

# OPERATING INSTRUCTIONS

## FOR

### MODEL ZT-100

### Water In Oil / Water Cut Analyzer



ZT-100 Product Photo

Certification Schemes:		
<b>QPS(CSA/UL)</b>	<b>IECEX</b>	<b>ATEX</b>
Class I Zone 1 AEx db IIC T4 Gb	IECEX QPS 19.0007X	II 2G
Ex db IIC T4 Gb	Ex db IIC T4 Gb	Ex db IIC T4 Gb
Class I Division 1 Gr. BCD	Ta= -20°C to +60°C	Ta= -20°C to +60°C
Ta= -20°C to +60°C		

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### Warranty

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This equipment is sold subject to the mutual agreement that it is warranted by us free from defects of material and of construction, and that our liability shall be limited to replacing or repairing at our factory (without charge, except for transportation), or at customer plant at our option, any material or construction in which defects become apparent within one year from the date of shipment, except in cases where quotations or acknowledgements provide for a shorter period. Components manufactured by others bear the warranty of their manufacturer. This warranty does not cover defects caused by wear, accident, misuse, neglect or repairs other than those performed by Zelentech or an authorized service center. We assume no liability for direct or indirect damages of any kind and the purchaser by the acceptance of the equipment will assume all liability for any damage which may result from its use or misuse.

We reserve the right to employ any suitable material in the manufacture of our apparatus, and to make any alterations in the dimensions, shape or weight of any parts, in so far as such alterations do not adversely affect our warranty.

### Important Notice

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This instrument provides measurement readings to its user, and serves as a tool by which valuable data can be gathered. The information provided by the instrument may assist the user in eliminating potential hazards caused by his process; however, it is essential that all personnel involved in the use of the instrument or its interface, with the process being measured, be properly trained in the process itself, as well as all instrumentation related to it.

The safety of personnel is ultimately the responsibility of those who control process conditions. While this instrument may be able to provide early warning of imminent danger, it has no control over process conditions, and it can be misused. In particular, any alarm or control systems installed must be tested and understood, both as to how they operate and as to how they can be defeated. Any safeguards required such as locks, labels, or redundancy, must be provided by the user or specifically requested of Zelentech at the time the order is placed.

Therefore, the purchaser must be aware of the hazardous process conditions. The purchaser is responsible for the training of personnel, for providing hazard warning methods and instrumentation per the appropriate standards, and for ensuring that hazard warning devices and instrumentation are maintained and operated properly.

Zelentech Pte Ltd, the manufacturer of this instrument, cannot accept responsibility for conditions beyond its knowledge and control. No statement expressed or implied by this document or any information disseminated by the manufacturer or its agents, is to be construed as a warranty of adequate safety control under the user's process conditions.

## Safety Messages

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Your safety and the safety of others are very important. We have provided many important safety messages in this manual. Please read these messages carefully.

A safety message alerts you to potential hazards that could hurt you or others. Each safety message is associated with a safety alert symbol. These symbols are found in the manual and inside the instrument. The definition of these symbols is described below:



**GENERAL WARNING/CAUTION:** Refer to the instructions for details on the specific danger. These cautions warn of specific procedures which if not followed could cause bodily Injury and/or damage the instrument.



**Technician Symbol:** All operations marked with this symbol are to be performed by qualified maintenance personnel only.



**NOTE:** Additional information and comments regarding a specific component or procedure are highlighted in the form of a note.



**CAUTION:** THE ANALYZER SHOULD ONLY BE USED FOR THE PURPOSE AND IN THE MANNER DESCRIBED IN THIS MANUAL.

IF YOU USE THE ANALYZER IN A MANNER OTHER THAN THAT FOR WHICH IT WAS INTENDED, UNPREDICTABLE BEHAVIOR COULD RESULT POSSIBLY ACCOMPANIED WITH HAZARDOUS CONSEQUENCES.

This manual provides information designed to guide you through the installation, calibration and operation of your new analyzer. Please read this manual and keep it available.

Occasionally, some instruments are customized for a particular application or features and/or options added per customer requests. Please check the front of this manual for any additional information in the form of an Addendum which discusses specific information, procedures, cautions and warnings that may be peculiar to your instrument.

Manuals do get lost. Additional manuals can be obtained from Zelentech at the address given in the Appendix. Some of our manuals are available in electronic form via the internet. Please visit our website at: [www.zelentech.co](http://www.zelentech.co)

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## DANGER - FLAMMABLE LIQUID USAGE WARNING



# DANGER



### FLAMMABLE LIQUID USAGE WARNING

The analyzer is housed in an flame proof/explosion proof housing and is designed for use in a Class 1, Division 1, Group A, B, C, D environment. It is the customer's responsibility to ensure safety especially when flammable liquids are being analyzed since the potential of leaks always exist.

The customer should ensure that the principles of operating of this equipment are well understood by the user. Misuse of this product in any manner, tampering with its components, or unauthorized substitution of any component may adversely affect the safety of this instrument.

Since the use of this instrument is beyond the control of Zelentech, no responsibility by Zelentech, its affiliates, and agents for damage or injury from misuse or neglect of this equipment is implied or assumed.

Certification Schemes:		
<b>QPS(CSA/UL)</b>	<b>IECEX</b>	<b>ATEX</b>
Class I Zone 1 AEx db IIC T4 Gb	IECEX QPS 19.0007X	II 2G
Ex db IIC T4 Gb	Ex db IIC T4 Gb	Ex db IIC T4 Gb
Class I Division 1 Gr. BCD	Ta= -20°C to +60°C	Ta= -20°C to +60°C
Ta= -20°C to +60°C		



#### SAFETY PRECAUTIONS

You must read carefully all the instructions of this manual. You must not start the installation before taking these instructions into account. This equipment might receive some hazardous voltages. If you do not consider these instructions, you risk to face serious corporal and / or material injuries.

Before setting up your installation, check the model suit your application. The wiring of this equipment must be executed with the in force rules by a qualified staff.

**TO REDUCE THE RISK OF IGNITION OF HAZARDOUS ATMOSPHERES, DISCONNECT THE SUPPLY CIRCUIT BEFORE OPENING KEEP COVER TIGHT WHILE CIRCUITS ARE ALIVE.**

<b>Manufacturer</b>	<b>Zelentech Pte Ltd</b>
	55 Serangoon North Avenue 4
	#04-05, S9 Building
	Singapore 555859
Instrument Type	ZT-100 Water in Oil Monitor

## Introduction

The Model ZT-100 Watercut/Water-In-Oil Monitor/Analyzer is a sophisticated instrument designed to measure water concentration in oil. It consists of an electronics assembly and a Capacitance Probe section.

