

453x Series Average Temperature/Water Bottom Sensors and Convertors

Intrinsically safe temperature and water bottom measurement for inventory control and custody transfer tank gauging applications

Varec®



FuelsManager®
Compatibility



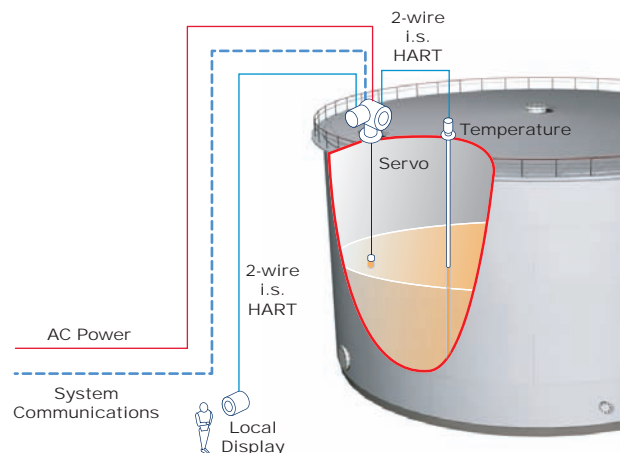
Benefits and Features

- Multiple product options available based on customer requirements:
 - Converter Only
 - Converter and Temperature probe
 - Converter and water bottom probe
 - Converter, temperature and water bottom probe
- Both explosion proof Exd and intrinsically safe versions are available for installation in various classes of explosion hazardous areas
- Continuous measurement of average liquid and /or average vapor temperature – Temperature profile throughout the tank is available by reading the position and temperature of each element
- Easy Configuration using Varec's 6000 Servo Tank Gauge or 4590 Tank Side Monitor
- Variety of process connections and cable entries available to meet worldwide classifications
- Options available for Pt100, Cu90, Cu100 and PtCu100 input conversion to HART compatible outputs

Applications

The 453x Series of Average Temperature/Water Bottom Sensors and Convertors (ATC) provide a highly capable solution for a variety of bulk storage tank gauging applications.

They can be combined with various HART compatible devices and tank sensors, such as Varec's 6000 Servo Tank Gauge, 7500 and 7200 Radar Tank Gauges and 4590 Tank Side Monitor.



Typical Radar Tank Gauge System Diagram

Function and System Design

Measuring Principle

Varec's modular range of temperature devices ensure accurate data for the calculation of the volume correction factor (VCF) and the net standard volume required for accurate inventory measurement.

Product Selection

4532 ATC

The 4532 Average Temperature Sensor and Converter (ATC) provides 2–6 resistance elements (Pt100) which have fixed interval (2 m or 3 m) that measure the average product temperature in bulk liquid storage tanks. The measured value is converted into a HART® compatible output for use in temperature compensated volumetric calculations.



4535 ATC

The 4535 Average Temperature Sensor and Converter (ATC) is a multiple element (Pt100) resistance device designed to measure the average product temperature in bulk liquid storage tanks. The temperature value is converted into a HART® compatible output for use in temperature compensated volumetric calculations.



4539 ATC

The 4539 ATC is a highly capable solution for a variety of tank gauging applications and provides both constant average temperature data and water interface data via HART communication.

- Average Temperature Converter – The 4539 ATC can be retrofitted onto an existing average temperature sensors. It converts Cu90, Cu100, PtCu100 and Pt100 temperature element resistance values into digital numeric data on HART protocol signal output. It is compatible to both multi-resistance thermometers (MRT) and multi-spot thermometers (MST).
- Average Temperature Converter and Sensor – To meet the tough demands of custody transfer applications, the 4539 ATC sensor and converter combination is intrinsically safe and provides a maximum of 16 class A Pt100 elements for average temperature measurement.
- Water Bottom Converter and Sensor – Combining only the 4539 ATC water bottom sensor with



converter allows independent measurement of water interface level.

- Average Temperature & Water Bottom Sensor and Converter – Both high accuracy temperature and continuous water interface measurement data are transmitting along only one pair of HART signal cables to the host device – 6000 Servo Tank Gauge (STG) or 4590 Tank Side Monitor (TSM).

Custody Transfer Approved Measurement

The 4539 Average Temperature Converter and Sensor combination is custody transfer approved and provides less than ± 0.1 °C of measurement deviation. Once configured to "W&M mode", all the changeable parameters are frozen by software and mechanical switch protection.

