

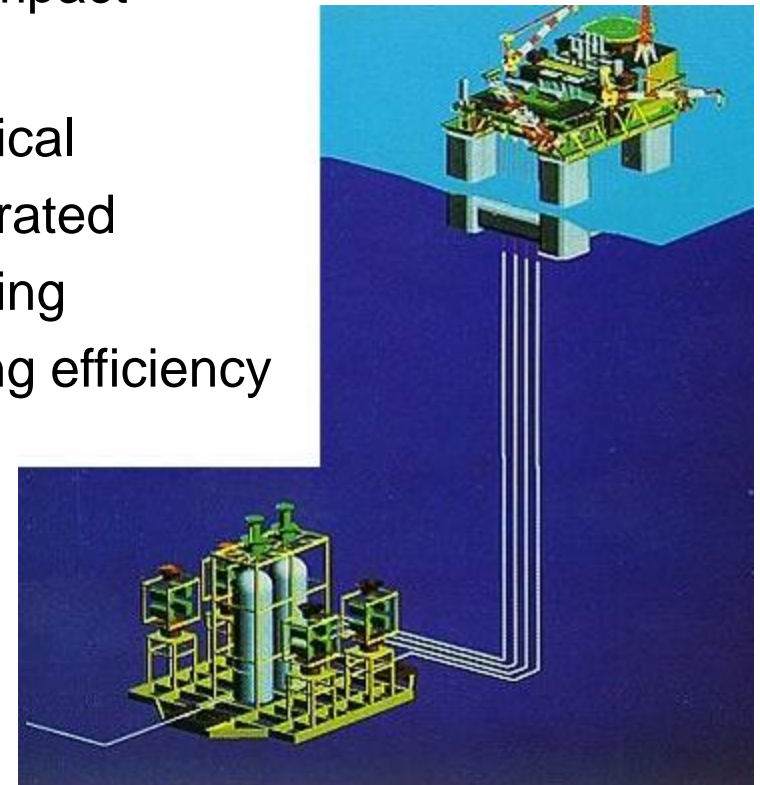
JM Canty International

Dynamic Imaging Based
Oil in Water Particle Analysis
&
Subsea Marinisation Challenges

1. Introduction
2. Explanation of How the Topside Systems Work
 - Hardware
 - Software
2. Advantages and Reliability
3. Subsea Marinisation of Technology
 - Challenges
 - Proposed Solutions

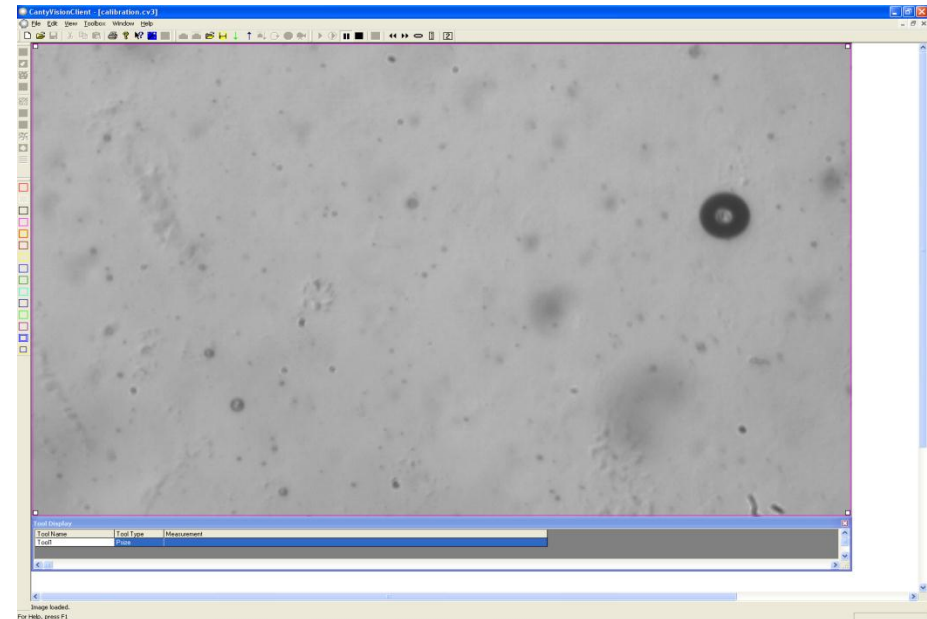
Introduction

- Subsea oil and water separation is becoming more and more relevant as the major oil operators put an emphasis on process efficiency, and the associated cost savings, and environmental impact
- Subsea separation allows for a more economical operation as the produced water can be separated and re-injected below the surface without having to come topside, reducing costs and increasing efficiency
- It remains critical to monitor the subsea produced water stream both from an environmental, and process performance point of view



JM Canty's Vision Based Technique

- JM Canty's vision based technique combines the latest CCD Ethernet camera technology, Canty's trademark fused glass and lighting technology, and Cantyvision Client software to provide real time measurement of oil in water
- Various topside systems depending on application retrieve live images from the process
 - Tru-Flow
 - Inflow
 - Particle Probe



Vision Based Particle Analysis Basic Principle

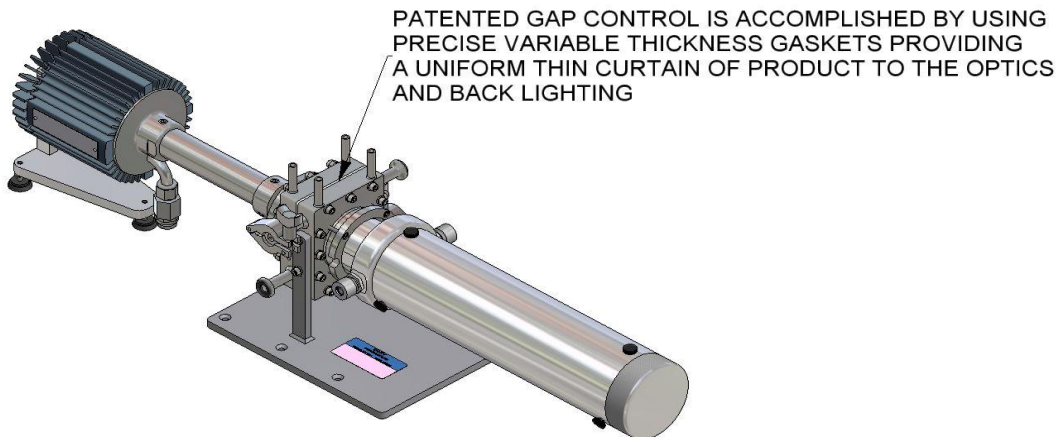
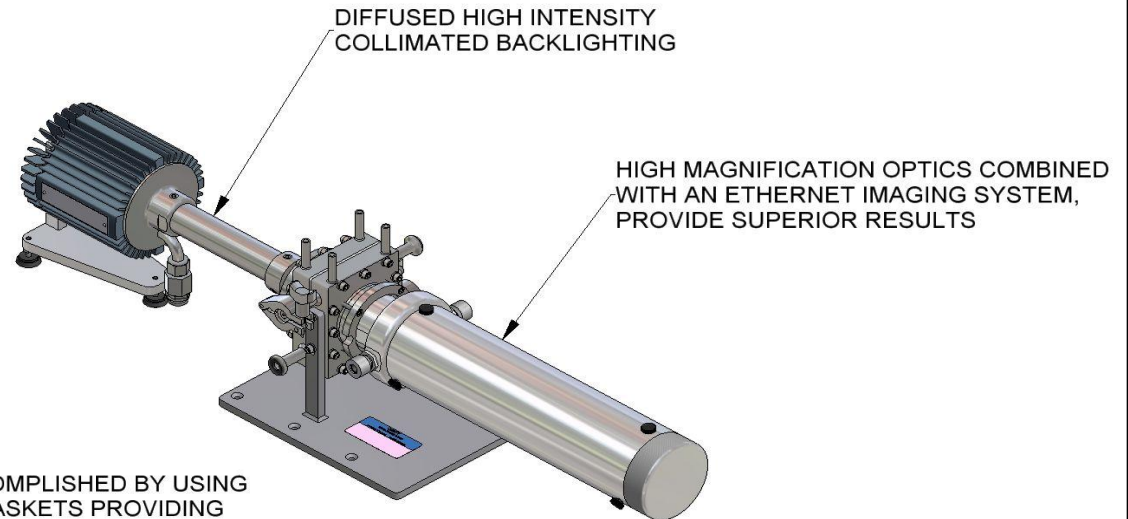
JM Canty's vision based technique works on the basic principle of presenting the produced water stream between a high intensity light source, and microscopic camera

