm	40 m	30.12 m	60.9 mm
NIR-B-2K 95° x 71°	2.2 m	1.6 m	1.1 mm	10.9 m	8.2 m	5.5 mm	21.8 m	16.3 m	11 mm	32.7 m	24.5 m	17 mm	43.7 m	32.7 m	22 mm







SVA Industrie Fernseh GmbH

SPECIFICATION AND DESIGN

1: WIDE VIEWING ANGLE
NIR-B-656 90° x 67.5° or NIR-B-2K 95° x 71° view maximises the area monitored giving a crystal clear and unparalleled internal tank thermal view.

2: RANGE OF PIXEL RESOLUTIONS
Provide accurate real-time temperature measurements from any selected area of interest or individual points within either a >300 thousand or nearly 3 million pixel image.

3: INTEGRATED AIR PURGE
The unique air purge design maintains a clean lens in harsh process environments. Plus, with built-in water cooling, the system minimises air and water flowrate requirements.

4: PROBE LENGTHS
A 3' (915 mm) borescope is supplied as standard, however other probe lengths available upon request.

5: MOUNTING
Two options available including an electrical or pneumatic automatic retraction system to easily and securely mount from the furnace steel framework and incorporates a "camera block" cover with integral air purge to provide process sealing when the NIR-B is withdrawn.

6: THERMOCOUPLE AT NIR-B TIP
Gives the operator an alarm for removing the instrument to prevent damage if maximum temperatures are exceeded.

7: AUTO-RETRACT SYSTEM
Designed to auto-retract and protect the thermal imager from damage by overheating in the event of loss of water flow, air pressure, electricity supply or high borescope tip temperature alarm.

FEATURES AND BENEFITS

HIGH-TEMPERATURE MEASUREMENT ACCURACY
Enables optimum process control through enhanced thermal imaging.

SHORT WAVELENGTH SENSOR
Low sensitivity to emissivity changes.

IMAGEPRO SOFTWARE
Data points, regions of interest, automated alarms, long term data trending and system inter-connectivity (DCS, Modbus).

REAL-TIME THERMAL DATA COMBINED WITH HIGH-RESOLUTION VISUAL IMAGE
Allows true batch control, flame optimization and the opportunity to improve energy efficiency without degrading the refractory lifetime.

24 HOUR, 7 DAY MONITORING
Shutterless operation guarantees accurate, reliable data with no blind time.

EXPORT LICENSE FREE
Rapid, hassle-free shipping.

BENEFITS OF THE NIR-B AT encirc

Encirc, a leading glass manufacturer, has implemented AMETEK Land's real-time, in-furnace thermal imaging Near Infrared Borescope (NIR-B) to optimise furnace operations and introduce reductions in emissions at its Elton plant in Cheshire, UK.

THE CHALLENGE

Encirc was looking for an innovative temperature measurement solution at its glass production plant to replace an existing CCTV system. The company required high-quality images for operators to monitor batch line/flow and improve set up of its 20 under-port, dual-impulse regenerative burners.

Prior to the uptake of a solution, it would typically take Encirc at least four hours to produce a thermal optical profile of a cross-fired container furnace, due to its 20 to 30-minute reversal time. The extended time frame, in addition to significant risk of human error due to the measurement position and limited resources to complete the profile meant temperature profiles often were only taken when it was absolutely necessary, such as quality problem.

THE SOLUTION

Thermal imaging was becoming widely accepted by glass manufacturers as a way to extend asset life and optimise their furnace operations. Encirc recognised this and in 2014 installed AMETEK Land's Near Infrared Borescope (NIR-B) in-furnace thermal imaging system on both furnaces at the Elton plant.

The NIR-B continuously takes over 300,000 optical pyrometer temperature measurements and then generates an extremely high-definition image based on them. With its thermal imaging capabilities, the NIR-B measures critical point temperatures in the crown and breastwalls, providing high quality temperature data to operators.

The NIR-B system offers the ability to measure optical profiles continuously and to specifically obtain all points at the end of the firing cycle.

Even if the system is not recording continuously and a quality issue is highlighted from a cold-end inspection, there is an opportunity to assess the temperature profile at the next reversal (and the following one) to check for differences and points of concern. That ability allows the problem to be addressed within an hour, compared with four hours, or more realistically 24 hours before a manual thermal profile is initiated.

EXTENSIVE STUDY

In 2016, AMETEK Land began working with a consulting firm, Simpson Combustion and Energy, to undertake an extensive study and identify the impact of effective temperature measurement on optimising furnace operations for Encirc. That study involved Simpson Combustion and Energy taking port flue gas measurements using AMETEK Land's Lancom analysers and

then analysing that data simultaneously with in-furnace thermal images generated by the NIR-B.