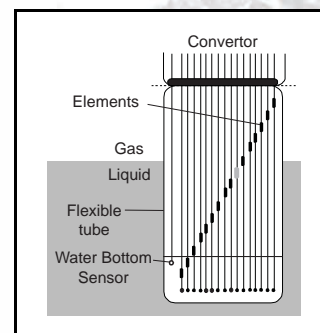
Average Temperature Calculation

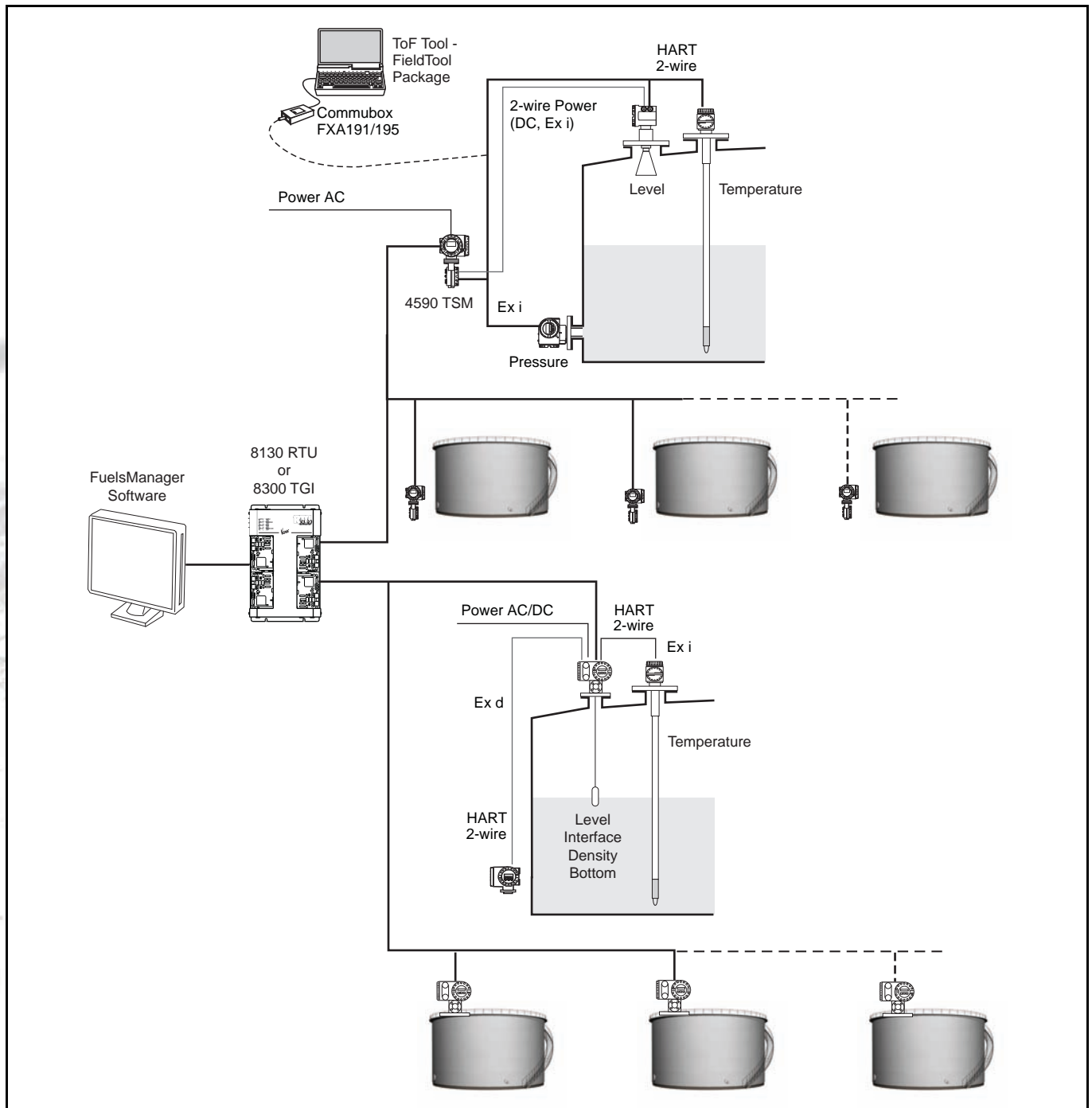
Both liquid and gas average calculation are performed based on level input from the host gauge. In order to provide sufficient averaging data, the 453x Series ATC considers appropriate elements, positioning 300 mm (11.8") below (for liquid average) or above (for gas average) liquid surface, to be a factor of precise average temperature calculation (default setting).

Water Bottom Sensor

The water bottom (capacitance) sensor is important for the detection of water below product (mainly crude oil) and determines water level by sensing the dielectric constant of the product in the tank. Measured data is transmitted via coaxial cable to the converter housing, where the capacitance signal is converted to a HART signal.

The sensor is generally set at the bottom of the average temperature sensor. The 4539 ATCs standard water bottom measurement ranges are 1m (3.3 ft) and 2m (6.6 ft). Pt 100 elements can be set inside of this tube structure so that water bottom functionality does not effect temperature measurement.