The captured images are then sent to Cantyvision Client Software for analysis, where they are measured under a number of different parameters (particulate measured by major axis, minor axis, area, perimeter, circularity, aspect ratio....)

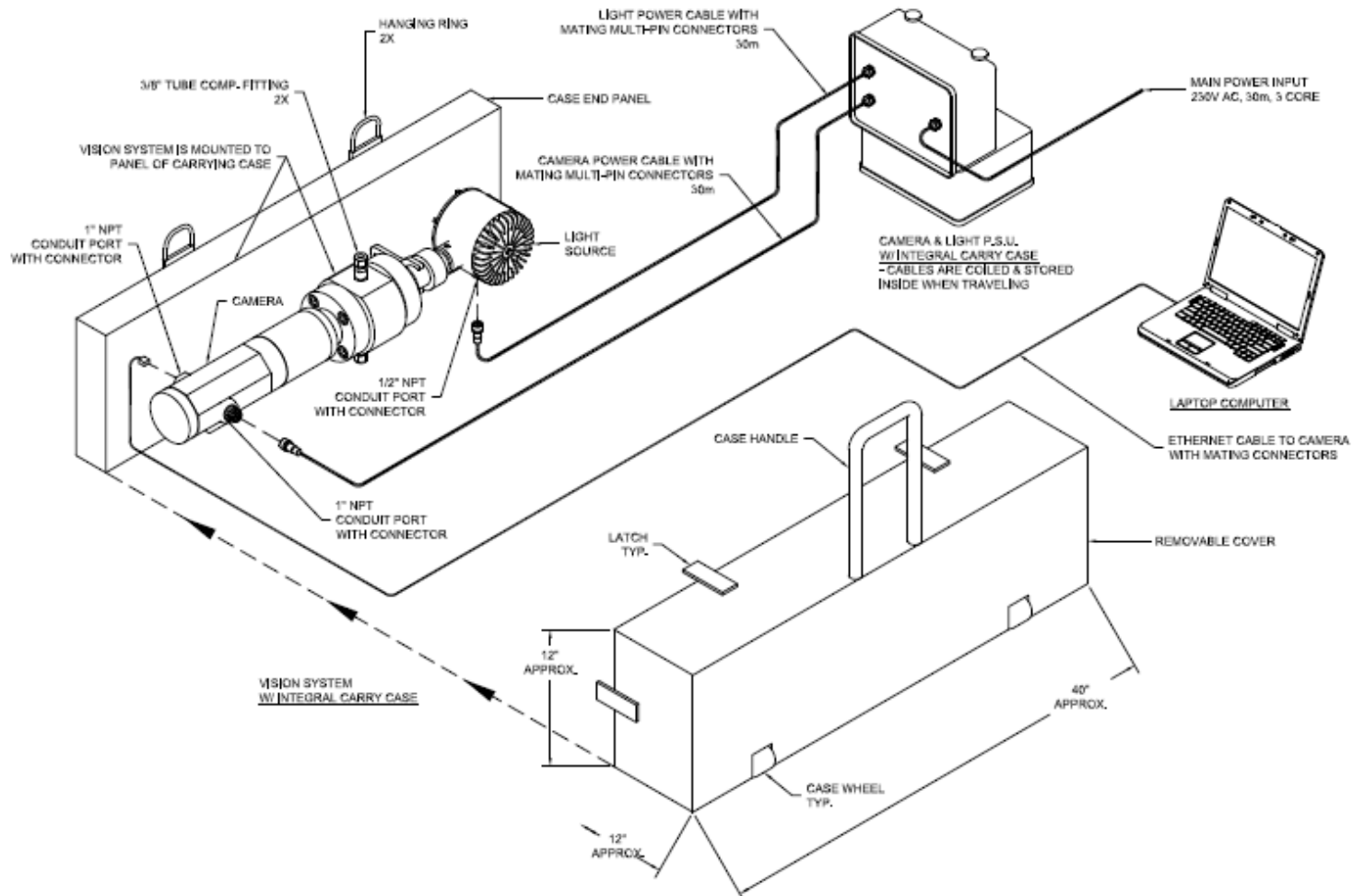
The same principle is applied across all of the systems, so what works on our lab system, will work on any of the other systems

