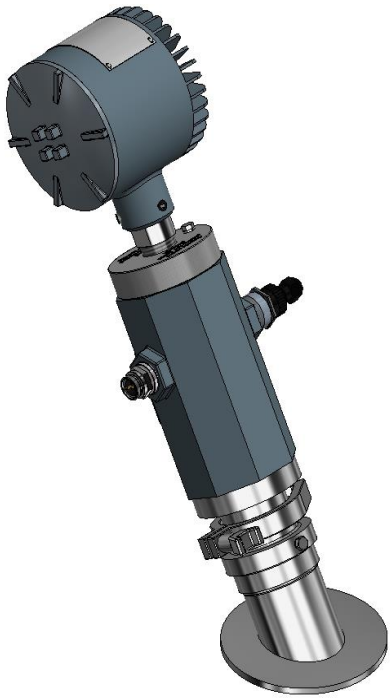


CENTRIFUGE CAMERA CONTROL

TA12300-1001_REV_A

Centrifuge Camera Control

Abstract:

The fundamental principle of Dynamic Imaging is relatively straightforward. CANTY's vision-based technique works on the basic principle of capturing high resolution images with a high-speed camera and relaying those images to the CANTY Vector Control Module. The Vector Control Module comes with embedded CANTY Vision Centrifuge Control (CVCC) software which analyses the images with the various CANTY algorithms. The binarized image is analyzed under a number of different parameters to provide cake thickness, slurry overflow, wash optimization, cake drying and basket imbalance. The data can then be stored via the excel database or output via 4-20mA/OPC UA/ Modbus / Profibus. The outputs can then be fed into the user's alarm system or DCS.

A common issue found in most centrifuges are the very limited options on the market for accurate and repeatable measurement of the cake thickness. Most of the technologies that are available can actually cause process upsets (Paddle style controller) when they touch the cake OR Ultrasonic type measurements which are susceptible to fluctuations on filling, repeatability issues and expensive for maintenance.

Add to this the ability to self-clean for unobstructed measurements, optimize the wash feed rate, filter performance, cycle time, cake drying, basket imbalance and there is really only one device on the market that can achieve this.

The CANTY Centrifuge camera & light combination is mounted on a single connection, replacing an existing sight glass

This document will show that the CANTY system not just meets, but exceeds all industry requirements and expectations while keeping installation and maintenance costs as low as possible.

The CANTY system foremost provides an unrivalled view for the operator in to the process through the wide-angle view camera. At a more advanced level, it provides continuous level/thickness measurement of the cake, de-watering alarm for optimization of washing and spinning phases, wet line detection (continuous centrifuge) and imbalance of the basket itself. Each measurement can be output on a single channel directly to the clients PLC/DCS for continuous monitoring.

The following key technologies are integrated into the system to provide a reliable and safe measurement:

- CANTY Centrifuge camera.
- High Intensity LED Lighting
- Fused glass (Glass to metal seal.) See appendix A.
- Jet Spray Ring. See Appendix C.
- Vision Control Module with embedded CANTYVISION™ software. (Rack or DIN mount)

Centrifuge Camera Control

Benefits of the CANTY System:

There are several benefits to be derived from CANTYVISION™ technology that are unique in the marketplace:

A. Vision into Process

1. View into the process is an enormous help in determining the process state and helpful in determining sources for upset conditions.
2. Brings the image of multiple centrifuges to a single point for ease of operator monitoring.

B. Process optimization

1. Cake thickness.
2. Prevention of overfilling.
3. Optimization of washing and spinning cycles.
4. Control filter performance (too many fine particles or too high a volume of wash fluid) to prevent outstanding liquid on the surface of the cake.
5. Reduce number of wash cycles.
6. Reduce de-watering/wash time.
7. Early detection of basket imbalance.
8. Automatic detection of completion of wash cycle and product discharge.
9. Repeatability of product quality on each batch
10. Yield increase of up to 20%
11. INCREASED PROFITABILITY.

C. Maintenance

1. System is remotely cleanable and resistant to fouling by design.
2. Fused Glass-to-Metal design provides a high pressure, rugged viewing port that is highly polished and extremely rugged with regard to vibration and impact.
3. The patented Spray Ring technology brings cleaning gas/air to the fused lens ports without disrupting the process.
4. LED light. (Up to 50,000 working hours)

D. Low Cost / Long Life

1. Initial system costs are lowest in the industry.
2. Maintenance costs are very low over the lifetime. System runs unattended.
3. System does not require any physical calibration after installation, but clients may wish to carry out period checks based on maintenance/safety schedules.
4. Long Life LED

E. Field Experience

1. Camera systems installed with various customers in the pharmaceutical, chemical, food & nutrient industries. (Bayer, Pfizer, MSD, Janssen, Sudzucker).

Centrifuge Camera Control

CANTY camera:

Mechanical Characteristics:

The system is designed to for use in the harshest of environments. The camera and light easily replace an existing sight glass for ease of installation. The following materials can be used for the process wetted material: 316/316L/C276/C22.