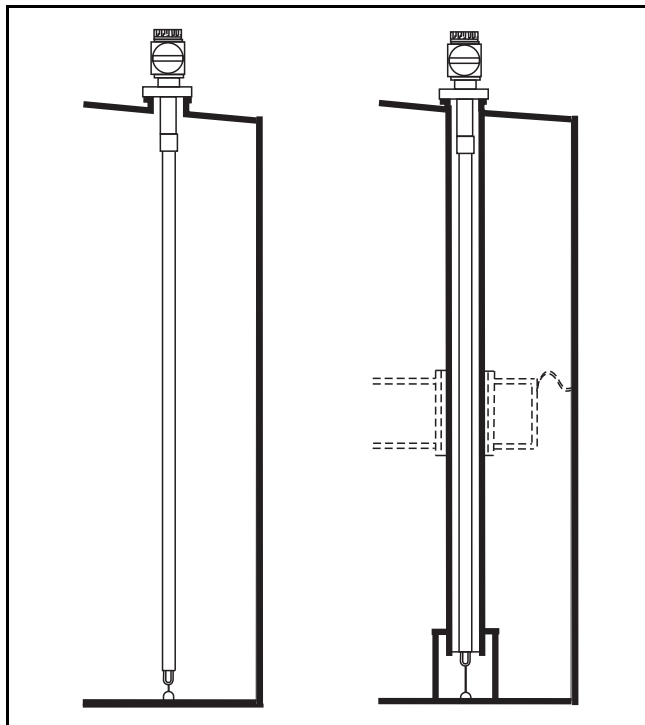




Typical Radar and Servo Tank Gauge System Diagrams

Installation Guidelines

The following information should be used as a guide only; please refer to the operation and maintenance manual of the specific instrument for complete installation instructions.



Example Temperature Sensor Installation

Temperature Sensor Installation

The 4532/5/9 ATC temperature sensor is primarily used in vertical cylindrical tanks with cone, dome, internal or external floating roof. The top mounted unit is connected via a flange and the sensor is connected to the bottom of the tank using a weight or anchor hook. Alternatively, a thermowell (slotted or unsettled) may be used to prevent turbulence.

If the 4532/5/9 ATC temperature sensor is installed in a tank with a pressure of greater than atmospheric pressure (at sea level), a closed pipe (thermowell) must be used to isolate the pressure. The recommended mounting position is a minimum of 500 mm (19.7") from the tank wall to prevent the ambient temperature change from influencing the measurement.

Various probe protections are available (pending function)

- Standard flexible tube
- Steel armored flexible tube
- Nylon or Teflon outer tube (installation must be in protection pipe only)

4539 ATC installation height adjuster

The height adjuster is an additional feature of the 4539 ATC. It can be used to adjust installation height of the

4539 temperature sensor within ± 180 mm (7") from original height.

Note! The height adjuster is not included in "Converter only" version.

Lowest element position

The standard location of the lowest temperature element should be set at 500 mm (20") from the tank bottom regardless of probe type. The factory setting of the height adjuster is set to the middle of adjustable range. Apply necessary adjustment during installation for desired height.

Note! The required bottom clearance of both the temperature probe and Water Bottom sensor depends on the anchoring method. Consider the required bottom clearance when ordering the 4539 ATC. Please see the recommended bottom clearance and/or consult your Varec representative for further information.

Note! When ordering the 4539 ATC with special element position and bottom clearance, please refer to "Ordering Information," Element Spacing. Select 4, Custom element position and spacing.

Note! The 4532 ATC provides multi-spot Pt100 (Max.6) elements which have a fixed interval of 2 or 3 meters