Tru-Flow Portable / Lab System

- Lighting
- Camera
- Flow Gap

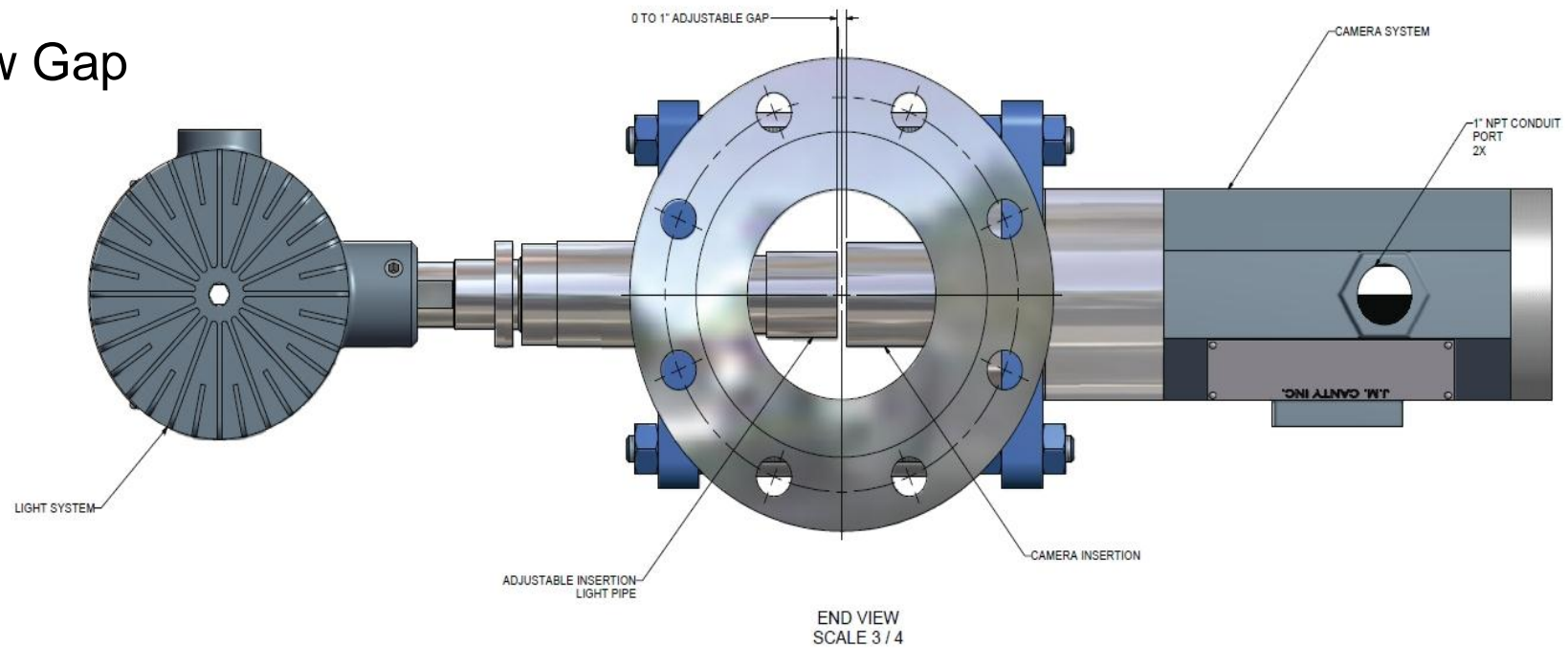


Tru-Flow Portable / Lab System



The Inflow (pipelines up to 10")

- Lighting
- Camera
- Flow Gap

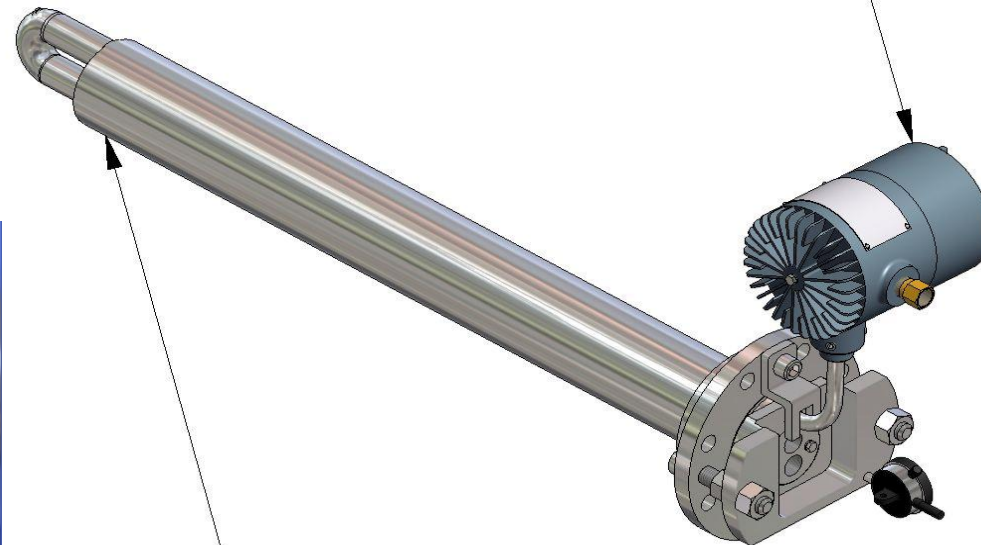


Particle Probe (pipelines above 10")