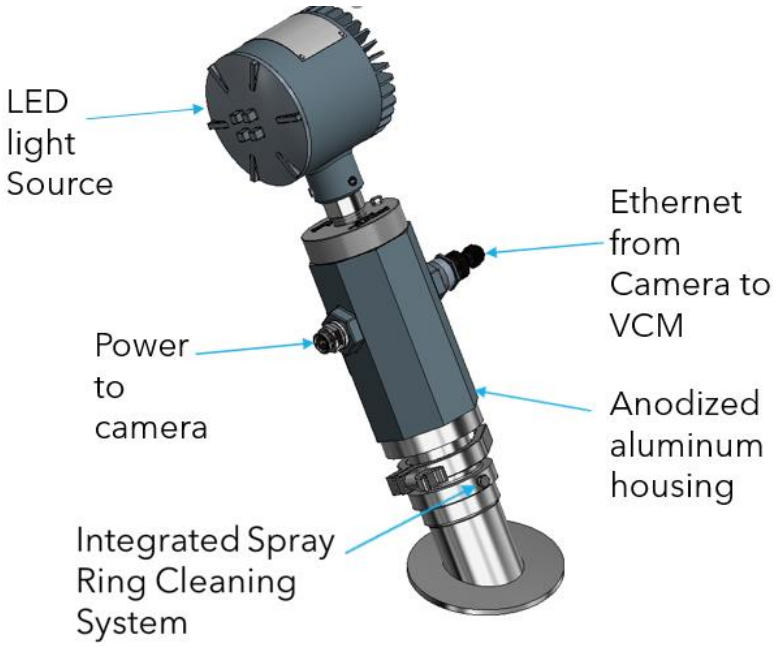


Fig 1.

Mounting is typically done by replacing an existing sight glass.

Typical mounting connections used: Flange mount, Tri-Clamp or N/A connect.

Environmental ratings of the CANTY system: ATEX/IECEX/FM/CSA/IP66/NEMA4X.

For additional environmental requirements please consult your local CANTY office.

Centrifuge Camera Control

Electrical Characteristics:

The system has been designed to take inputs of Power over Ethernet (PoE up to 100m for the camera only), 24VDC or 120(US)/230(EU/ASIA) VAC @ 60/50Hz depending on region of installation. Power cabling should be 16 AWG (US) / 1.5mm² (EU/Rest of World) as a minimum and data cabling should be CAT 6 up to 328FT / 100M. For distances greater than this, fiber cabling would be required up to a distance of 6.2miles / 10Km.

The Vector Control Module can be mounted in the power supply or remotely in the server room.

Centrifuge Camera Control

Installation Requirements:

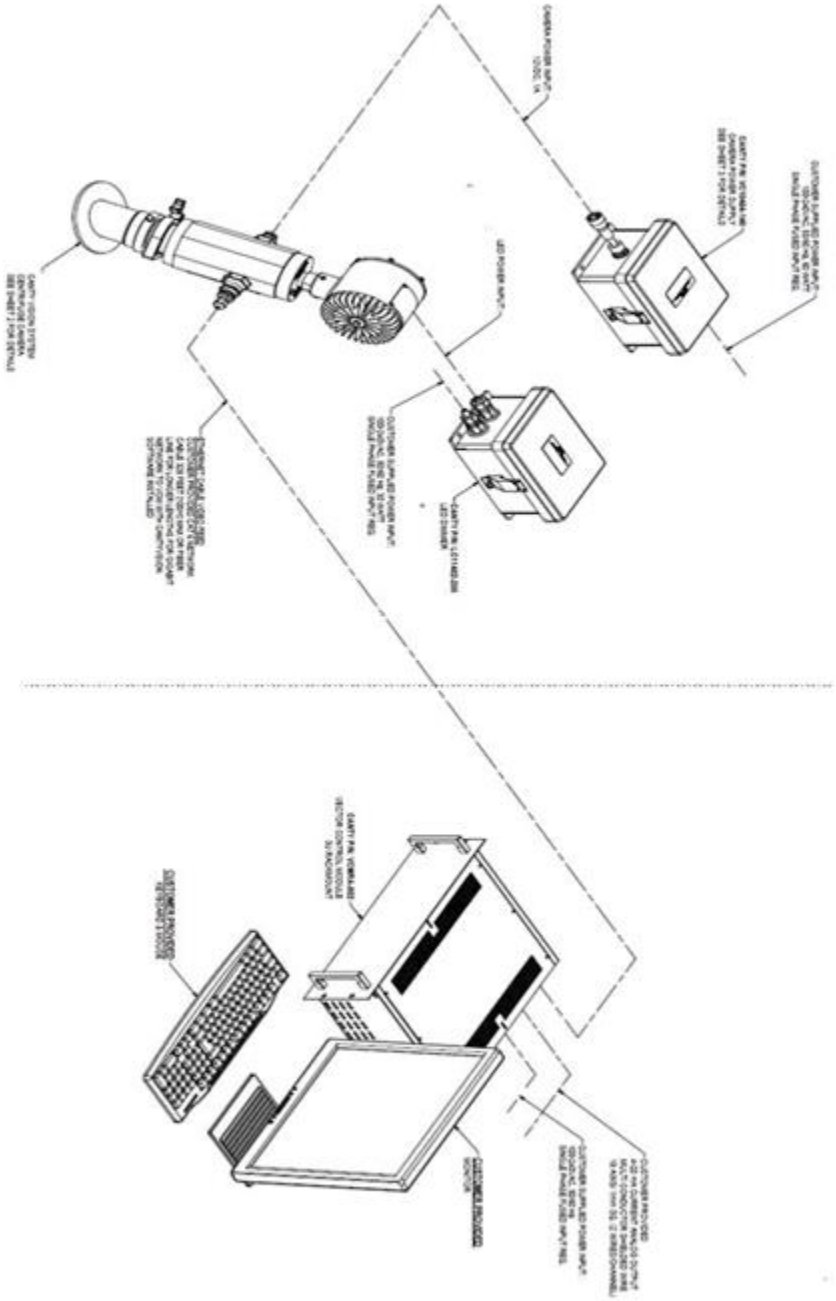


Fig 2.

Centrifuge Camera Control

Camera mounting:

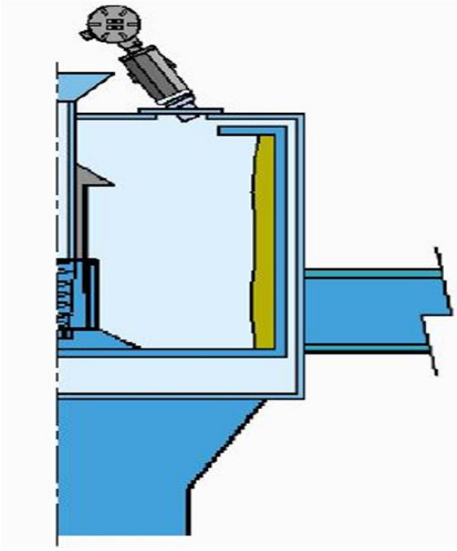


Fig 3

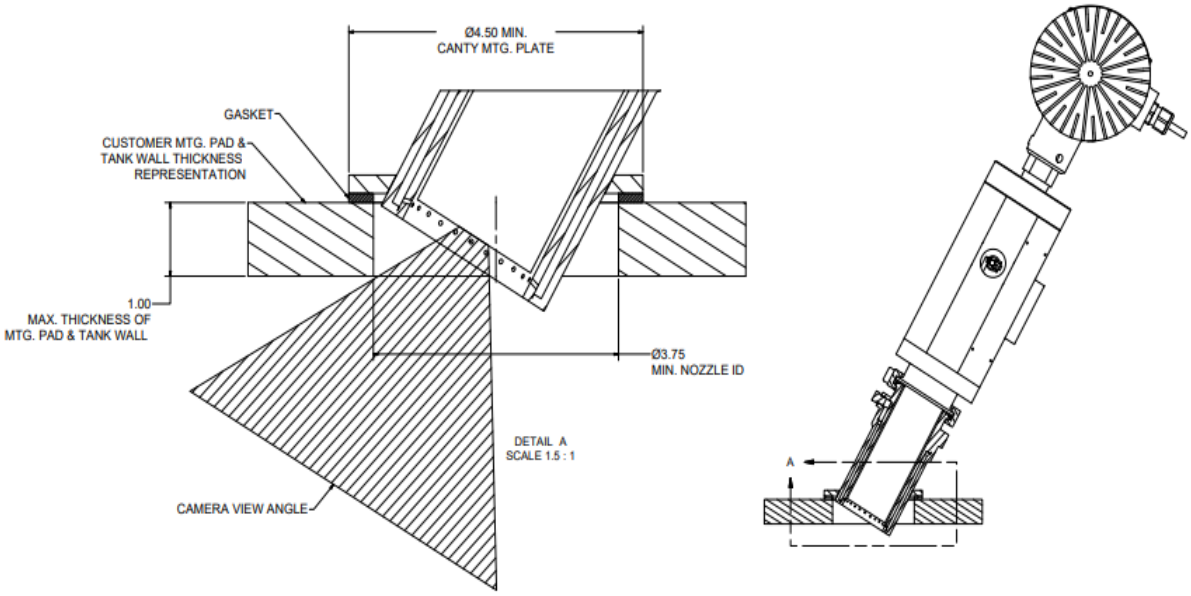


Fig 4.

Centrifuge Camera Control

Fig 5.

Centrifuge Camera Control

Cleaning:

The CANTY system comes with a built in Jet Spray Ring in order to maintain a clear, unobstructed view in to the process. Cleaning frequency is usually determined at time of start-up as it can be process dependent (see appendix C).

Any low viscosity fluid compatible with your process @ 28-30 PSI above Internal pressure, may be used for cleaning.

For short batches a brief jet of wash fluid maybe required at the initial filling, where as in longer run batches, where processes have multiple filling cycles, a brief jet of wash fluid for 1-3 seconds maybe required periodically.

The integrated cleaning is an integral part of the CANTY centrifuge control which allows for the vision-based system to accurately carry out its non-contact measurements. This ensures that the CANTY system does not suffer from the same inaccuracies during filling that systems such as contact measurements (Fill arm; Causes splashing of the product, product lost to drain) or other non-contact measurements (Ultrasonic; Error conditions & Fluctuations of up to 10% during filling).