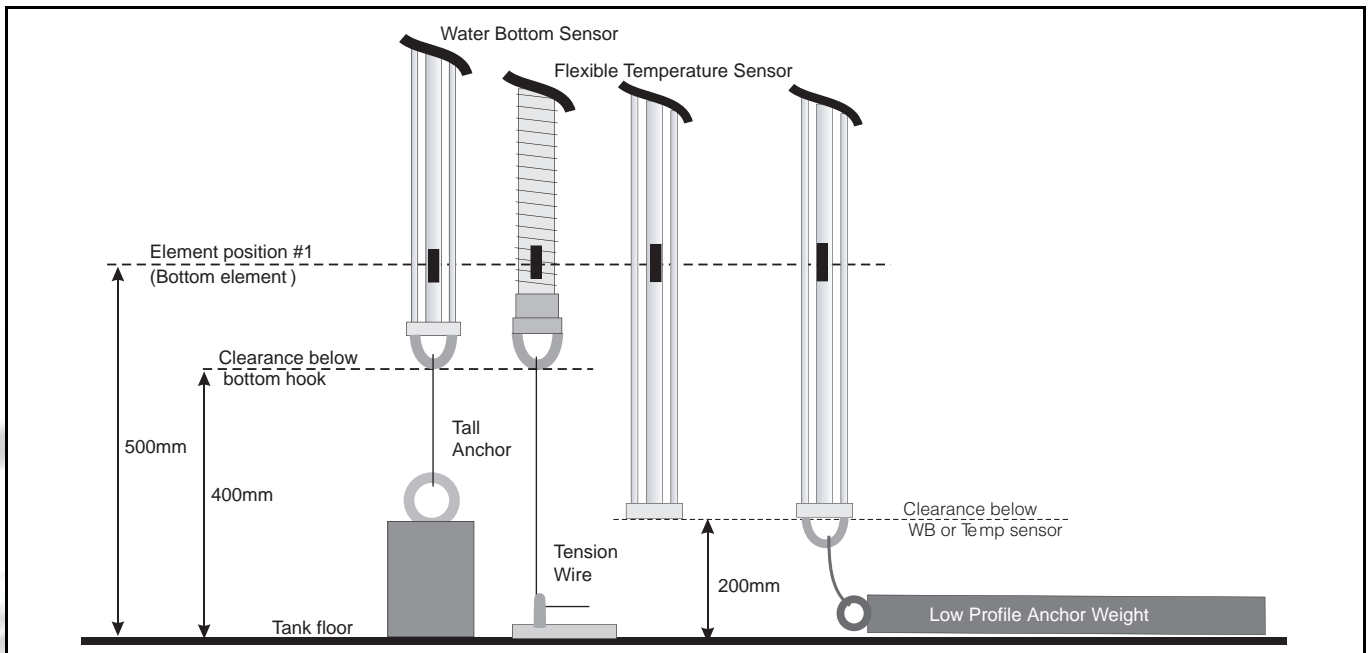
Average Temperature Converter

The 4538/9 ATC temperature and water bottom version has an additional terminal housing for the coaxial cable from the capacitance water bottom sensor and a cable outlet for easy accessibility.

Note! Due to the characteristic of capacitance measurement, precise initial calibration must be performed in order to achieve the maximum measurement accuracy. Condition of the tank contents (both oil & water), liquid temperature, individual probe characteristic can greatly effect the measurement performance.

Cable Glands

A metal cable gland (not a plastic one) that has shield cable grounding functionality should be used to meet the condition of EMC certification. Size and condition of the communication cable must also meet the requirements of intrinsically safe HART communication.



Example Lowest Element Position and Bottom Anchor Installation Method

Operation

Configuration and Operation

The 453x Series ATC can be integrated into a Varec servo or radar tank gauging system. Both the 6000 STG and 4590 TSM support local configuration and diagnostics (Basic functionality of the 4539 ATC is displayed and configured on the 4590 TSM). Additionally, the 6000 STG displays the compatibility details of the exact element type and software version.

The 453x Series ATC are also supported by the 'Time of Flight' platform and ToF Tool.

All gathered data in the interface unit is sent to inventory management software, such as Varec's FuelsManager or directly sent to the customer's specific DCS or PLC.

Inputs & Outputs

Terminal Connections

Function	4535 ATC Terminal	4590 TSM Terminal	6000 STG Terminal
Temperature (I.S.)	1+	24+ or 26+	24+
	2-	25+ or 27+	25-
Function	4532/9 ATC Terminal	4590 TSM Terminal	6000 STG Terminal
Temperature & water bottom data (I.S.)	H1-	24+ or 26+ or 28+	24+
	H1+	25+ or 27+ or 29+	25-
Multi-drop HART loop daisy chain connection	H2-		
	H2+		

Note! For detailed connection information to 6000 STG and 4590 TSM please refer specific product technical documentation for each.

Note! 4539 ATC allows an intrinsically safe HART connection only. Please refer to the intrinsically safe regulations for establishing wiring & field device layout

Note! 4532/9 ATC has convenient DG chain HART loop terminals that enable 4532/9 ATC to be a terminal junction of HART multi-drop instruments

4590 TSM Terminal Connections

The Tank Side Monitor can interface to a maximum of 6 i.s. HART sensors. All HART sensors are connected to one HART multi-drop communication loop. In order keep wiring simple, 3 interconnected terminal pairs are available. The terminal pairs are marked respectively H+ and H-.

Note! Do not connect signal HART lines from 4532/9 ATC to terminal 30 & 31 of the 4590 TSM - They are designed to supply drive power of 7500 Radar Tank Gauges only.

6000 STG Terminal Connections

Note! Do not connect 4532/9 ATC HART communication on terminal 4 & 5 on the 6000 STG. These terminals are designed to connect Ex d HART communication.

Note! Intrinsically safe instruments can be connected to the Ex i side/HART connection of the 6000 STG terminal housing.