- Lighting
- Camera
- Flow Gap



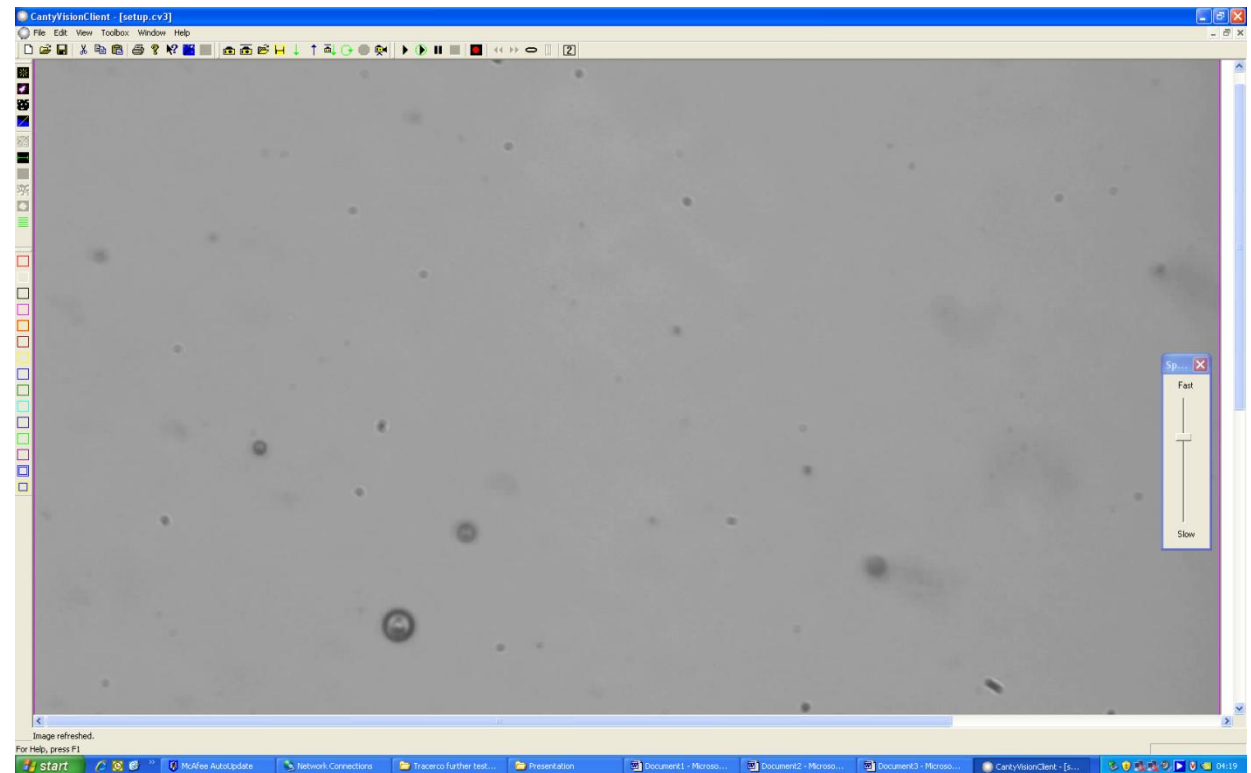
HIGH INTENSITY LIGHT SOURCE



HIGH RESOLUTION IMAGING SYSTEM

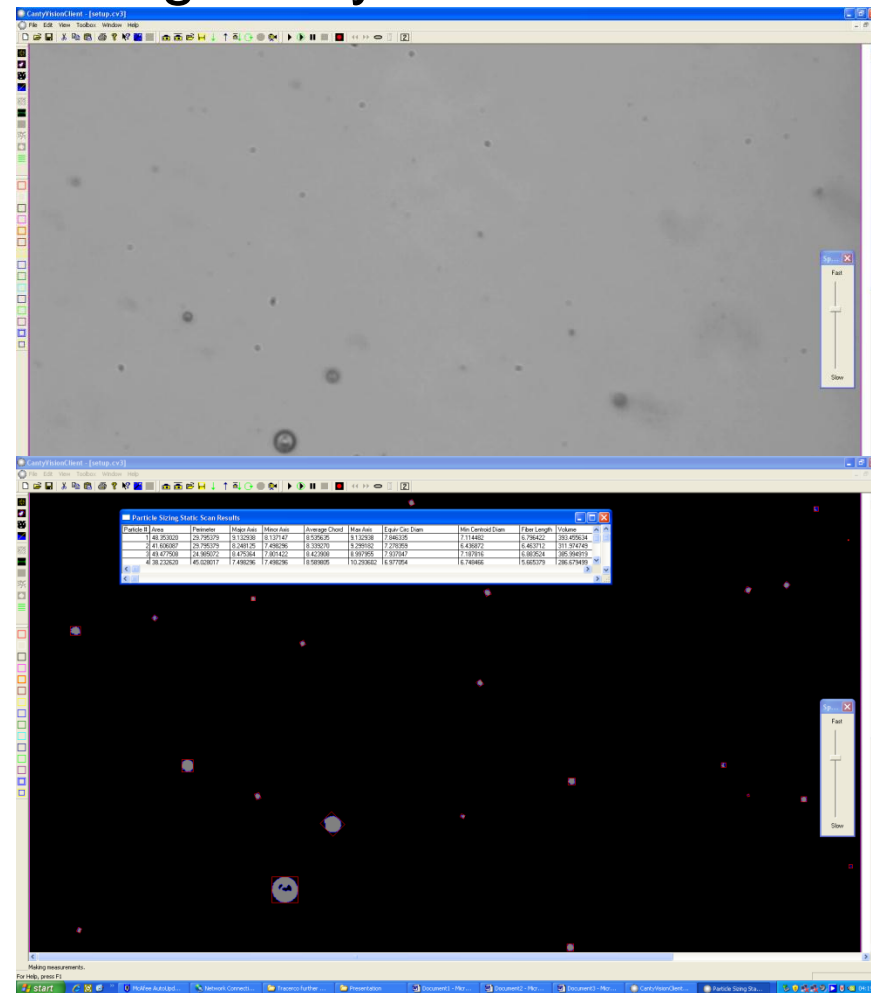
Image Analysis with Canty Vision Client

- Utilizing the latest Gigabit Ethernet camera technology available, users can see particles all the way down to 1 micron.
- The images retrieved from each of the 3 particles sizing systems are analysed in real time by Cantyvision Client Software

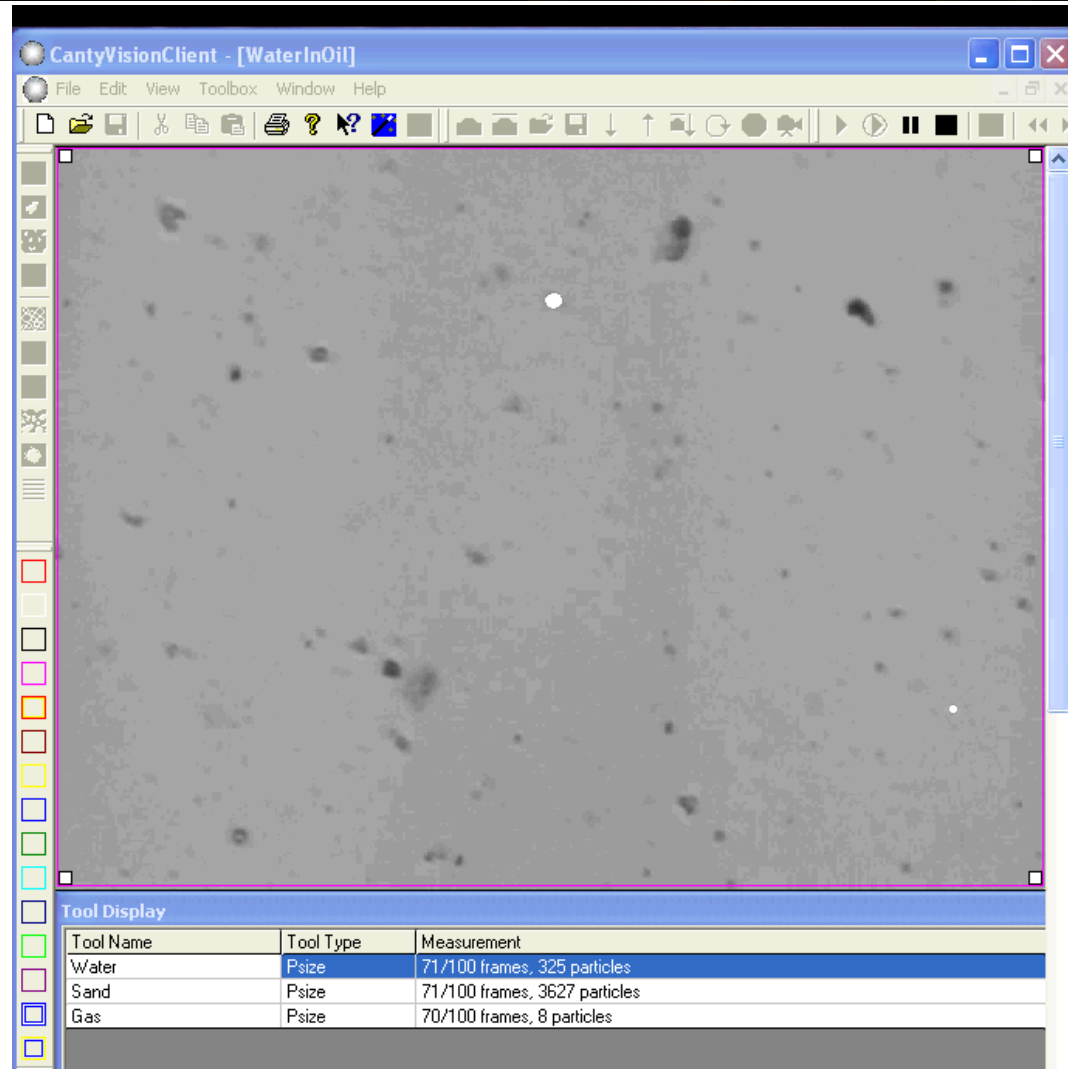


Oil in Water Detection using Canty Vision Client

- Each individual particle within the image is digitally mapped and analyzed.
- Visual verification of particles truly sets Canty apart from all other systems