By comparing that information with data from 2014, the study determined that specific regenerators now had restrictions (cold temperatures), with overheating in clear ports indicating higher-than-design port volume flow. Port fuel distribution now was governed by where there was available air for combustion.

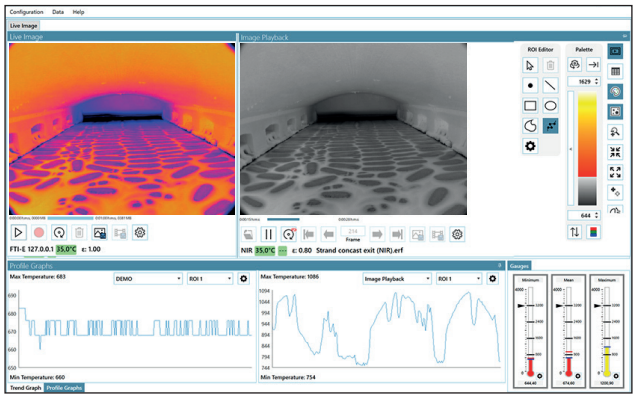
The NIR-B showed that the hot spot had moved significantly from its original ideal position, and, in addition, there appeared to be excessive metal-line cooling. The metal-line cooling was turned down slowly to reduce energy consumption as well as reducing refractory wear as part of an asset protection program. When the Encirc team reviewed thermal imaging data with port flue gas measurements, there was a clear indication of a significant restriction in one of the ports, with most of the flue gases going to other ports. Encirc addressed regenerator flow with an external cleaning. It then gave the team the flexibility to start moving fuel to get the hot spot closer to where it needed to be. That resulted in a record pull rate with lower specific energy on an asset that was then approaching a major repair.

Alongside this, images generated by the NIR-B are also a valuable tool for Encirc in supporting customer visits, by clearly demonstrating how product quality is optimised and how emission reductions may be achieved in the future. The clear thermal images of the furnaces generated by the NIR-B are projected onto screens in the control room at Encirc plant, providing an extra attraction for Encirc's award-winning Vidrala Academy

CONCLUSION

The extensive study carried out to assess the impact of the NIR-B-Glass for Encirc has revealed some very impressive results. The NIR-B's data was used to improve response times and to identify and then troubleshoot furnace operations, improving yield and achieving higher pull and lower specific energy. So far, a record pull rate has been achieved. That should result in increased asset life. Additionally, the NIR-B helps provide technical support during customer visits and can potentially reduce emissions.

THERMAL IMAGING SOFTWARE



IMAGEViewer

IMAGEViewer is a free software download enabling viewing, analysis and storage of thermal data captured by NIR thermal imaging cameras.

It provides a free, easy-to-use solution for thermal image processing using a Windows PC. Once installed, connection to a camera is simple using the menu or an installation wizard. A clear, intuitive interface quickly enables the user to view and analyse imaging data in different views.

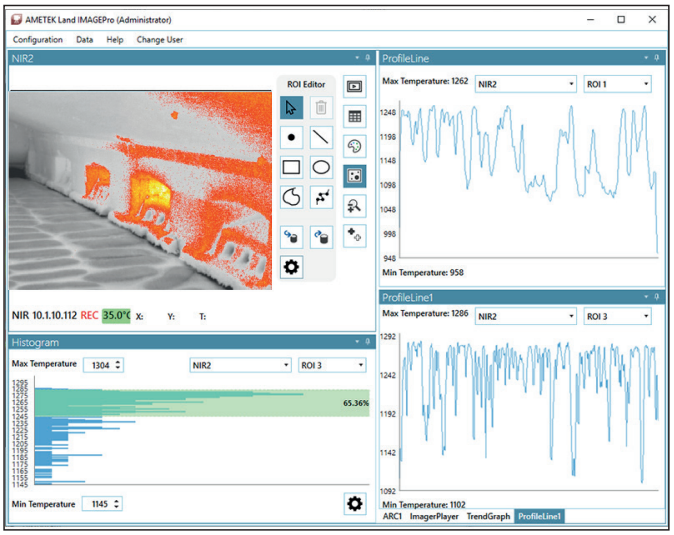
IMAGEViewer IS FOR A SINGLE THERMAL IMAGER

IMAGEPro

The innovative IMAGEPro software is an advanced image processing software for controlling, monitoring, analysing and capturing imager data.

IMAGEPro is a Windows PC software system that enables configuration of imager, display properties and advanced temperature analysis options and supports multiple simultaneous imagers. Free 30-day trial available for extensive testing.

Able to monitor and control up to sixteen imagers, IMAGEPro offers real-time analysis for thermal imager ranges. Giving users exceptionally detailed control over their thermal imaging measurements, IMAGEPro enhances application measurements.