4532 ATC External Standards and Guidelines

Based on IEC 61326, Immunity according to table A-1

- EN 61000-4-6: Immunity to conducted RF (high frequency) disturbance
- EN 61000-4-5: Immunity to surge on data lines
- EN 61000-4-4: Immunity to burst on data lines
- EN 61000-4-3: Immunity to electromagnetic field disturbance
- EN 61000-4-2: Immunity to electrostatic discharge
- EN 61326/CISPR 16: Electromagnetic emission

4535 ATC External Standards and Guidelines

- EN 50081-1: Conducted emission on main supply & radiated emission
- EN 61326: 1998 – Immunity test report revised on EN 50082-2: 1995
- ENV 50140: Radiated radio-frequency electromagnetic field, 80 – 1000MHz
- EN 61000-4-2: Electrostatic discharge
- EN 61000-4-4: Electrical fast transient / burst
- ENV 50141: Conducted disturbances induced by radio-frequency field
- EN 61000-4-8: Power-frequency magnetic field

4539 ATC External Standards and Guidelines

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- EN 61000-4-3: Immunity to electromagnetic field disturbance
- EN 61000-4-2: Immunity to electrostatic discharge
- EN 61326/CISPR 16: Electromagnetic emission

4532 ATC Technical Specifications

The following specifications apply to the 4532 ATC over the normal (ambient) operating temperature range.

General

Manufacturer	Varec, Inc. Atlanta, USA
Designation	4532 Average Temperature Sensor and Convertor
Function	Average temperature (Liquid, Gas) profile

System Design

Number of elements	2 – 6 points
Measuring element	Platinum (Pt. 100), Class A element, multi spot configuration (standard type) PUB 751 1983
Measuring range	–20... + 100 °C, –4... +212 °F (standard)

Physical

Enclosure	IP65 Explosion-proof die-cast epoxy-coated aluminium PF 3/4" (NPS 3/4") universal coupling
Flange material	SUS304
Flange size (Process connection)	ANSI 150 lbs. 2" RF (SUS304) DIN DN50 PN10RF (SUS304) Others (optional)
Probe material	SUS 316 flexible tube SUS 316 flexible tube + SUS316 armoured mesh.... pending
Conduit entries	NPT ½ M20
Element position (standard)	Fixed interval of 2 or 3 meters
Flexible tube minimum installation height	400 mm from tank bottom

Field Communications

Output	2-wire, HART multi drop
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Power

Power supply	DC16–30V Normally the 6000 Servo Tank Gauge or the 4590 Tank Side Monitor will supply DC24V ±10% on i.s. HART communication line.
Current consumption	The 4532 ATC consumes fixed current of average 6.0 mA constantly.
Input	16.... 30VDC (via HART line from host gauge)

Environmental

Ambient temperature	–40 °F and +185 °F (–40 °C and +85 °C) Converter (housing)
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Performance

Accuracy of conversion	±0.1 °C (±0.4 °F), or better
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Certifications and Approval

CE approval 4532 ATC meets the legal requirement of the EC-guidelines. Varec confirms the instrument passing required tests by attaching the CE-mark.
Factory Mutual (FM) IS class1, Division 1, Groups A–D....pending
ATEX EEx [ia] IIB T4 –T6

Product Dimensions

See Page 10.

4535 ATC Technical Specifications

The following specifications apply to the 4535 ATC over the normal (ambient) operating temperature range.

General

Manufacturer	Varec, Inc. Atlanta, USA
Designation	4535 Average Temperature Convertor
Function	Average temperature (Liquid, Gas) profile

System Design

Number of elements	2 – 16 points
Measuring element	Platinum (Pt. 100), Class A element, multi spot configuration (standard type) PUB 751 1983 and / or JIS 1604 01989
Measuring range	–20... + 100 °C, –4... +212 °F (standard) –50... + 200 °C, –58... +392 °F (wide range) –18... + 80 °C, 0... +176 °F (PTB W&B)

Physical

Enclosure	Explosion-proof die-cast epoxy-coated aluminium PF 3/4" (NPS 3/4") universal coupling
Flange material	Mild steel (standard) SS304 / 316 (optional)
Flange size (Process connection)	JIS 10K 50A RF ANSI 150 lbs. 2" RF JPI 150 lbs. 2" RF DIN DN50 PN10RF Others (optional)
Flexible tube	Inner tube – SS316
	Outer mesh – SS304
Conduit entries	G (PF) ½ NPT ½ PG16 M20
Element position (standard)	Lowest 100 mm (3.9") above bottom of flexible tube Highest 1000 mm (39.4") below flange surface
Flexible tube minimum installation height	400 mm from tank bottom

Field Communications

Output	2-wire, HART multi drop
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Power

Power supply	DC16–30V Normally the 6000 Servo Tank Gauge or the 4590 Tank Side Monitor will supply DC24V $\pm 10\%$ on i.s. HART communication line.
Current consumption	The 4535 ATC consumes fixed current of average 9.0mA constantly. The current consumption shifts ± 0.5 mA from 9.0mA during sending and receiving HART signal to the host gauge as the 6000 Servo Tank Gauge or the 4590 Tank Side Monitor.