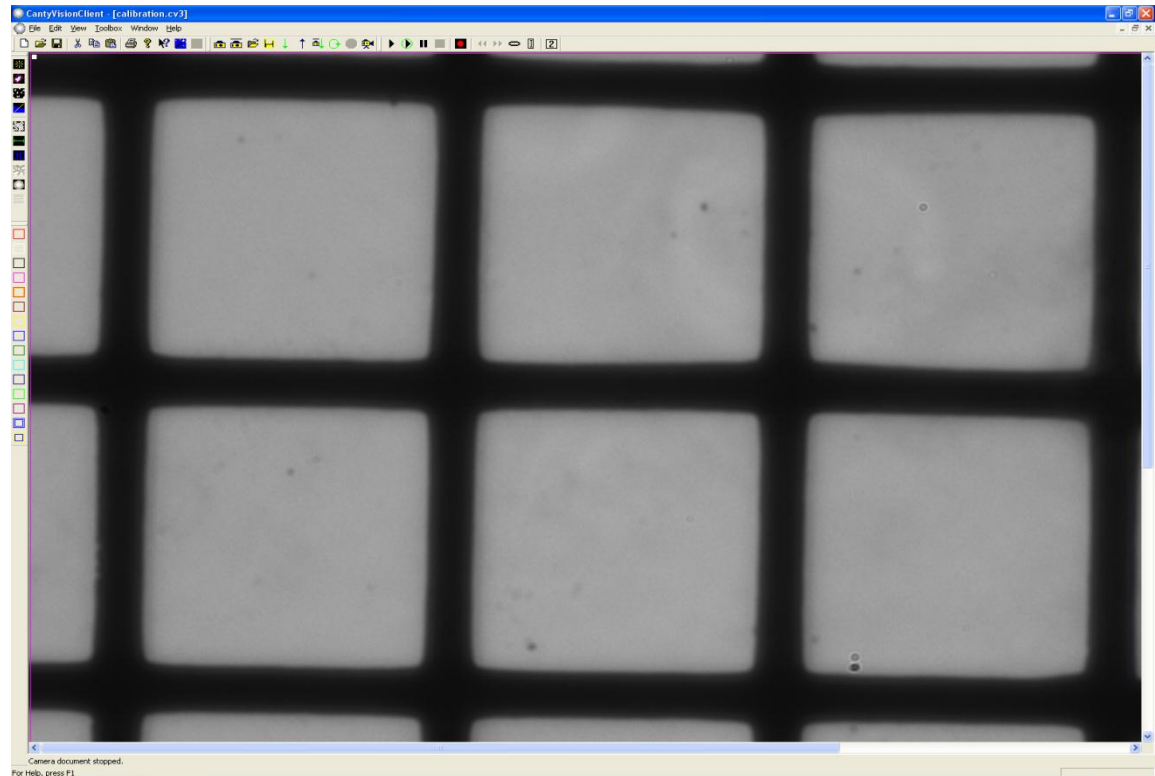


- There is no guessing with a Canty Particle Sizing System
- Particle filters enable the software to distinguish between oil, air and other contaminants that may be present



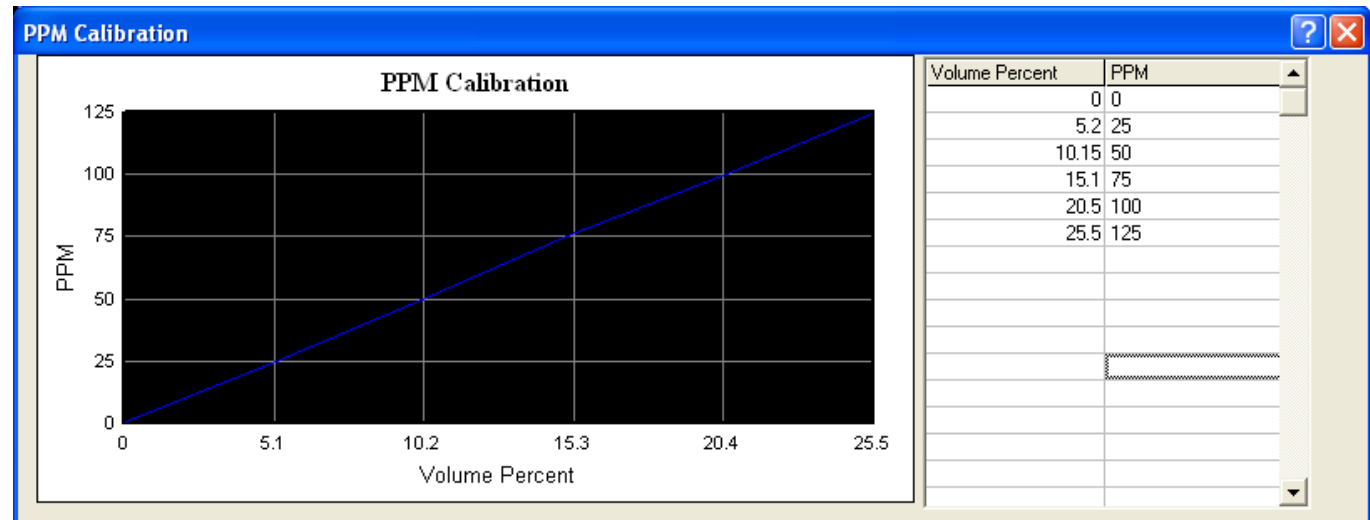
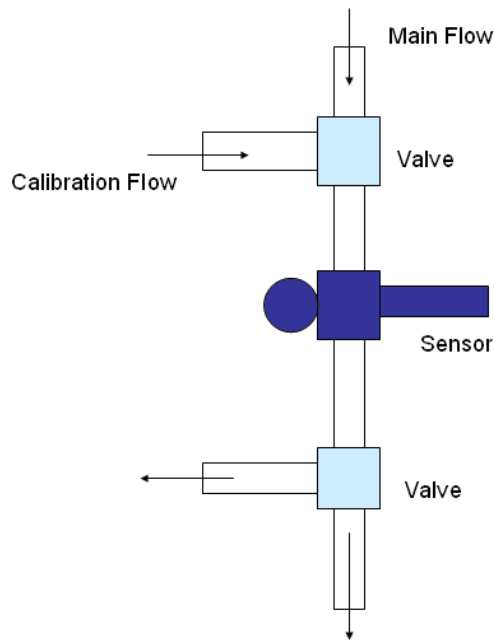
System Setup / Calibration – Particle Size

- The system is visually calibrated and programmed to correlate each pixel into a real world measurement value
- A known size reference or a simple reticule, such as the one shown here, will be correlated providing an accurate scale for particle size analysis.



System Setup / Calibration – Particle Concentration

- Run a sample of known concentration through the unit
- Scan the sample through the unit using the Cantyvision software
- Calibrate the output PPM value using the total volume percent value, and the known PPM value in the Cantyvision software.