Centrifuge Camera Control

Vector Control Module with Embedded CANTY Vision Centrifuge Control Software

Fig 6.

The Vector Control Module (VCM) is a small embedded processor that has CANTYVISION™ software pre-installed. It is designed to keep project costs low and to also eliminate the need for a computer. It is capable of supporting up to 6 camera systems and running analysis on all systems simultaneously.

The system sends out the control signals via OPC or 4-20mA or TCP/IP Modbus to a PLC or DCS for complete control.

The VCM comes with the ability to have full administration-controlled passwords and permissions. This compact design and cost-effective system are easily setup and has a customizable screen. Customers will need to provide a monitor or use an existing one. Wireless options are available and access to technical support can be obtained with an Internet connection.

Using Embedded CANTYVISION™ SMART CENTRIFUGE software (pre-installed on the Vector Control Module), it is possible to monitor your centrifuge for cake thickness and cake wetness in your batch centrifuge or wet line detection on your continuous centrifuge.

Centrifuge Camera Control

Software Measurements:

Cake Thickness:

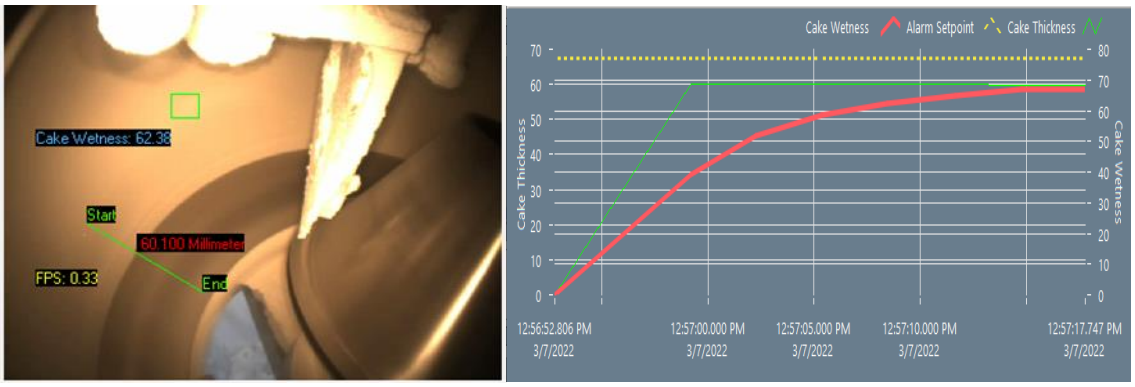


Fig 7.

The CANTYVision™ CENTRIFUGE software, cake thickness can be configured to track the edge between the centrifuge base and product cake. This is a continuous real time measurement that can be sent to the control system to provide a cake thickness measurement.

Measurement can be output in real world values (INCHES, MM, CM) or the pixel position where the interface of the cake and the basket meet.

In continuous centrifuges this can be used to track the 'Wet line' where the product transitions from a wet to dry cake.

The benefit to the cake thickness measurement carried out by the CANTY system is not just the accuracy or the repeatability of the measurement but the fact it is a non-contact measurement that does not cause splashing around the centrifuge that may result in product loss to drain or off-color spots (where product splashed all around the centrifuge drips on to the cake after washing) like the paddle-based method.

Also it does not suffer from errors and inaccuracies in the filling which are ever present in the Ultrasonic systems. The other main issues with the ultrasonic systems are the expensive maintenance and, in some cases, may not even be supported by the manufacturer and are discontinued.

Centrifuge Camera Control

De-Watering/Wash optimization:

Detection of outstanding liquid on the surface of the cake during the wash cycles can be indicative of less-than-optimal filtration in the centrifuge. This can be caused by a number of issues such as too high of feed rate on the wash fluid or upsets in the crystallization process itself (too many fines/large crystals).

The Cake Wetness measurement carried out by the CANTY system allows for optimization of the wash cycle through detection of this surface liquid. Once the liquid has filtered through the cake the CANTY VCM will send the signal to the control system (Via 4-20mA, OPC US, TCP/IP Modbus or Profibus) to start the next wash cycle or to confirm that the wash process is complete and the product can be discharged from the centrifuge.

The CANTY system ensures a quality, repeatable product from batch to batch, whilst ensuring that it is produced in the most cost-efficient manner possible. This can be achieved through reduction of the amount of wash fluid, reduction in the wash time, reduction in the spinning time, optimized filling cycles and over all cycle times