Environmental

Ambient temperature	–4 °F and +140 °F (–20 °C and +60 °C) Converter (housing)
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Performance

Accuracy of element	$\pm(0.15 + 0.002 t)$ °C, ($\pm 0.3 + 0.004 t $) °F or better
Accuracy of conversion	± 0.25 °C (± 0.5 °F), or better
Total accuracy	$\pm\{0.25 + \pm(0.15 + 0.002 t)\}$ °C, $\pm\{0.5 + (\pm 0.3 + 0.004 t)\}$ °F

Certifications and Approval

CE approval 4535 meets the legal requirement of the EC-guidelines. Varec confirms the instrument passing required tests by attaching the CE-mark.
ATEX EEx ia IIB T4 and T2
Factory Mutual (FM) IS Class 1, Division 1, Groups C & D,

Product Dimensions

See page 10.

4539 ATC Technical Specifications

The following specifications apply to the 4539 ATC over the normal (ambient) operating temperature range.

General

Manufacturer	Varec, Inc. Atlanta, USA
Designation	4535 Average Temperature/Water Bottom Sensor and Convertor
Function	RTD average temperature signal to HART conversion RTD average temperature measurement + HART converter Capacitance water interface measurement + HART converter Average temperature & Water interface measurement + HART converter

System Design

Compatible element type	Pt100 (MST) Cu90 (MST, MRT) PtCu100 (MRT) Cu100 (MRT)
Number of elements	Maximum of 16 can be connected to the convertor Note! 4539 Converter + Temp. version has only Pt100 elements installed. The element types above can be utilised in foreign average temperature probes, such as the Varec 9909, 1700 or Weed Beacon MWR. Other manufacturer multi-resistant and multi-spot average temperature probes may be compatible. Please consult your Varec representative for further details.

Physical

Enclosure	Explosion-proof die-cast epoxy-coated aluminium Weather Proof – IP 65
Process connection	PF 3/4" (NPS 3/4") universal coupling M20, Varec 1700 probe connection only
Conduit entries	G (PF) ½ NPT ½ PG16 M20

Field Communications

Output	Temperature & Water Bottom data via 2-wire intrinsically safe HART protocol.
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Power

Input	16.... 30VDC (via HART line from host gauge)
Power consumption	6mA@16VDC (HART converter only)
	6mA@16VDC (Temp. probe + HART converter)
	12mA@16VDC (Water Bottom sensor + HART converter)
	12mA@16VDC (Temp. probe + Water Bottom sensor + HART converter)

Environmental

Ambient temperature	-40...+85 °C (-40...+185 °F) Converter housing
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Performance

Temperature accuracy	±0.1 °C or less (at reference condition)
Water bottom accuracy	4mm (±2mm) or better (at reference condition)

Temperature Probe Specifications

Temperature element	Class A Pt100, IEC PUB 751 1983 and / or JIS 1604 1989
Installation height adjuster	±360mm threaded, (SUS 316)
Probe material	SUS 316 flexible tube SUS 316 flexible tube + SUS316 armoured mesh.... pending
Operation temperature	-200...+235 °C (-328...+455 °F)
Flange size (Process connection)	JIS 10K 50A RF ANSI 150 lbs. 2" RF JPI 150 lbs. 2" RF DIN DN50 PN10RF Others (optional)

Water Bottom (Capacitance) Sensor Specifications

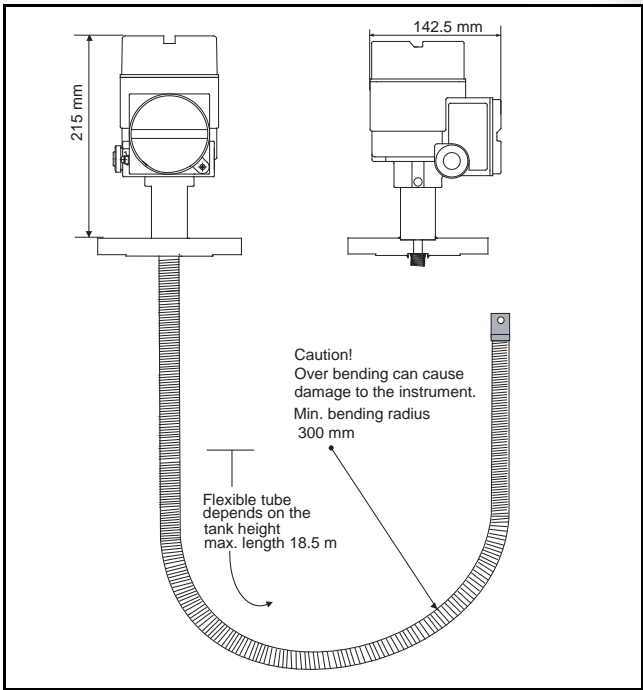
Sensor material	SUS 316 (center rod SUS 304 & PFA protected)
Operation range	1m (3.3 ft) and 2m (6.6 ft)
Operation temperature	-20...+100 °C (-4...+212 °F)
Data transmission	2.5mm coaxial cable & common ground