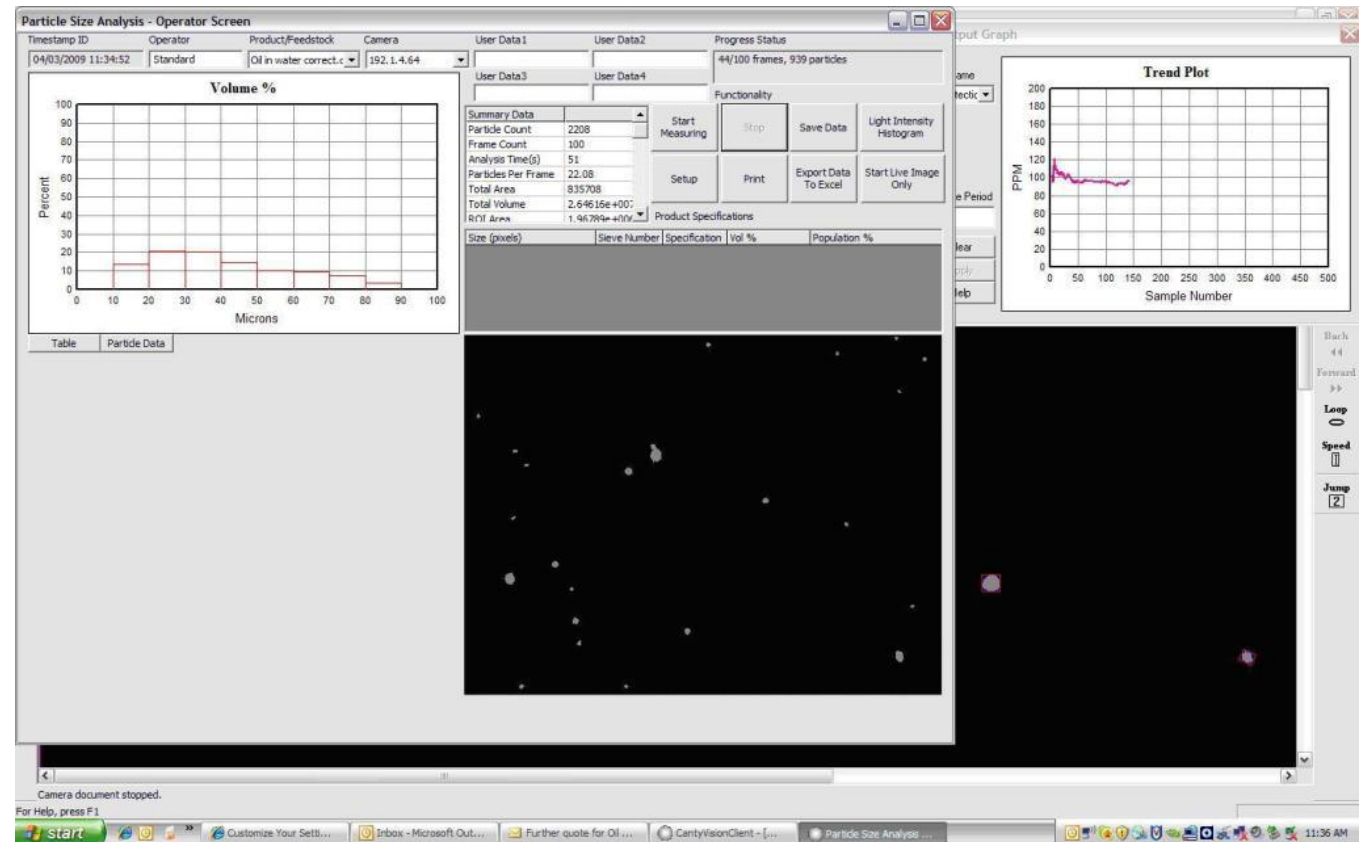


Cantytvision Client Operator Screen

Puts information and configuration in an easy to read format for ease of operator control

Graphical outputs of particle size distribution and concentration

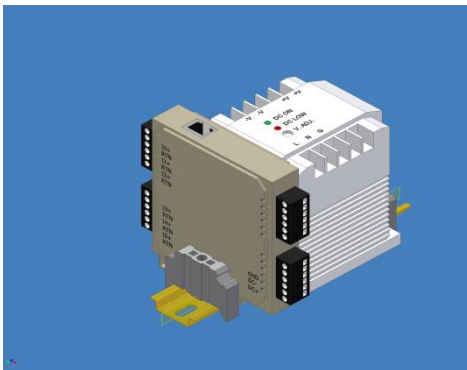
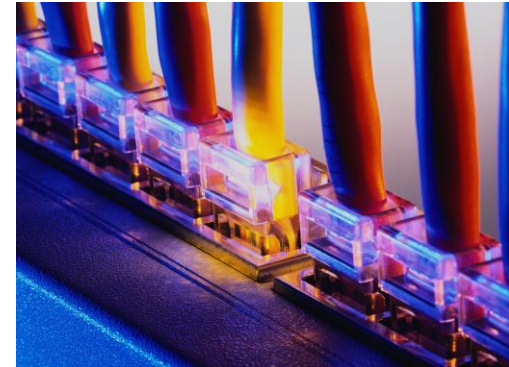
Configurable calculation for client specific products



Output Options

OPC - Open Connectivity for Process Control

Canty provides both an OPC client and server to connect CANTYVISIONCLIENT™ Software to our customers' digital control systems. This comes standard with CANTYVISIONCLIENT™!



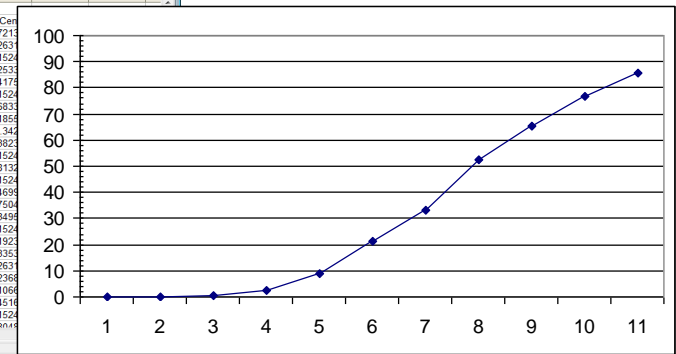
4-20mA Output - Ethernet Output Module

Canty also offers an Ethernet 4-20mA current loop CANTYVISIONCLIENT™ across a network, and convert it to a 4-20mA current loop signal. This is a separate DIN rail mounted module that can be purchased as an accessory.

MS Excel Output

PPM, PPB, major diameter, minor diameter, area and perimeter are measured and logged into an Excel spreadsheet for each particle detected.