The Monitor/Analyzer is housed in an explosion proof housing. Certain versions may be fitted with a window and a control unit display. Setup is available through HART.

The ZT-100 electronics is fully integrated with the Sensor Probe and to maintain safety and certification integrity only a fully qualified engineer should attempt to dismantle electronics housing from the probe. The main PCB board can be swapped out by user, given specific instructions are followed, but no other work should be performed as it can violate the hazardous area safety.

The analyzer is equipped with a 4-20mA analogue output with Out Of Range alarm level and can be interfaced with using HART.

## Operating Principle

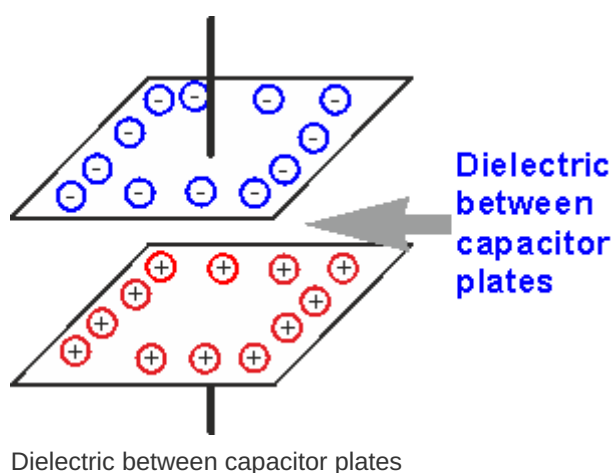
The dielectric properties of Oil and Water are vastly different and the ZelenTech ZT100 is able to determine the ratio by measuring the capacitance of the passing stream. The ZT100 constantly measures the temperature and compensates for capacitance changes that are due to temperature fluctuations.

ZT100 is available in Standard Version capable of 0-25% of water as well as in High Range versions capable of 0-100% water.

The Dielectric Constant (DC) varies from oil to oil and is mainly a function of the Specific Gravity (SG). The ZT100 will measure any oil with a DC in the range of 1.7 to 2.3 without a need for any additional tweaking. This covers all normal fuels, lubrication and hydraulic oils as well as crude oils. The ZT100 will also work fine with most vegetable oils and biofuels. A simple calibration procedure will get the ZT100 ready for your oil. In most cases a single press of a button will do.

### Dielectric Constant:

The dielectric constant is the ratio of the permittivity of a substance to the permittivity of free space. It is an expression of the extent to which a material concentrates electric flux, and is the electrical equivalent of relative magnetic permeability.



## Zelentech ZT-100 - Probe Series

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The Zelentech ZT-100 is available in 3 main variations.

### S-Series

The S-Series sensor is a spool section for inline measurements from 1 to 8 inch. Sizes 1 to 3 inch are available with threaded connections. S-Series is available in SS316L Stainless Steel and a variety of higher grade steel such as Duplex and Super Duplex up to Class 600# working pressure. Not all components on the S-Series allow full NDT.



### F-Series

The F-Series sensor is a spool section for inline measurements from 3 to 48 inch. The F-Series uses a fully flanged design and can be provided with complete NDT for all welds. This model is made for working pressure up to Class 1500#. The F-Series can be supplied in most common piping materials including Carbon Steel to match existing pipe line specifications.



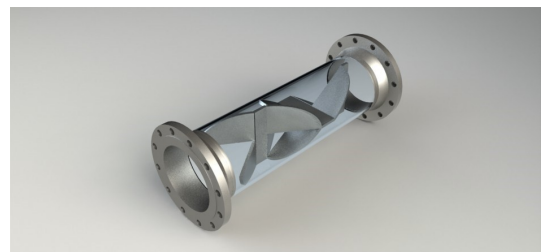
### I-Series

The I-Series sensor is an insertion model that can be provided as a fixed length flanged unit or supplied with a kit providing retraction under pressure. Materials for wetted parts is available as SS316L or higher qualities such as Duplex, Super Duplex or other specialized steels. Carbon steel is not available. Pressure Class up to 1500#. The I-Series can be supplied with a measurement spool in any readily available piping material.



### Static Mixer

*S-Series, F-Series and measurement spools for I-Series can be supplied with Static Mixer to homogenize the Oil/Water flow before measurement.*

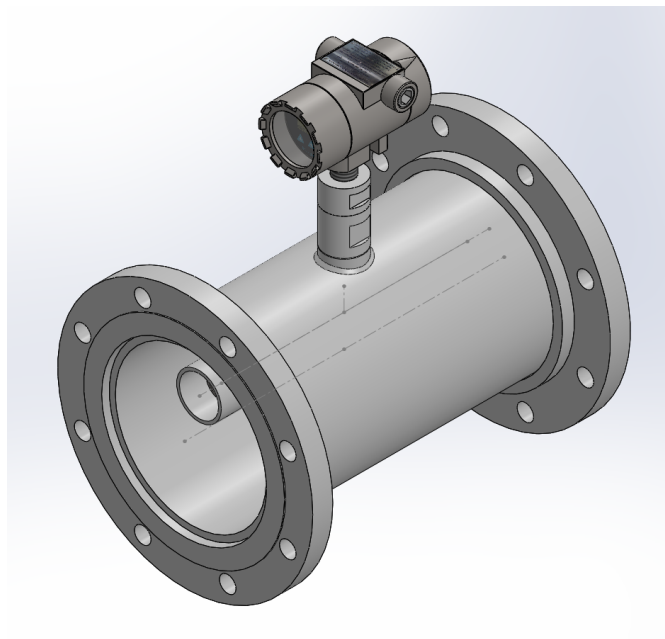


## S-Series - Flanged and threaded version

The S-Series sensor consists of a EXD certified Electronics Enclosure with cable entries for electrical wiring, a spool section for mounting into the pipe line to be measured. Smaller sizes are well suited for installation into by-pass or fast-loop arrangements . The EXD enclosure is available in different versions to suit different markets/ certification requirements.