IMAGEPro IS FOR UP TO 16 THERMAL IMAGERS*

KEY BENEFITS OF IMAGEPRO

EXTENSIVE FUNCTIONALITY - extensive control and analytical functions for exceptional process control, including multiple free defined ROIs (regions of interest).

FLEXIBLE COMMUNICATIONS - enables exchange of information using a simple cross-platform Modbus TCP protocol, analogue signals or alarm output via I/O modules.

**** Dependent on network capacity and PC hardware***

REAL-TIME RESULTS & ANALYSIS - powerful image processing allows for real-time monitoring and analysis of the thermal information provided by up to 16 imagers.

FLEXIBLE INTERFACE LAYOUT - allows complex configuration and arrangement of windows by the user across multiple monitors, which is stored and opens automatically on restart.

ADJUSTABLE WINDOWS - can be docked, re-sized and made floatable to suit specific needs.

TOOLS & DISPLAY - can be displayed and hidden as needed to maximise screen space.

USER LEVELS - ensures only those with password access can change system configuration.

NIR-B MONITORING EFFICIENCY

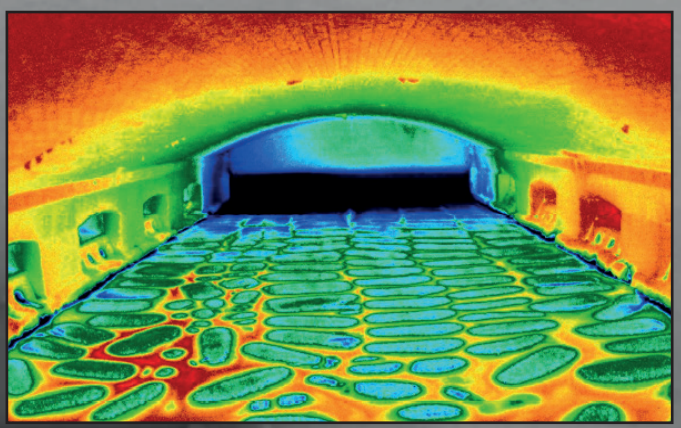
The melt tank experiences the highest temperatures of the glass production process. Real-time monitoring of these temperatures is vital to the efficiency of the application and the quality of the product. It is important to be able to study the entire tank interior to detect any structural damage.

Reversals of the furnace's burner and exhaust ports take place every 20-30 minutes, making traditional, slower-response thermal profiling difficult and time-consuming, with significant risk of human error. Real-time analysis is required to ensure overheating is avoided and the hot spot is located at the optimum point for fuel-efficiency.

The condition of the furnace refractories is vitally important to safety and process efficiency, especially towards the end of the life of the tank. Deterioration of the refractories can increase fuel costs and may cause glass breakouts or refractory failure.

Detection of damage to the tank allows early maintenance and extends the tank's lifespan. Around 70% of container glass production costs come from energy, so preventing cracks and lost heat produces significant savings. Early detection of glass breakouts enhances plant safety.

Monitoring the condition of the melt tank enables interior damage to be detected and repaired, improving energy efficiency and reducing unplanned downtime. Thermal measurements in the melt tank also support process efficiency and consistent glass quality.

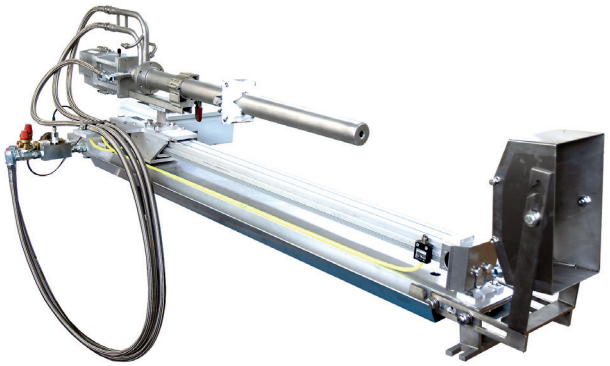


FOR MORE INFORMATION AND TECHNICAL SPECIFICATIONS PLEASE VISIT
WWW.AMETEK-LAND.COM

RETRACTION SYSTEMS

AUTO-RETRACT SYSTEMS PROTECT THE THERMAL IMAGING CAMERAS FROM DAMAGE BY OVERHEATING IN THE EVENT OF LOSS OF WATER FLOW, AIR PRESSURE, ELECTRICITY SUPPLY OR HIGH BORESCOPE TIP TEMPERATURE ALARM

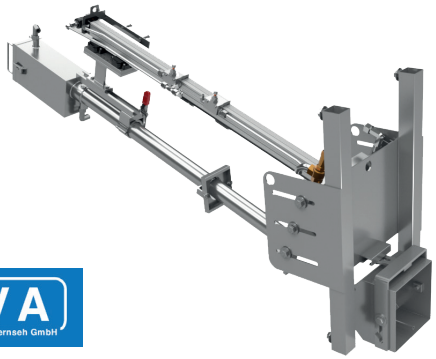
ELECTRICAL AUTO-RETRACT (AR) SYSTEM



The system comprises borescope thermal imaging camera, water cooled and air purged borescope tube and imager protective housing, electric auto retraction system (24V), control box, (IP65 rated and includes PLC, UPS and customer connection terminals), inter connects and IMAGEPro software. The UPS provides the power to retract the borescope should power failure occur. If the stored energy in the UPS falls to a certain level, the borescope automatically retracts.