| Time (h:m:s) | Area (mm²) | Perimeter (μ) | Major Axis | Minor Axis | Average Ch | Max Axis (t) | Equivalent t (Min Cent) |
|--------------|------------|---------------|------------|------------|------------|--------------|-------------------------|
| 12:40:10 | 268 | 0.772072 | 3.78371 | 1.21738 | 0.830512 | 1.10109 | 1.28433 |
| 12:40:10 | 314 | 0.10223 | 1.33908 | 0.467642 | 0.290329 | 0.393371 | 0.472011 |
| 12:40:10 | 374 | 0.0002323 | 0.0678699 | 0.0152428 | 0.0152428 | 0.0152428 | 0.0171996 |
| 12:40:10 | 374 | 0.0915427 | 1.225 | 0.458111 | 0.275337 | 0.376336 | 0.458331 |
| 12:40:10 | 374 | 0.152881 | 1.56725 | 0.484576 | 0.438554 | 0.471595 | 0.506096 |
| 12:40:10 | 374 | 0.0002323 | 0.0678699 | 0.0152428 | 0.0152428 | 0.0152428 | 0.0171996 |
| 12:40:10 | 426 | 0.985204 | 4.24005 | 1.47377 | 0.817534 | 1.22397 | 1.51257 |
| 12:40:10 | 426 | 0.0662174 | 1.09462 | 0.242807 | 0.322069 | 0.370762 | 0.290363 |
| 12:40:10 | 426 | 0.200743 | 2.00728 | 0.754318 | 0.390059 | 0.585139 | 0.754623 |
| 12:40:10 | 426 | 0.14289 | 1.56725 | 0.521821 | 0.414038 | 0.462972 | 0.524679 |
| 12:40:10 | 426 | 0.0002323 | 0.0678699 | 0.0152428 | 0.0152428 | 0.0152428 | 0.0171996 |
| 12:40:10 | 484 | 0.884525 | 4.17486 | 1.28374 | 1.01306 | 1.15118 | 1.28622 |
| 12:40:10 | 484 | 0.0002323 | 0.0678699 | 0.0152428 | 0.0152428 | 0.0152428 | 0.0171996 |
| 12:40:10 | 484 | 0.206907 | 1.9769 | 0.548739 | 0.503011 | 0.554042 | 0.595592 |
| 12:40:10 | 484 | 0.50664 | 2.78956 | 0.863495 | 0.765994 | 0.83399 | 0.889914 |
| 12:40:10 | 547 | 0.116171 | 1.35538 | 0.432931 | 0.37385 | 0.405791 | 0.444739 |
| 12:40:10 | 597 | 0.0230018 | 0.605689 | 0.213399 | 0.152428 | 0.187238 | 0.218607 |
| 12:40:10 | 597 | 0.12895 | 1.61614 | 0.620412 | 0.276437 | 0.485302 | 0.622257 |
| 12:40:10 | 597 | 0.197955 | 1.94209 | 0.735941 | 0.396354 | 0.581676 | 0.731498 |
| 12:40:10 | 648 | 0.0717936 | 1.09462 | 0.433794 | 0.260628 | 0.338152 | 0.433794 |
| 12:40:10 | 697 | 0.0534386 | 0.947938 | 0.300702 | 0.260658 | 0.280793 | 0.302843 |
| 12:40:10 | 697 | 0.0151022 | 0.475309 | 0.182913 | 0.106999 | 0.152897 | 0.18566 |
| 12:40:10 | 747 | 0.242332 | 2.02368 | 0.624953 | 0.518254 | 0.606653 | 0.683495 |
| 12:40:10 | 747 | 0.0002323 | 0.0678699 | 0.0152428 | 0.0152428 | 0.0152428 | 0.0171996 |
| 12:40:10 | 747 | 0.246076 | 2.04683 | 0.803766 | 0.453783 | 0.688466 | 0.80681 |

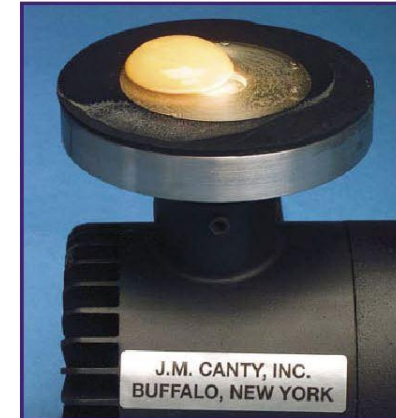


Advantages & Reliability

- Lighting
- Fused glass
- Atex and FM approved explosionproof (no purge)
- Inline (no sample line)
- Remote software support
- Output to Control 4-20ma and OPC

HOUR BAKE-ON TEST

- Lighting is critical for any vision based system
- Canty have been doing process lighting for well over 30 years – part of our core business
- Would not be so confident in our vision based technique without our lighting expertise
- Cold lighting – No temperature differential
- No synchronisation issues with camera shutter speed

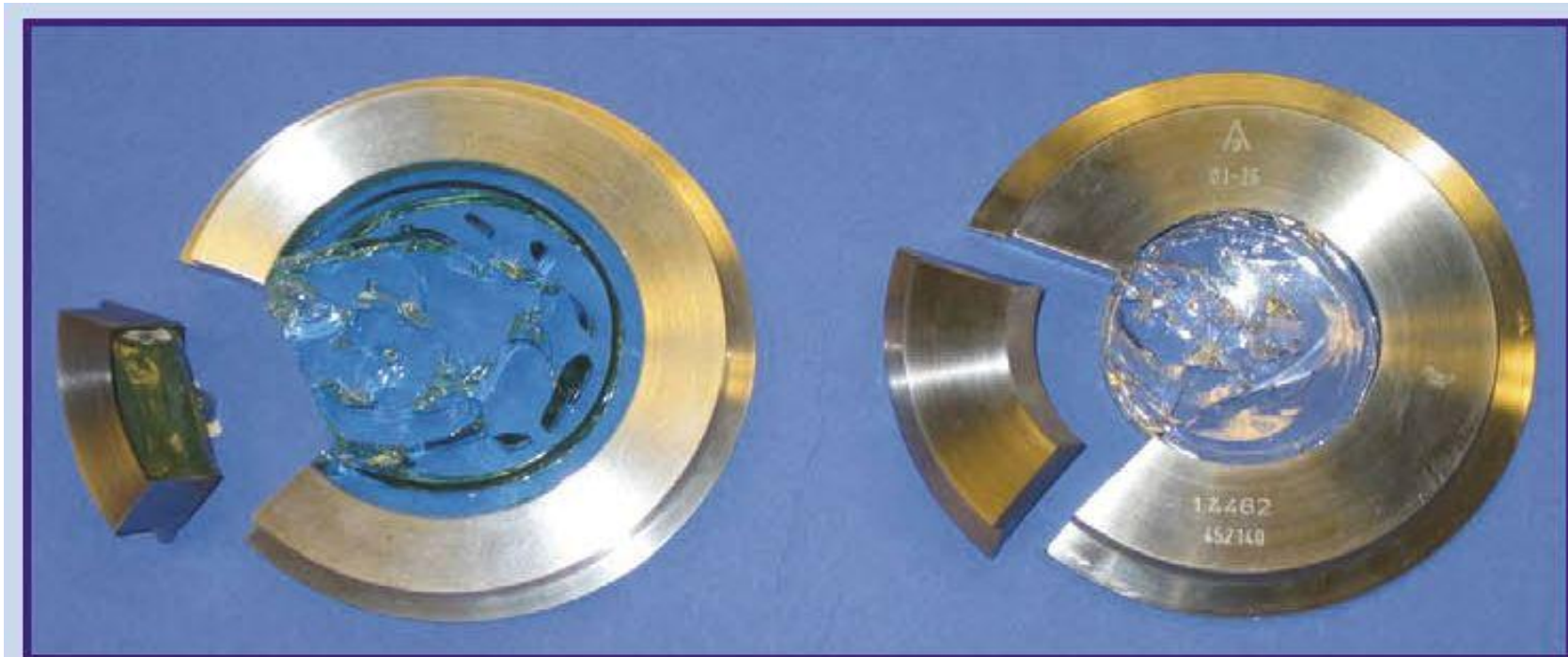


CANTY COLD LIGHT



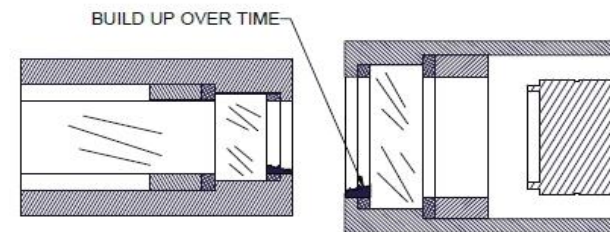
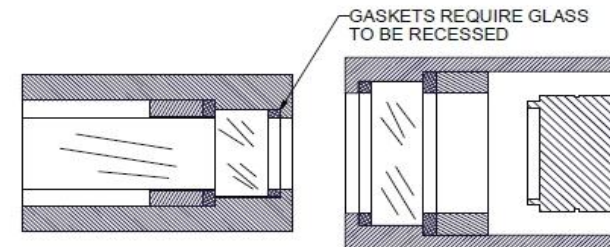
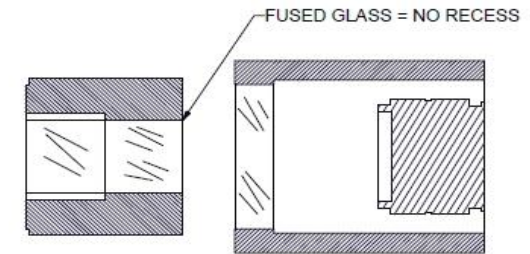
Canty's Fused Glass Technology