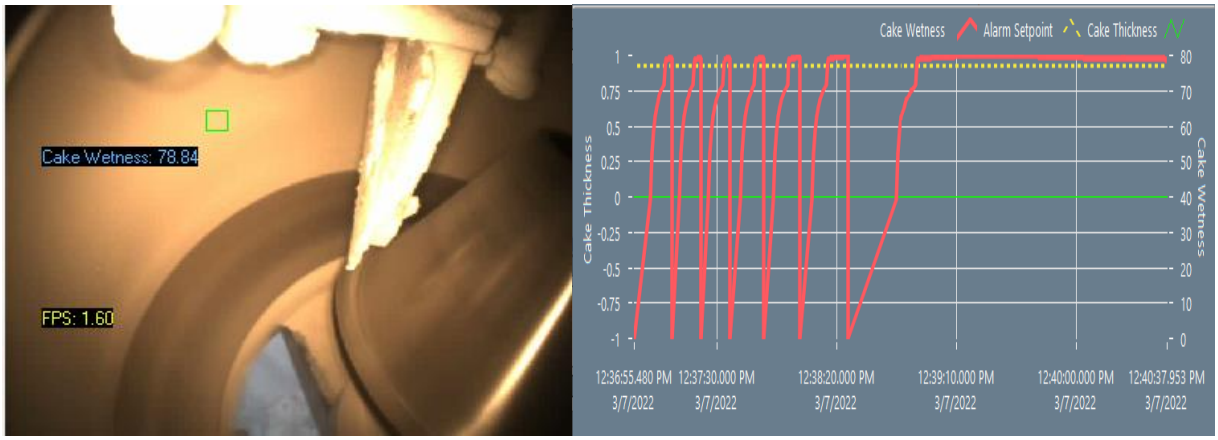


Fig 8.

Centrifuge Camera Control

Basket imbalance:

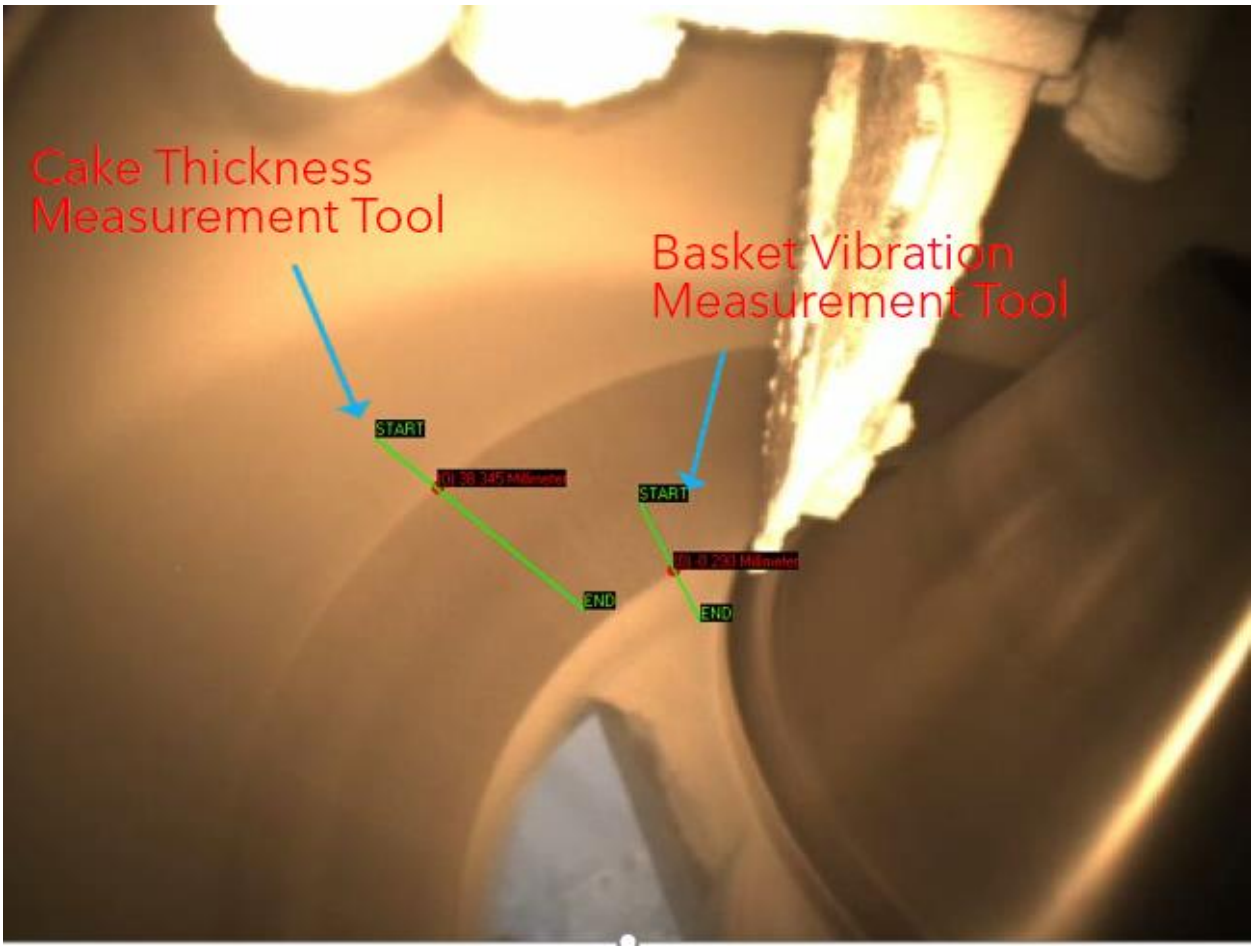


Fig 9.