*Typical 2 inch model*

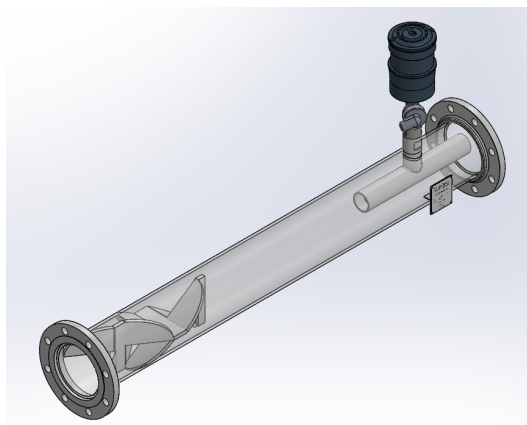


*Typical 8 inch model*

## SM-Series — Built in Static Mixer

Oil and water does not mix well. Depending on location, type of oil, flow rate, upstream obstructions causing mixing these meters can be supplied with built in static mixer. This ensures that the water and oil do not travel in separate layers risking water to slipstream passed the sensor undetected.

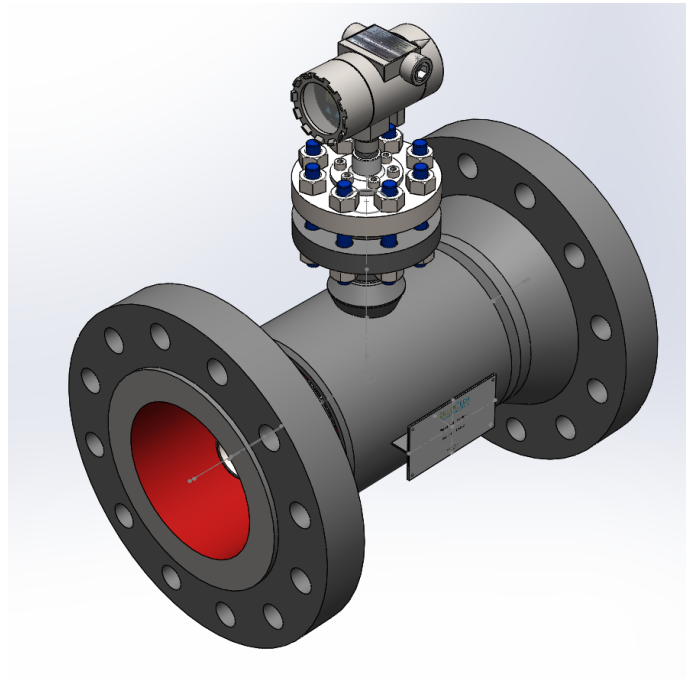
*Fitted with built in Static Mixer*



## F-Series - Fully flanged analyzers

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The F-Series sensor consists of a EXD certified Electronics Enclosure with cable entries for electrical wiring ,a spool section for mounting into the pipe line to be measured. The EXD enclosure is available in different versions to suit different markets/ certification requirements.

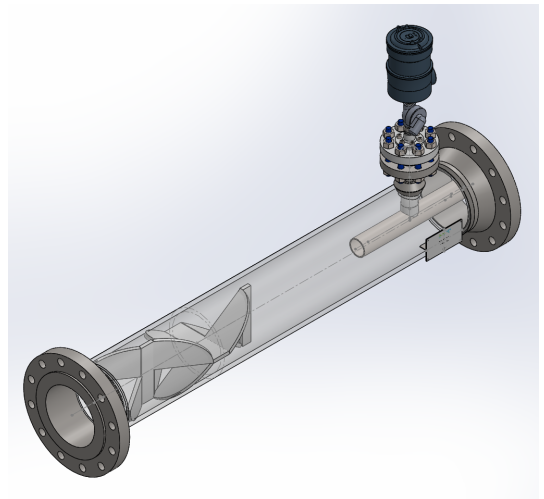


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### FM-Series — Built in Static Mixer

Oil and water does not mix well. Depending on location, type of oil, flow rate, upstream obstructions causing mixing these meters can be supplied with built in static mixer. This ensures that the water and oil do not travel in separate layers risking water to slipstream passed the sensor undetected.

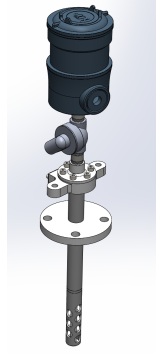
*Fitted with built in Static Mixer*



## I-Series — Flanged version

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The flanged I-Series consists of a EXD certified Electronics Enclosure with cable entries for electrical wiring, a flanged probe section for insertion into the pipe line to be measured. The EXD enclosure is available in different versions to suit different markets/ certification requirements.



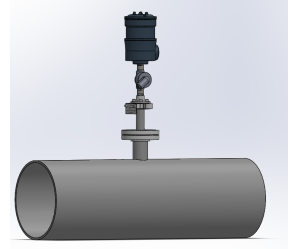
### Installation Examples — Flanged I-Series

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Installation into larger pipe through a 2 or 3 inch side port.

Works with 6 inch or larger lines.

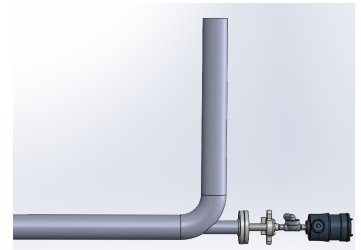
Pressure Rating up to 1500#.



Installation into smaller pipe through a pipe bend, T-section or similar arrangement allowing probe to insert along the main line.

Generally for 2" to 4", but can be used also for larger pipe.

Pressure Rating up to 1500#.



The I-Series can be supplied with a measurement spool fitted with static mixer and other features such as sampling ports..



## I-Series — Version for extraction under line pressure

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The non-flanged I-Series consists of a EXD certified Electronics Enclosure with cable entries for electrical wiring and a rod style probe section for insertion into the pipe line to be measured through a Zelentech process gland. The EXD enclosure is available in different versions to suit different markets/ certification requirements.

The Zelentech Extraction Kit allows inserting/removing the I-Series probe safely through a ball valve under line pressure.



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### Installation Example

Installation into larger pipe through a 2 or 3 inch side port.

Perpendicular installation works with 6 inch or larger lines. For 2" to 4" it can be used at an elbow/T-Section or similar as shown for the flanged version.