Dimensions (Auto-Retract Mechanism & Borescope):	486 x 709 x 1900 mm/ 19 x 28 x 75 in
Weigh (Auto-Retract Mechanism & Borescope):	95 kg / 223 lb
Dimensions (Control Box):	730 x 530 x 277mm/ 30 x 22 x 11.5 in
Weight (Control Box):	28 kg / 61.7 lb

PNEUMATIC AUTO-RETRACT (PAR) SYSTEM



The system comprises borescope thermal imaging camera, water cooled and air purged borescope tube and imager protective housing, pneumatic auto retraction system, 25 m high temperature cable set (imager to control unit), control unit and media control box, local control box (mounted next to thermal camera auto retraction system), local media bar complete with 6 ball valves, PTFE hoses one set (ambient temperature 200 °C) (protective housing to media bar), air filter set and IMAGEPro software.

Dimensions:	410 x 700 x 1400 mm / 16 x 27.5 x 55 in
Weight:	63 kg / 139 lb
Dimensions (Control Unit):	1000 x 400 x 200 mm / 40 x 16 x 8 in
Weight (Control Unit):	31 kg / 69 lb
Dimensions (Media Control Box):	1000 x 400 x 200 mm / 40 x 16 x 8 in
Weight (Media Control Box):	31 kg / 69 lb
Dimensions (Local Control Box):	200 x 175 x 80mm / 8.3 x 7.3 x 3.3 in
Weight (Local Control Box):	2 kg / 4.4 lb

NIR-BORESCOPE-GLASS

THERMAL IMAGING SOLUTIONS

SPECIFICATIONS

	NIR-B-656 Glass	NIR-B-2K Glass
CAMERA UNIT		
Measurement Ranges:	1000 to 1800 °C / 1832 to 3272 °F	
Pixel Resolution:	656 x 494	1968 x 1472
Spectral Response:	1 µm	
Frame Rate:	30 fps (Gigabit Ethernet)	15 fps (full frame mode)
Detector:	FPA - Semiconductor	
Optic (HFOV x VFOV):	90° x 67.5°	95° x 71°
Optic (IFOV):	2.4 mrad (90°)	0.84 mrad (95°)
Focus Range:	1 m to infinity	
Probe Diameter:	61 mm	
Probe Length(s):	915 mm (36 in) with AR or PAR; 610 mm (24 in) with AR	
Protection Window:	Sapphire	
Accuracy:	1% of reading (K)	
Dimensions:	254 x 560 x 810 mm (or 1120 or 1420 mm); 10 x 22 x 32 in (or 44 or 56 in) depending on probe length	
Repeatability:	1 °C	
Power Rating:	24 V DC, 3 W	24 V DC, 4W
Data Out:	Digital data over Gigabit Ethernet	
Weight:	15 kg / 33.07 lbs (for 24" variant)	
Environmental Rating:	IP65	
CAMERA SUPPLY		
Connections:	Gbit Ethernet; Local connection interface between camera unit and image processing system	
Service:	Water, instrument air, power input, located to the rear of the enclosure	
POWER SUPPLY UNIT (PSU) & TERMINAL ETHERNET BOX		
Components:	Power supply (PSU), Ethernet communications box (ECB)	
IP Rating:	IP65	
Size:	230 x 200 x 115 mm / 9.1 x 7.9 x 4.5 in	
Weight:	Approximately 1 kg	
Connections:	Light fiber data connection as an option	
IMAGE PROCESSING		
Software:	IMAGEViewer & IMAGEPro Advanced Image Processing and Controlling Software	
Workstation:	PC-Workstation (option)	
Interfacing:	Open Data Interface, Modbus TCP, Moxa I/O unit	
ACCESSORIES		
Optional Accessories:	Power supply, cables, water cooled/purged mounting and tube, software, workstation, auto-retraction systems	

NIR-BORESCOPE
656 x 494 PIXELS
600 - 1800 °C
44° x 33°, 90° x 67.5°

NIR-BORESCOPE-640
WIDE DYNAMIC RANGE
640 x 480 PIXELS
600 - 2000 °C
90° x 67.5°

NIR-BORESCOPE-3XR
WIDE DYNAMIC RANGE
HAZARDOUS AREA
640 x 480 PIXELS
600 - 1800 °C
90° x 67.5°

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