The CANTYVision software can also be calibrate to detect basket imbalance in the centrifuge. In the software an edge detection measurement can be drawn on the edge if the basket. The tool is then centered on this point. Significant movement from the '0' point would signify imbalance/vibration in the basket which is most likely caused by uneven loading.

Centrifuge Camera Control

Technology Comparison:

	Cake thickness	Cake Wetness	Repeatability	Accurate	Cleaning	Maintenance
CANTY Camera	Yes	Yes	Yes Extremely repeatable	Yes	Yes Built in	Virtually maintenance Free
Paddle System	Yes	No	No Causes splashing of the product resulting in off color spots.	No Causes splashing of the product resulting in off color spots.	No	Spring loaded hydraulic system or pneumatic system maintenance. Erosion of paddle
Ultrasonic	Yes	No	No Up to 10% level inaccuracy during filling	No Up to 10% level inaccuracy during filling	No	No longer supported by some manufacturers. Susceptible to build up/condensation. Possible corrosion as a result.

Centrifuge Camera Control

Case Study:

As part of a case study CANTY went head-to-head with an Ultrasonic system at a client's site to measure the thickness of the cake. The requirements were for the client to optimize their measurement and to have a system that provided a stable and repeatable measurement from batch to batch.

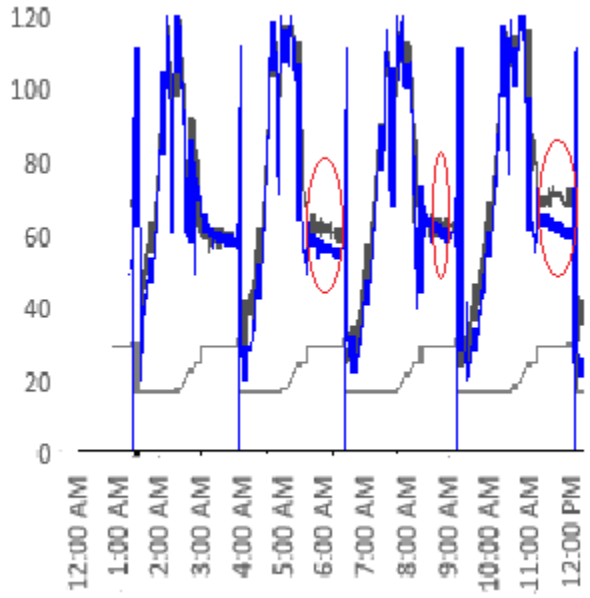


Fig 10

Result:

The table above shows the CANTY camera in 'BLUE' and the ultrasonic system highlighted in 'Black'. Highlighted in the 'RED' circles are the filling phase for each run.

What we learn from the above table is that the Ultrasonic system tended to vary batch to batch. The variance could be anywhere between 5-10% in the accuracy, while the CANTY system remained stable and accurate from batch to batch.

The inaccuracies in the Ultrasonic system tended to be in the filling stage each time which is the crucial stage in which the level accuracy is required.

Centrifuge Camera Control

Conclusion:

In conclusion there is only one system on the market that truly optimizes the clients Centrifuge and this is the CANTY system. Time and again the CANTY system has provided massive cost savings at each client's site, with payback on the system being a matter of weeks.

When compared with alternative technologies the CANTY system has stood head and shoulders above all others with the accuracy and repeatability of their level, cake wetness detection and basket imbalance detection.

The system is virtually maintenance free and with the integration of the spray ring cleaning, the system requires no operator intervention to ensure the system runs correctly.

All these items combined ensures that the CANTY system should not only be installed on all centrifuges as a matter of urgency to ensure the highest quality product, but is the most important and powerful piece of analytical technology currently on the market that can be added to a centrifuge.

Centrifuge Camera Control

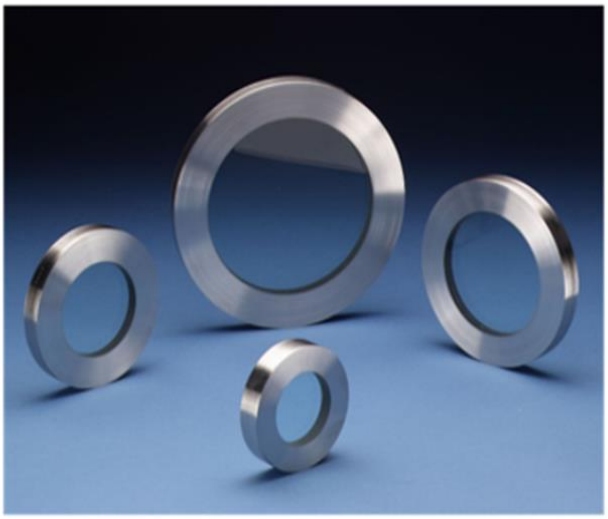
Appendix A: Fused Glass

Fusion of glass and metal is a unique process whereby a one-piece construction component is produced. BoroPlus™ glass in its molten form is poured into the center of a metallic ring where it flows to the metal wall. At that point due to the chemical make-up of BoroPlus™ glass, the glass fuses to the metal.