## INSTALLATION

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- **Location** : Ensure that product marking is suitable for the classified area of installation. Ambient temperature shall not exceed 60 deg C.
- **Fixing and mounting** : The housing must be protected against mechanical shocks. No drilling or machining must be done. Make sure the cable gland is appropriately tightened and make a loop with your cable to avoid running water alongside. If you do not take these precautions into account, the envelop certification would be put at risk, and the ingress of protection of the housing might be modified !
- **Electrical wiring** : Electrical wiring must be executed when DE-ENERGIZED after mounting and fixing the instrument. Electrical wiring must be executed with respect to the sound engineering practice and the in force norms. Cables used must be selected according to area classification standard used. Use shielded cables to minimize interference. Shield shall be grounded control side only, do not ground shield in instrument. In order to guarantee a perfect tightness, the cable gland should be screwed with an appropriate spanner. Terminals wiring are designed for 2.5mm<sup>2</sup> max. wires.
- **Cables path** : The type and the path of cables must comply with the in force rules. Careful precautions must be taken to avoid electromagnetic couplings with other cables capable of causing hazardous voltages or currents. Cables and wires must be protected against any damages.
- **Setup** : Setup in safe area can be done using the RS-232 terminal located under the cover of the unit. RS-232 shall not be used in hazardous area without special precaution/approvals (Hot Work Permit). The provided HART interface allows safe access/setup/calibration for hazardous area locations. For in-situ setup and calibration use HART interface as this does not require opening the EXD enclosure.
- **Precautions to be observed during maintenance** The dismantling of the equipment must be executed when DE-ENERGIZED. ZELENTECH guarantees the certification of the equipment EX Works. Any wiring except connecting the 4-20mA cable in therefore provided connector will rule out ZelenTech's responsibility in case of failure. If a fault is suspected or observed, the equipment must be immediately de-energized and returned to safe area for service / fault finding. Only authorised personnel should repair the equipment.
- **Storage and Preservations** Please refer to reference Doc G02-01 - Unpacking and Preservation Procedures



## Electrical : 4-20mA

### Power Supply - 4-20mA Current Loop

The ZelenTech ZT100 Water In Oil provides an Analog Signal 4-20mA proportional to measured water content. The Current Loop has to be powered externally and will provide enough power for the ZT100 to operate. The ZT100 will operate from 12 to 26VDC.

### Connector Current Loop

Voltage: 12 to 26VDC  
(Floating / Isolated)

Power Consumption: 0.66W

### Power requirements

Maximum ripple (47 to 125 Hz)	0.2 V p-p
Maximum noise (500 Hz to 10 kHz)	1.2 mV rms
Maximum series impedance (500 Hz to 10 kHz)	10 $\Omega$

Power for a two-wire instrument loop is typically 24VDC. As always, the voltage must be sufficient to provide the necessary lift-off voltage for the field device. Take into account voltage drops in the cable and load resistor. Smart devices may take up to 22 mA to indicate an alarm condition. Use this value to calculate the worst case loop voltage drop.

### Cable considerations

If possible, use individually shielded twisted pair cable. Unshielded cables may be used for short distances, provided ambient noise and cross-talk will not adversely impact communication. The minimum conductor size is 0.51mm diameter (#24 AWG) for cable runs less than 1,500 meters (@ 5,000 ft.) and 0.81mm diameter (#20 AWG) for longer distances.

Shield shall be grounded in ONE end only to avoid earth loops.



#### CAUTION!

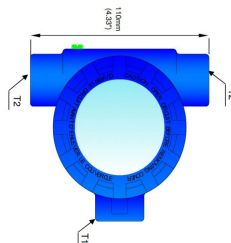
The Current Loop **MUST** be floating!  
Grounded or badly isolated loop **WILL** cause damage to the ZT100 electronics!

*How to verify: Measure resistance between +24VDC and pipeline as well as -24VDC and pipeline. Resistance must be infinite or the ZT100 electronics may be damaged.*

### Enclosure Cable Entries / Cable Glands / Stopping Plugs



ZT-100 Wiring Terminal  
(2 wire loop powered)



For threaded entries use only already certified connection facilities suitable for application and rated for a minimum of 80°C.

Unused openings shall be closed using certified stopping plugs suitable for application and rated for a minimum of 80°C.

T1: Used by factory

T2: 2 entries, see marking label for size.

## Communication: RS-232 Interface

### RS-232 Interface — WARNING! NOT TO BE USED IN HAZARDOUS AREA!

The ZelenTech ZT100 Water In Oil is fitted with a RS-232 terminal interface. The interface is accessible using the supplied RS-232 cable only. Connect the cable to terminal J7 on the PCB. Connect the other end to a PC with RS-232 interface, or as many PCs today lack RS-232, use a USB-RS-232 Converter. The supplied RS-232 cable has a small PCB in the black RS-232 Connector and communication will not work with any other cable.

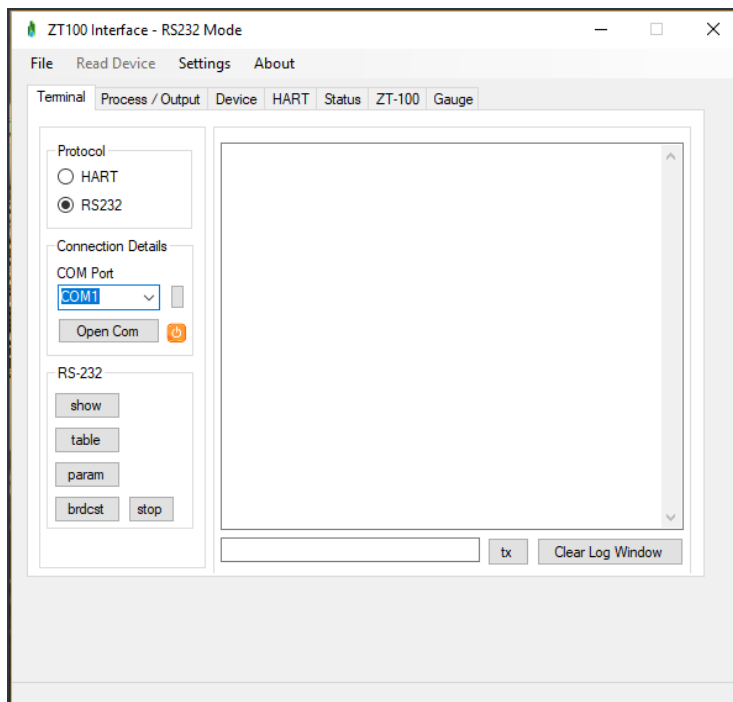
#### RS-232 Communication Settings

Bits per second:	9600
Data bits:	8
Parity:	None
Stop Bits:	1
Flow Control:	None

### Terminal Software

There are many alternatives available. **PUTTY.EXE** is a free open source terminal software that can easily be found for free download.

**ZT100 Interface.exe** is a windows only software that is capable of RS-232 as well as HART modem communication, contact us for a copy.



# Field Calibration - Zero Offset

## Field Calibration Overview

Field calibration is the process of teaching the ZT100 Water In Oil Monitor what level of capacitance corresponds to given level of water content. This is a single point offset, the electronics will take care of the rest. This teaching process is referred to as **Zero Offset**. The process can be performed at any water content, the software will automatically calculate the zero point from any given water content.