- Fusion of glass to metal – one piece construction
- Critical to our vision based technique
- Pressures to 10,000 PSI, Temp -450 to 800°F



Importance of fused glass technology

- Hermetically sealed one piece construction means no recesses or gaps where product can adhere to and start to build up
- Self cleaning unit



Relevant Topside Field Experience

- **Conoco Phillips**
- **Shell**
- **Original Red Eye Water Cut (fused glass hardware)**
- **Syncrude**
- **Exxon/Mobile**
- **BP**
- **Petro Canada**
- **Dow/DuPont/BASF/Borealis/National Starch ...(Polymers)**

Challenges of Sub Sea Marinisation of Technology

- Remote Connectivity of Instrument to Process Line
- Component Lifetime (maintenance)
- Electrical Design
- Data Handling
- Testing & Verification

Challenges of Sub Sea Marinisation of Technology

Remote Connectivity of Instrument to Process Line:

Installation and maintenance via remote operated submersible vehicle will require design of a clamping system that can easily be operated by a submersible

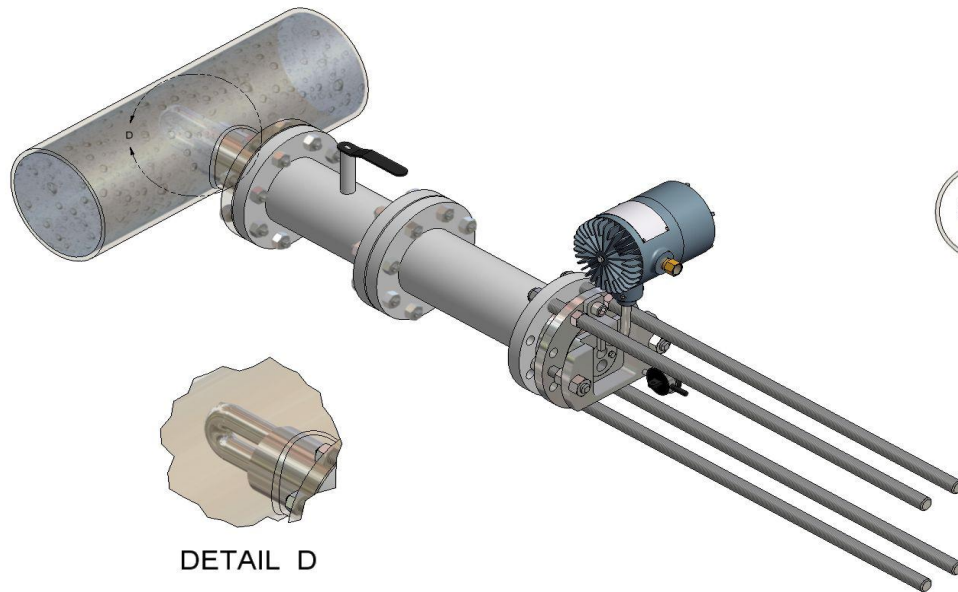
A simple shape enclosure will be required for the camera, and possibly a newly designed pipe fitting for process connection

System will need to be environmentally sound during instrument insertion and removal

Challenges of Sub Sea Marinisation of Technology

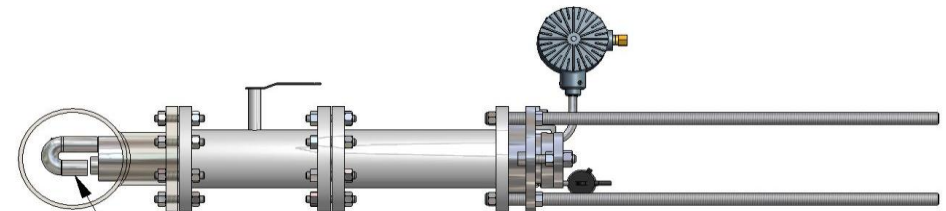
Remote Connectivity of Instrument to Process Line to be based on particle probe design

PARTICLE PROBE SHOWN AT INSTALLATION AND ENGAGED AT LINE



FLUID REMOVED FOR CLARITY

SIDE VIEW OF PIPE WITH PARTICLE PROBE INSERTED



LIGHTING PRESENTED TO HIGH RESOLUTION IMAGING SYSTEM

Sub Sea Marinisation of Technology

The ability to detect oil in water and solids is key for subsea operation to avoid reinjection well plugging .

All housings are duplex Stainless steel and provided with quick connects compatible with Submersible operations.

Ethernet signal returns to the surface . OPC signal for subsea control of all readings.

Signal provides OIW ,WIO ,solids (sand) concentration and particle distribution to detect upsets and optimize control

Sub Sea Marinisation of Technology

Component Lifetime:

Light Source Dual Light sources and liquid cooled lighting has increased life to 1 year

Pressure Fused glass technology allows for pressure ratings up to
Boundary 10,000 PSI (690 BAR)
Installed in several demanding topside applications without any recorded failure

CCD Camera Operates for a number of years

Challenges of Sub Sea Marinisation of Technology

- Electrical Design: ROV actuated wet-mateable connectors
- Data Handling: Compression of data will likely be needed if speed is to be maintained in the monitoring and control of the process facility
Canty systems currently send data from the instrument via Ethernet protocol. Optimization of the application needs along with data transmission allowances will need to be done
- Testing & Verification: Method has been verified topside
Qualification to ISO13628-6
(pressure, temp, shock, vibration...)

Other Relevant Vision Based Applications

Oil / Water Separator Vessels: Interface Monitoring

Vision based system with unique lighting system can detect the interface between organic & aqueous layer, as well as rag layer detection based on the varying colour

Other Relevant Vision Based Applications

Oil / Water Cyclone Separator: Vortex Monitoring

Supplementary Information

Additional information intended for those who want more information on a particular part of an application or the vision system.

- Particle Sizing Software -- Document P/N: TA8356-1 Rev. 2
- Particle Sizing Set-up -- Document P/N: TA7564-1 Rev.2
- CantyVision Client Software -- Document P/N: TA10592-1
- Ethernet Output Module -- Document P/N: TA9688-1
- OPC - Open Connectivity for Process Control -- TA10560-1

This concludes the Presentation!

Thanks for choosing CANTY!

**For Further Information on this
product please visit
www.jmcanty.com.**