Certifications and Approval

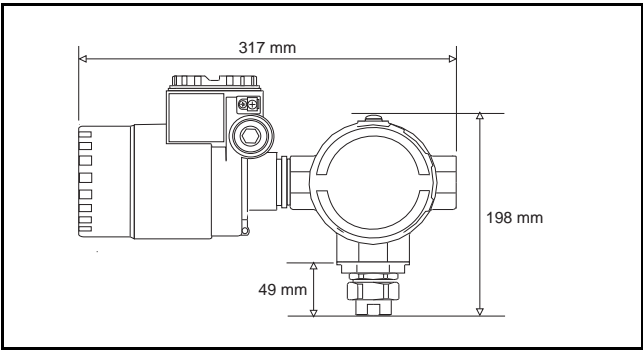
CE approval 4535 meets the legal requirement of the EC-guidelines. Varec confirms the instrument passing required tests by attaching the CE-mark.
ATEX EEx ia IIC T2... T4
Factory Mutual (FM) IS Class 1, Div. 1, Gp. CD...(pending)

Product Dimensions

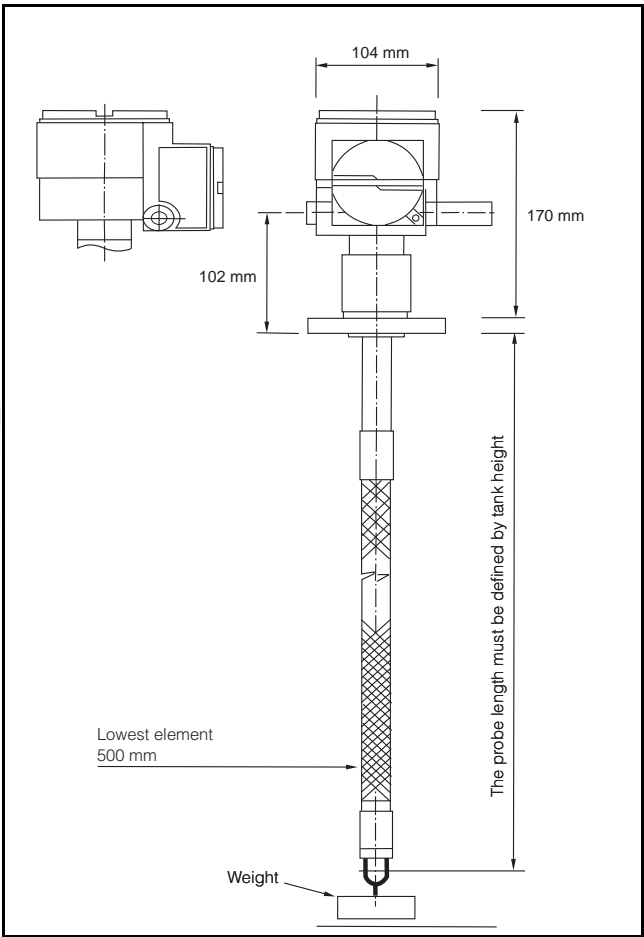
4532 Average Temperature Sensor and Convertor



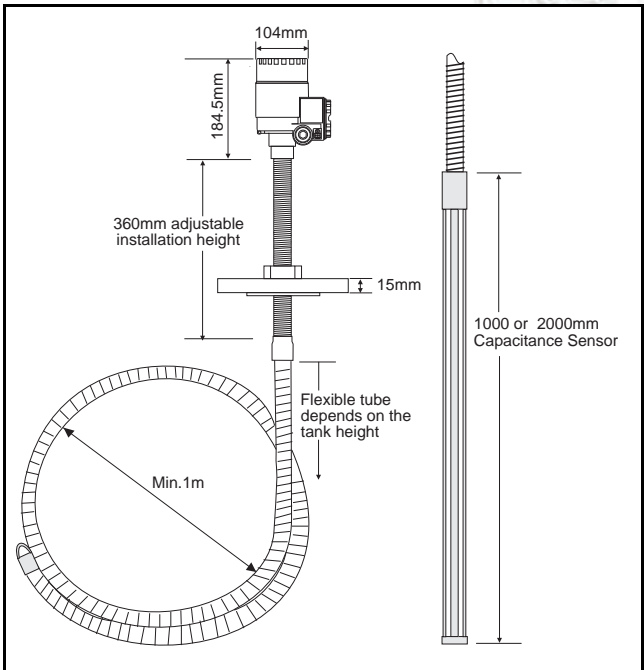
4539 Average Temperature and Water Bottom Convertor