For applications with large temperature fluctuations optionally the ZT100 can be taught how to compensate for temperature inflicted changes in capacitance. Temperature is compensated for using a **Temperature Compensation Factor**.

### Zero Offset using S1 button **DO NOT USE IN HAZARDOUS AREA**

Pressing the S1 button located on the PCB inside the unit will instantly zero the unit to the liquid inside the unit and use the current temperature as the point of origin for temperature compensation. It will assume the oil is dry (0%). The Zero level can if needed be modified using the command **cal** should a lab result be available at a later point in time.

### Zero Offset using RS-232 Interface **DO NOT USE IN HAZARDOUS AREA**

This is a 2 step process using 2 different commands.

Command **save** will save the current capacitance and temperature reading to memory.

Command **cal #.##** (#.## being known or estimated water content) will offset the internal reference table to match given water content using the values saved with command **save**.

It is quite possible to enter an estimate for **cal** directly after having performed the **save** command. This estimate can be corrected at a later time should a lab result or better estimate be available later on. Note: Do not **save** again as this will overwrite the saved reference points that you have water content data for.

**ABOVE METHODS CAN BE USED ONLY IF YOU HAVE A HOT WORK PERMIT AS THEY REQUIRE OPENING THE EXD ENCLOSURE.**

### Zero Offset using HART Interface

Performed exactly as the RS-232 process.

**save** command is represented by HART Command #144

**cal** command is represented by HART Command #143

See Device Specific HART Commands for byte format.

## Zero Offset

Zero Offset can be performed using 3 different methods:

- 1) S1 button located inside the unit.
- 2) Using the RS-232 Terminal Interface.
- 3) Using the HART Interface.

## RS-232 Terminal

Zero Offset commands

**save[enter]**

**cal 0[enter]**

*The above commands will save the current readings and tell the unit that current water content is 0%. Water content level can be tweaked to match lab results later.*

**cal 0.25[enter]**

*This will tell the unit that the water content (at time of save) was 0.25%.*

## Calibration samples

Take sample as close in time as possible to the time of issuing the **save** command.

Take sample from a location close to the ZT100 Monitor.

Ensure your sample is representative.

Allow sample line/points to drain out old stuck content allowing you a fresh sample.

# Field Calibration - Temp compensation

## Temperature Compensation

The temperature coefficient (**tc**) is the relationship between temperature and capacitance. The coefficient is applied to the measured capacitance per degree Celsius of temperature change and pivots around the temperature saved using the **save** command.

### Find the tc

Record T1 and C1 as temperature and capacitance while running at a lower temperature. Record T2 and C2 as temperature and capacitance while running at an elevated temperature.

Calculate tc using the formula to the right.

### Apply the TC

The temperature compensation coefficient is entered into the ZT100 using the RS232 or HART interface.

### Important

In most field applications the process temperature stay within a few degrees over long periods of time and there is no need to apply any temp compensation factor. Keeping tc=1 will do just fine.

### Temperature Coefficient Formula

$$1 - ((C2 - C1) / (T2 - T1)) / C1$$

### RS-232 Terminal / HART

The RS-232 command for setting the temperature coefficient is **tec #.####**.  
(#.#### being the TC)

Command #142 is used to set tc using HART. See HART Command reference for byte format.

## RS-232 Protocol

Command	Action	Terminal Output Example
show	Provides a terminal output of the latest reading	Capacitance 270.1pF Per cent H2O: 13.6% Temperature: 21.7C
param	Printout of current parameters	Calibrated to: 0.0% H2O Range: 3% Tempco:1.0000 Alarm level: high
table	Printout of the Lookup Table showing the relationship between probe capacitance and the water content.	a. Capacitance: 179.8pF H2O: 0% b. Capacitance: 185.3pF H2O: 1% c. Capacitance: 190.9pF H2O: 2% ...
reset	Reset the lookup table to Factory Default	Reset [enter]
alarm	Set current loop alarm level for out of range values. Can be either high or low, where low is 3.8mA and high is 20.2mA, e.g. In parameters: low or high. Default is high.	alarm high [enter]
tec	Temperature Coefficient Factor. (See elsewhere how to derive the TC factor)	tec 1.0007 [enter]
save	This command will tell ZT100 to save its latest capacitance and temperature measurement as a calibration reference value to be used with the cal command.  Manual storage of pF or temp value is possible., see example.	Save [enter] save pf 199.9 [enter] save t 75.5 [enter]
avg	Sets the number of measurements over which reading is averaged. In effect a damping.  Max: 20 Default 20 Min: 1	avg 10 [enter]
cal	Sets the percentage value used after cal to match the pF value stored using store.  The internal calibration table will be offset using the value saved with command save. Accepts 2 decimals.  The S1 button on the PCB performs command save followed by cal 0 and therefore allows zeroing to dry oil without computer.	cal 0.00 [enter]
brdcst	Broadcast readings continuously over RS-232. at whatever rate is set by command average. Stop broadcasting by pressing q [enter]  capacitance (pF) , water content (%) , temp (°c)	Brdcst [enter]
scale	This command will scale the 4-20mA output to desired range.  Max 25 for Low Range units, max 100 for High Range units.	scale 10[enter]

# HART Protocol

<b>DD</b>	device description	<b>MSB</b>	most significant bit	<b>SV</b>	secondary (2nd) variable
<b>FSK</b>	frequency shift keying	<b>PDU</b>	protocol unit data	<b>TV</b>	tertiary (3rd) variable
<b>HCF</b>	HART Comm. Foundation	<b>PLC</b>	programmable logic controller	<b>QV</b>	quaternary (4th) variable
<b>LSB</b>	least significant bit	<b>PV</b>	primary (1st) variable		

## HART – Introduction

ZelenTech ZT100 complies with HART protocol revision 6. This document specifies all device specific features and documents HART protocol implementation.

## HART Communication - Basics

HART (Highway Addressable Remote Transducer) is a digital protocol for field communication. It is widely accepted as a standard for digitally enhanced 4-20 mA communication with smart and microprocessor based field devices.

HART is a digital master/slave protocol. Slaves only send information when requested to do so by a master. The digital signal is superimposed onto the analog current loop without affecting it. The serial digital data channel is used to configure the device as well as allowing access to multiple process variables. To superimpose the digital signal with the current loop, a frequency shift keying (FSK) technique, based on the Bell 202 communication standard is used. Two frequencies, 1200 Hz and 2200 Hz are used to represent binary 1 and 0. Thus, HART communication is limited to 1200 Baud.