Canty Fuseview Sight Glasses

All Canty Fuseviews feature a unique fusion of glass to metal, which far exceeds all conventional tempered glass windows in safety and performance

The BoroPlus glass and metallic outer ring fuse to become one component



As the unit is then cooled, the metal, having a higher coefficient of expansion than the glass, contracts onto the solidifying glass putting it under uniform radial compression. This The fused glass and metal surface can then be finely polished to produce a smooth even surface with no crevices.
The importance of the fused glass relates to the ability of the unit to stay as clean as possible which is clearly critical for a vision-based system. Due to the fact that there are no crevices or spaces between the fused glass and metal, there is nowhere for product to begin to build up. Non-fused glass and metal systems would not have a smooth transition from glass to metal, and it is in this step area that product (liquid / solids) would inevitably build up. The fused glass also allows higher pressure operation of the systems (up to 600 Bar possible) due to the fact there is no danger of the glass and metal separating into 2 separate components.

Centrifuge Camera Control

Appendix C: Jet Spray Ring

Patented Spray Ring Technology – Maintaining the view if particulate eventually gathers onto the lens is critical for continuing system function. The CANTY system is fitted with a spray ring which is able to blast clean the viewing and not interfere with the process. This development is a critical building block in the larger design. Not only is the viewing lens resistant to fouling, but the spray ring, using any gas compatible with the process, to keep it in operating order indefinitely

A jet spray ring is included in the system as a means of flushing the glass clean in the event that particulate does become lodged on the glass.

Centrifuge Camera Control

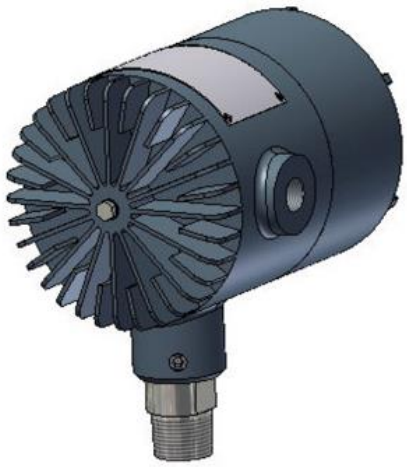
Appendix D: LED Light

The CANTY high intensity LED light has been designed for a working life of 50000 hours of continuous use. The initial concept was developed as part of CANTY's Oil & Gas sub-sea development for their analyzer.

This solid-state lighting development was then incorporated across the product ranges to give a more uniform, dispersed light in order to provide better illumination for the camera systems.

Certain models such as the lighting used in the centrifuge camera are dimmable models to allow for light optimization of the image. Based on the size of the centrifuge basket and objects in close proximity to the camera front cap, reflection of light could be considered an issue, however with the integration of the dimmable LED this is no longer a concern.

The dimming of the light can be controlled from the CANTY Vision Centrifuge Control Software.



Anodized Aluminum
Explosion Proof/Flame Proof

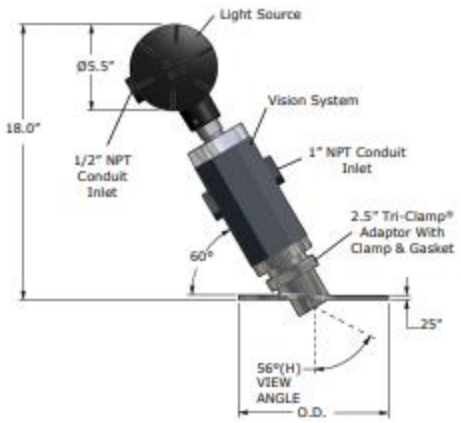
316L Stainless Steel
IP66 Weatherproof NEMA 4X

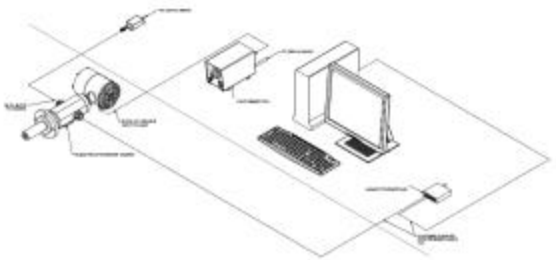
Centrifuge Camera Control

Appendix E: Ordering

Centrifuge Camera Control

MOUNTING CONNECTIONS





Notes:
1. Camera and Light PSUs are not shown but must be located within 100 feet of the unit. The Camera Power Supply enclosure has the same environmental rating as the system.
2. CantyVisionClient™ Software is included but the customer provides the PC which is not included with the system. Reference Document TA10592-1 for computer requirements.

Ordering Information

HOW TO ORDER: Select the appropriate symbols and build a part number :

EXAMPLE: **CBB1100-6OD**

WETTED MATERIAL	
B -	316 Stainless Steel
D -	Hastelloy® C276

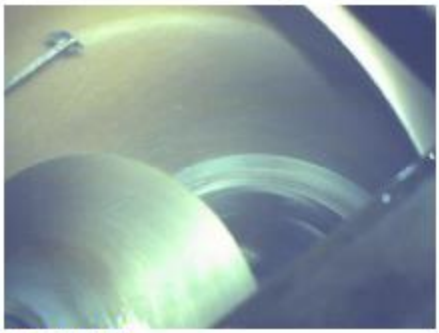
CAMERA & LIGHT OPTIONS	
1 -	1SRDO (Toroidal light with dimmer)
2 -	1SDO (Standard light with dimmer)
3 -	Remote flex bundle lighting (72" TYP.)