4535 Average Temperature Sensor and Convertor



4539 Flexible Average Temperature and Rigid Water Bottom Sensors



Ordering Codes

4532 Average Temperature Sensor and Convertor

10	Protection class			
	7	FM, IS class1, Div.1, Gr. A-D....pending		
	B	ATEX, EEx [ia] IIC T4 -T6		
20	Cable entry			
	B	Thread NPT 1/2		
	D	Thread M20		
30	Process connection (SUS304)			
	1	2" 150lbs RF, 304 flange ANSI B16.5		
	2	DN50 PN0 B1, 304 flange EN1092-1 (DIN2527 C)		
	9	Special version, to be specified		
40	Element #, Interval, Probe range (Below flange to end of probe)			
	022	...mm; 2x Pt100; 2 m (min 2,500 mm, max 4,500 mm)		
	032	...mm; 3x Pt100; 2 m (min 4,500 mm, max 6,500 mm)		
	042	...mm; 4x Pt100; 2 m (min 6,500 mm, max 8,500 mm)		
	052	...mm; 5x Pt100; 2 m (min 8,500 mm, max 10,500 mm)		
	062	...mm; 6x Pt100; 2 m (min10,500 mm, max 12,500 mm)		
	023	...mm; 2x Pt100; 3 m (min 3,500 mm, max 6,500 mm)		
	033	...mm; 3x Pt100; 3 m (min 6,500 mm, max 9,500 mm)		
	043	...mm; 4x Pt100; 3 m (min 9,500 mm, max 12,500 mm)		
	053	...mm; 5x Pt100; 3 m (min 12,500 mm, max 15,500 mm)		
	063	...mm; 6x Pt100; 3 m (min 15,500 mm, max 18,500 mm)		
50	Specific probe length, Length within selected item at Pos. 040(UP to max. 18,500)			
	A	Not selected		
	B	Anchor weight, tall profile		
	C	Anchor weight, low profile		
	D	Tensioning wire, wire hook, top anchor		
4532 -				Complete product designation

4535 Average Temperature Sensor and Convertor

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4539 Average Temperature/Water Bottom Sensor and Convertor

10	Protection class				
	0	Protection: Waterproof IP 65			
	7	IS class1 Div1 Gp ABCD, FM... pending			
	B	EEx ia IIC TB -T6, ATEX			
	9	Special version			
20	Measuring function				
	0	Converter only			
	1	Temperature + Converter			
	2	Water Bottom + Converter			
	3	Temperature + Water Bottom +Converter			
	4	Temperature +Converter (PTB, NMI T&W)...pending			
	5	Temperature +Water Bottom + Converter (PTB, NMI T&W)...pending			
30	Temp. measuring range				
	0	Temp. device not selected			
	1	-40...+100 °C (-40...+212 °F)			
	2	-55...+235 °C (-67...+455 °F)			
	4	-18...+80 °C (-0.4...+176 °F) (W&M only)...pending			
	9	Special version			
40	Water Bottom measuring range				
	0	Water Bottom device not selected			
	1	1 m (3.3 ft)			
	2	2 m (6.6 ft)			
	9	Special version			
50	Cable entry				
	A	1 x G (PF) ½, thread			
	B	1 x NPT ½, thread			
	C	1 x PG16, thread			
	D	1 x M20, thread			
	Y	Special version			
60	Process connection				
	0	JIS 10K 50A RF, flange			
	1	ANSI 2" 150lb RF, flange			
	2	DIN DN50 PN 10RF, flange			
	3	JPI 50A150lb RF, flange			
	4	PF 3/4" (NPS 3/4"), universal coupling...Converter only Type 1			
	5	M20, thread...Converter only Type 2			
	9	Special version			
70	Number of elements				
	A	2...Pt100 elements			
	B	3...Pt100 elements			
	C	4...Pt100 elements			
	D	5...Pt100 elements			
	E	6...Pt100 elements			
	F	7...Pt100 elements			
	G	8...Pt100 elements			
	H	9...Pt100 elements			
	J	10...Pt100 elements			
	K	11...Pt100 elements			
	L	12...Pt100 elements			
	M	13...Pt100 elements			
	N	14...Pt100 elements			
	O	15...Pt100 elements			
	P	16...Pt100 elements			
	Q	Element not selected			
	Y	Special version			

Continued...

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80										Element spacing										
										1	2000 mm									
										2	1500 mm									
										3	1500 mm									
										4	Custom element position & spacing									
										5	Element spacing: 3000 mm									
										6	Spacing not selected									
										7	UK Standard (Convertor Only)									
										9	Special version									
90										Probe length 3 ft to 98 ft below flange to edge of probe price per 3ft (1000 mm)										
										A	mm probe length									
										B	Probe not selected									
										Y	Special probe version									
100										Mounting attachment										
										A	No installation material									
										B	Anchor weight (Tall profile)									
										C	Anchor weight (Short profile)									
										D	Tensioning wire + top anchor									
										Y	Special version									
N4539-											Complete product designation									





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Your Official Representative

If no official representative is listed here, please visit www.varec.com to find your local representative.
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