HART provides two different masters (primary and secondary) to each loop. Primary masters are typically PLCs, computer based controllers or monitoring systems. Secondary masters are for example handheld communicators. Both masters can be connected to one current loop without disturbing the communication.

HART devices can operate in one of two network configurations:

- point-to-point
- multidrop connection

In case of a point-to-point connection, the 4-20 mA signal is used to communicate one process variable, while other process variables or configuration data are transferred digitally.

For multidrop mode the 4-20mA is locked at 4mA and all data is transferred digitally over HART.

## HART Setup

Poll address can be reset to 0 by keeping button S1 pressed during power up.



## HART : Universal Commands (Rev 6)

The following universal commands are implemented. Please refer to your HART documentation for extensive information on each of these commands.

Commands from 0-100 in the HART protocol are standardized, i.e. all common HART field communicators can interact with the ZT-100 using these commands without any setup or programming being required.

Command	Description
Command 0:	Read unique identifier.
Command 1:	Read primary variable.
Command 2:	Read loop current and percent of range.
Command 3:	Read dynamic values and loop current.
Command 6:	Write polling address and set/reset multi-drop mode.
Command 7:	Read loop configuration.
Command 11:	Read unique identifier associated with tag.
Command 12:	Read message.
Command 13:	Read tag, descriptor and date.
Command 14:	Read primary variable transducer information.
Command 15:	Read device information.
Command 16:	Read final assembly number.
Command 17:	Write message.
Command 18:	Write tag, descriptor and date.
Command 19:	Write final assembly number.
Command 20:	Read long tag.
Command 22:	Write long tag.
Command 34:	Write primary variable damping factor.
Command 35:	Write primary variable range values.
Command 38:	Reset configuration changed flag.
Command 40:	Enter/exit fixed current mode.
Command 42:	Perform device reset.
Command 43:	Set primary variable 0.
Command 45:	Trim loop current zero.
Command 46:	Trim loop current gain.
Command 48:	Read additional device status.
Command 56:	Write device variable transducer serial number.
Command 59:	Write number of response preambles.

## HART : Device Specific Commands

HART commands from 100 and up are Device Specific. Field communicator will need additional programming to understand/present these commands.

Command	Description	Parameter	Value
Command 141	Load the capacitance/ H2O table with the default values.	Request Data Bytes: Response Data Bytes: Response Codes:	none none 0x0 Success
Command 142	Set temperature coefficient.	Request Data Bytes: Response Data Bytes: Response Codes:	0-3, float 0-3, float 0x0 Success 0x3 Parameter Too Large 0x4 Parameter Too Small 0x8 Warning, set to nearest value
Command 143	Calibrate to entered percentage of water.	Request Data Bytes: Response Data Bytes: Response Codes:	0-3, float 0-3, float 0x0 Success 0x3 Parameter Too Large 0x4 Parameter Too Small 0x8 Warning, set to nearest value 0x72 Capacitance Not Set 0x73 Temperature Not Set
Command 144	Store current value of capacitance and temp. Return values to master.	Request Data Bytes: Response Data Bytes: Response Codes:	none 0-3, float (capacitance) 4-7, float (temperature). 0x0 Success
Command 145	Store an entered value of capacitance to use for future calibration.	Request Data Bytes: Response Data Bytes: Response Codes:	0-3, float 0-3, float 0x0 Success 0x3 Parameter Too Large 0x4 Parameter Too Small 0x8 Warning, set to nearest value
Command 146	Store an entered value of temperature to use for future calibration AND for reference when calculating temperature drift.	Request Data Bytes: Response Data Bytes: Response Codes:	0-3, float 0-3, float 0x0 Success 0x3 Parameter Too Large 0x4 Parameter Too Small 0x8 Warning, set to nearest value

## HART : Device Specific Commands (continued)

Command	Description	Parameter	Value
Command 147	Read H2O calibration value, temperature coefficient and reference temperature.	Request Data Bytes: Response Data Bytes:  Response Code:	none 0-3, float (H2O calibration value) 4-7, float (temperature coefficient) 8-11, float (calibration temperature) 0x0 Success
Command 148	Read the table of Capacitance and %H2O	Request Data Bytes: Response Data Bytes:  Response Code:	none 0-50, 3*17 bytes Table of 17 rows of 3 bytes 2byte unsigned int = Capacitance 1 unsigned char = Water Content (%) 0x0 Success
Command 149	Write a complete cap/ H2O table to the card.	Request Data Bytes:  Response Data Bytes:  Response Code:	0-50, 3 byte X 17 entries 0-1 : unsigned int = Capacitance 2: unsigned char = Water Content (%) 0-50, 3 byte X 17 entries 0-1 : unsigned int = Capacitance 2: unsigned char = Water Content (%) 0x0 Success
Command 150	Change single row in cap/H2O table.	Request Data Bytes:  Response Data Bytes:  Response Code:	0-4 0: unsigned char = Table position 1-2 : unsigned int = Capacitance 3: unsigned char = Water Content (%) 0-4 0: unsigned char = Table position 1-2 : unsigned int = Capacitance 3: unsigned char = Water Content (%) 0x0 Success 0x02 Invalid selection 0x3 Parameter Too Large 0x4 Parameter Too Small

## Model Nomenclature

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ZT100-F[Mixer][Nominal Size]-[Pressure Class]-[Pipe Schedule]-[Material]-[Range]-9080[Electronics Enclosure]-[Cable Entry]

ZT100-F##-##-##-##-##-##-9080##-##

ZT100-S[Mixer][Nominal Size]-[Pressure Class]-[Pipe Schedule]-[Material]-[Range]-9080[Electronics Enclosure]-[Cable Entry]

ZT100-S##-##-##-##-##-##-9080##-##

ZT100-I[Nominal Size]-[Pressure Class or Retractable]-[Material]-[Range]-9080[Electronics Enclosure]-[Cable Entry]-[Throw-Length]

ZT100-I##-##-##-##-##-9080##-##-##

ZT100-T[Nominal Size]-[Pressure Class or Threaded]-[Material]-[Range]-9080[Electronics Enclosure]-[Cable Entry]-[Throw-Length]

ZT100-T##-##-##-##-##-##-9080##-##-##

[[Mixer][Nominal Size]-[Pressure Class]-[Pipe Schedule]-[Material]-[Range]-[Throw-Length]