ENVIRONMENTAL RATING	
1 -	EXPLOSION PROOF (120V)
2 -	FLAME PROOF (240V)
3 -	NEMA 4 WEATHERPROOF (120V)
4 -	IP 66 (240V)

INTERNAL SEAL MATERIAL	
6OD -	Specify Outer Diameter in inches Ie. 6"

SPRAYTUBE	
0 -	NONE
1 -	SPRAY TUBE
2 -	SPRAY RING

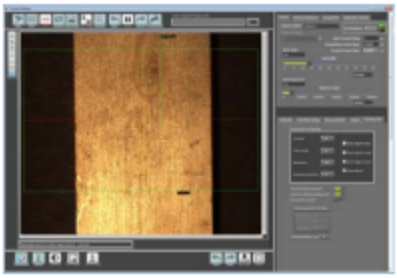
VIDEO OUTPUT	
0 -	EIA U.S. B&W FORMAT
1 -	CCIR EURO B&W FORMAT
2 -	NTSC U.S. COLOR FORMAT
3 -	PAL EURO COLOUR FORMAT
4 -	ETHERNET



CANTY Buffalo, NY USA Ph: (716) 625 4227 Dublin, Ireland Ph: + 353 (01) 882 9621 Phuket, Thailand Ph: + 66 (83) 968 9548

Centrifuge Camera Control

TECHNICAL INFORMATION



Visual Verification On Screen • Easy Command Prompt Module • Graphical & Numerical Analysis Output • Customizable Operator Screen

RACK MOUNT MODELS ◊

PART NUMBER	CAMERAS SUPPORTED †	4-20 Ma OUTPUT, 8 CHANNEL	DIGITAL BREAKOUT BOARD
VCMRA-001	6 POEC or 6 NPOEC	✓	✓
VCMRA-002	3 POEC or 4 NPOEC	✓	✓
VCMRN-004	6 POEC or 6 NPOEC		
VCMRN-005	3 POEC or 4 NPOEC		

All RACK MOUNT VCM's include: 1 LAN Connection.

EXTREME PERFORMANCE

PART NUMBER	CAMERAS SUPPORTED †	4-20 Ma OUTPUT, 8 CHANNEL	DIGITAL BREAKOUT BOARD
VCMEA-001	UP TO 6 WITH POE	✓	✓
VCMEN-004	UP TO 6 WITH POE		

All EXTREME PERFORMANCE VCM's include a total of ten (10) Ethernet Ports (8 POE, 2 NPOE)

VCM LTE - NON-EXPANDABLE

PART NUMBER	CAMERAS SUPPORTED †	4-20 Ma OUTPUT, DIN RAIL MOUNTED MODULE
VCMLA-003	2 POEC or 2 NPOEC	✓ 4 CHANNEL
VCMLA-007	3 POEC or 3 NPOEC	✓ 6 CHANNEL
VCMLN-006	3 POEC or 3 NPOEC	

NOT APPLICABLE FOR PARTICLE SIZING APPLICATIONS.

ADD-ON COMPONENTS

PART NUMBER	FEATURES
VCMAK-001	MONITOR, KEYBOARD & MOUSE KIT
NET1500-10	OPC-UA LICENSE

DISPLAY CONNECTIVITY

MODEL	HDMI	DISPLAY PORT	DVI
EXTREME PERFORMANCE		1	1
RACK MOUNT	1	1	1
VCM LTE		1	

POEC = Power Over Ethernet Camera. NPOEC = Non-power Over Ethernet Camera.
Please note: All cameras must be configured such that there is a direct connection between the camera and the VCM. All cameras cannot be ran through additional hardware such as a switch or hub. VCM's are compatible with Ethernet cables; for longer distances Canty has available for purchase fiber converters that are rated for a variety of environmental classifications. For more information on OPC see document TA10560-1.
Extreme Performance Models: Cellular 4G Internet Option Available. Consult factory for details.
◊ RACK MOUNT models are designed for non-industrial environments with air conditioning and clean, filtered air.
† Number of cameras supported depends on application. Consult factory for more information.
**Assumes cameras are ordered with the VCM. Start up services may be necessary for applications outside of view-only.*
***Depends on model selected. Consult factory for details.*

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Document P/N: TA11500-1034 Rev 15

Centrifuge Camera Control

Reference Links:

https://www.jmcanty.com/

https://www.jmcanty.com/product/

https://www.jmcanty.com/product/centrifuge-camera-control/

https://www.jmcanty.com/wp-content/uploads/2015/05/TA9618-1-CENTRIFUGE-CAMERA-CONTROL.pdf

https://www.jmcanty.com/product/jet-spray-ring-2/

https://www.jmcanty.com/wp-content/uploads/2015/04/TA4727-1-JET-SPRAY-RING.pdf

https://www.jmcanty.com/product/crystalscope-pat-particle-sizing-system/

https://www.jmcanty.com/product/canty-brochure/