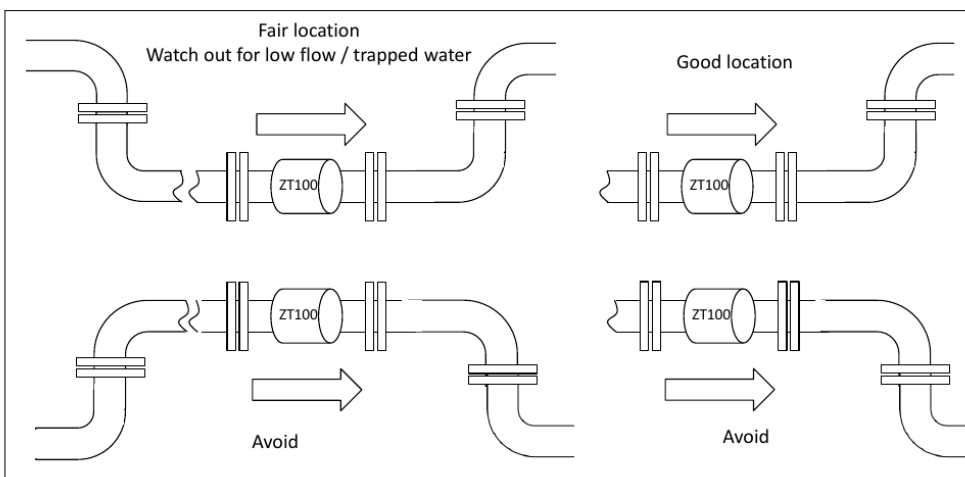
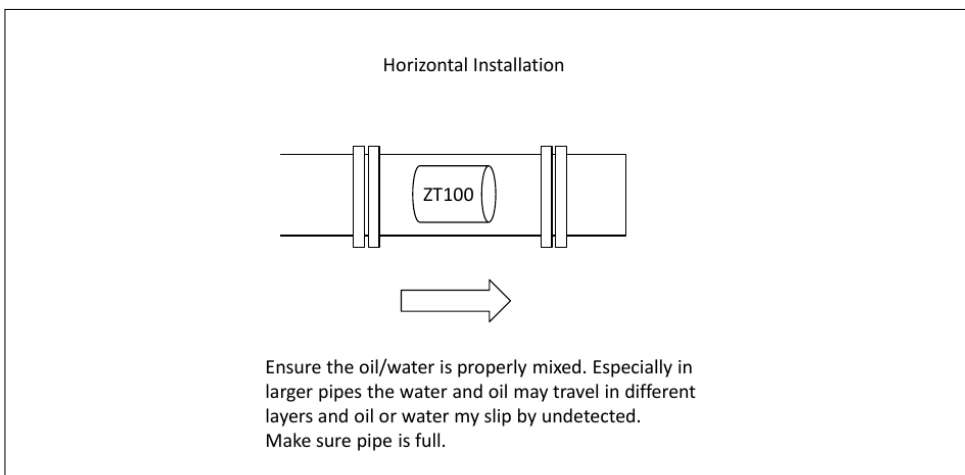
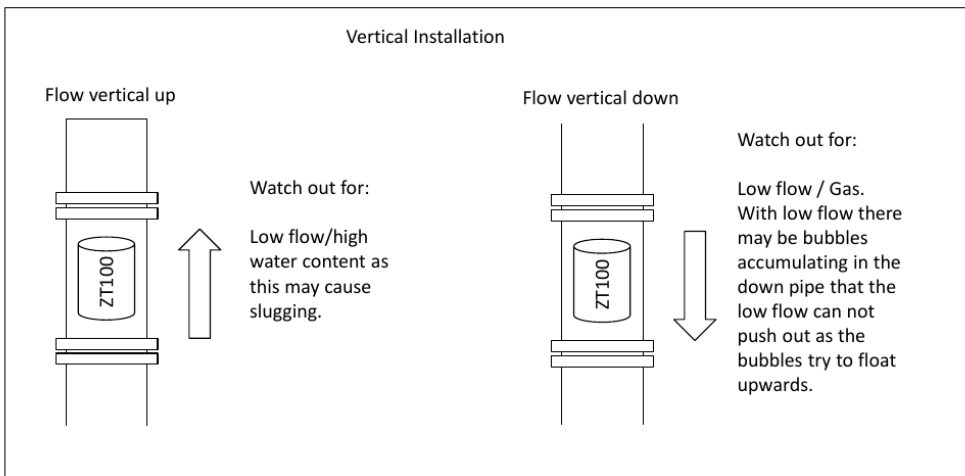
Piping/measurement spool/probe related details.

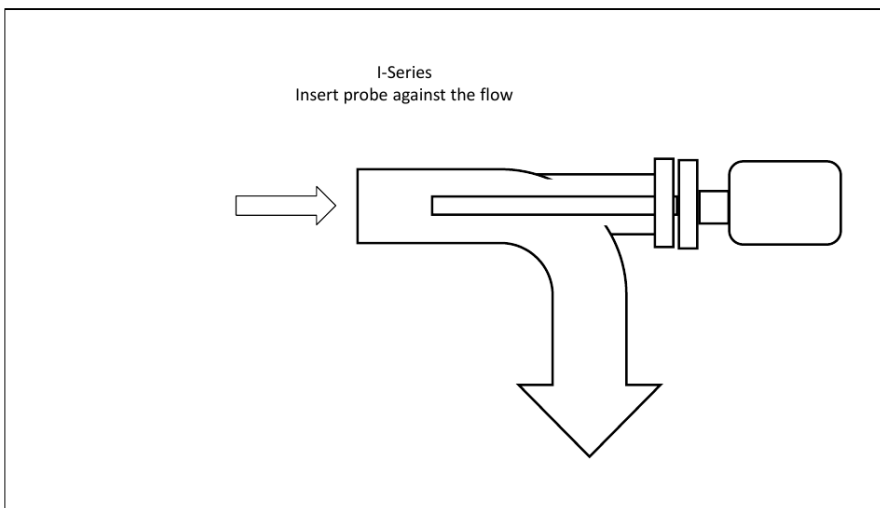
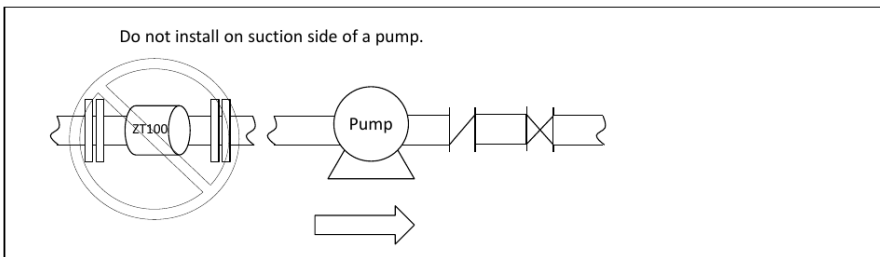
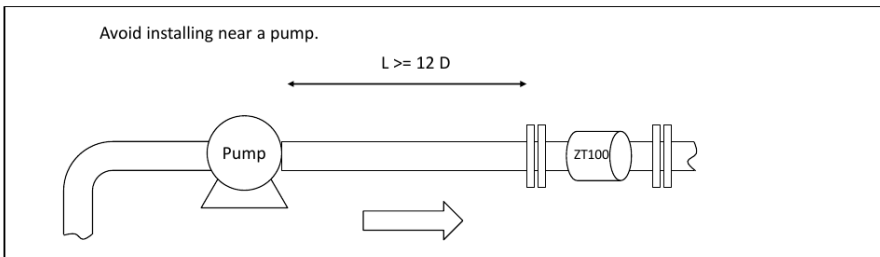
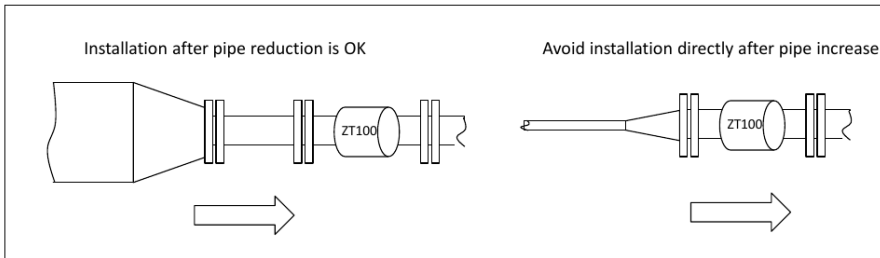
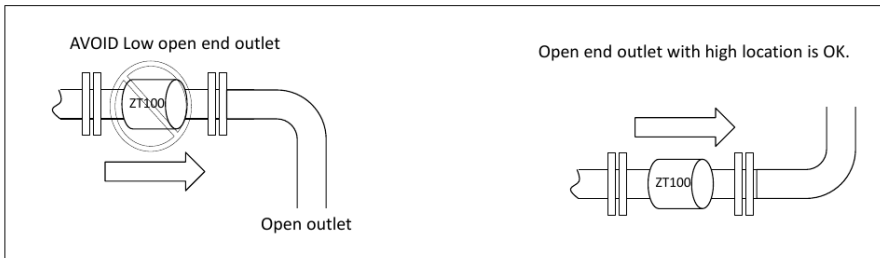
**[Electronics Enclosure]:** - 9080AM = IME 9080 Aluminum EXD Blind - 9080WM = IME 9080 Aluminum EXD with Window - 9080TM = IME9080 SS316L EXD Blind - 9080SM = IME080 SS316L EXD with Window

**[Cable Entry]:** - 07 = 3/4" NPT - 08 = 1/2" NPT - 09 = M20 x 1.5 - 32 = M25 x 1.5

## General Installation Guidelines

The following images provides a few pointers to good vs. bad installation. Key to a good measurement is to avoid slugging, partially filled pipes, gas/air pockets, fast pressure drops, open end outlets, pump interference and stratified water/oil.





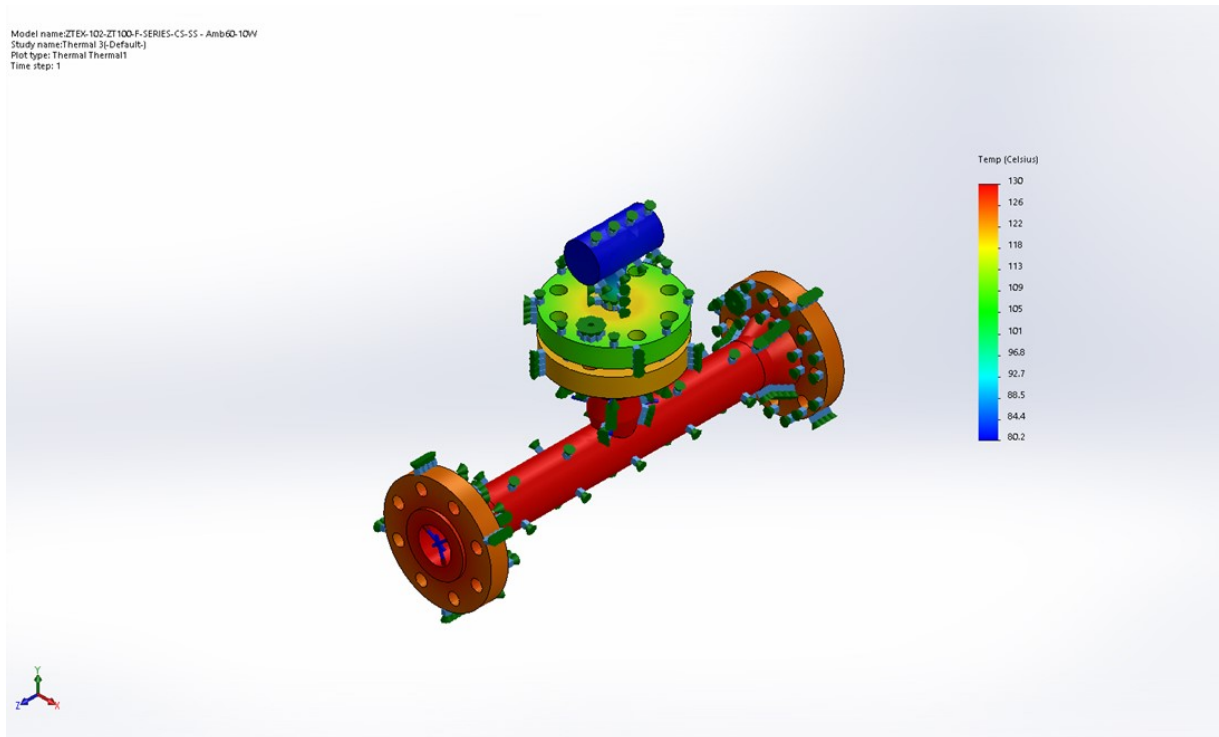
## Process Temperature Considerations

The Zelentech ZT-100 is certified for up to 130 deg C surface temperature (T4) for EXD components and an ambient temperature up to 60 deg C.

**This must not be exceeded.**

Calculations have shown that the ZT-100 will stay within it's limitations for all standard models/ designs regardless of materials for process temperatures up to 130 deg C with an ambient temperature at 60 deg C.

Higher process temperature may be achieved for certain models/configurations, in which case a Thermal Evaluation will be performed to support such an installation.



Thermal Analysis