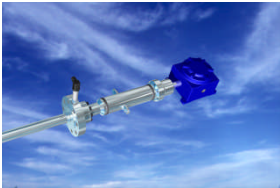
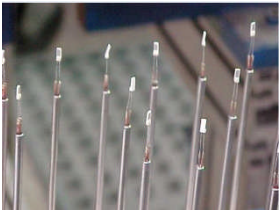


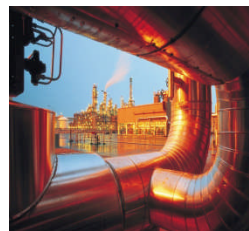
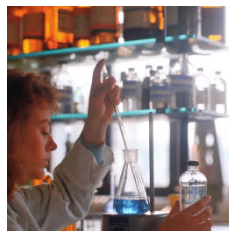
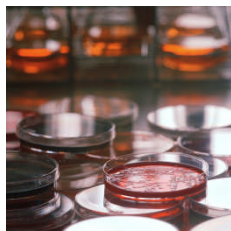
Products	Solutions	Services
Misure di Temperatura con RTD e TC AIS 2015 – 17th September – Endress+Hauser Sicestherm Pessano c. Bornago Engineered solution: Skin point, High temperature TC, Multipoint		
 Reliable in experience and technology. Endress+Hauser Sicestherm Pessano c. Bornago Associazione Italiana Strumentisti ISA Italy Section		
Slide 1	07/16/2015	Dino Mariani
Endress+Hauser  People for Process Automation		

AIS 17/09/2015 - Temperature Engineered solution, Skin Point, High Temperature TC, Multipoint		
Misure di Temperatura: Agenda		
■ Cenni storici		
■ Teoria RTD e TC		
■ Assiemi Termometrici /Thermowell		
■ Applicazioni Skin Point		
■ Applicazioni TC alta temperatura		
■ Applicazioni Multipoint / Octoplus		
Slide 2	07/16/2015	Dino Mariani
Endress+Hauser  People for Process Automation		

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Misure di Temperatura

- La temperatura è la grandezza fisica fondamentale per la caratterizzazione di processi fisici, chimici, biologici
- In quasi tutti i settori industriali è richiesta la misura ed il controllo della temperatura
- Nei processi industriali i punti di misura Temperatura sono i più numerosi



Slide 3

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Cenni storici

- Fino a circa il 1550 non si aveva ancora una distinzione chiara tra temperatura e calore
- Primo termometro inventato da G. Galilei attorno al 1600 bulbo di vetro con attaccato un tubo (termoscopio basato sull'espansione e sulla contrazione dell'aria interna al bulbo)

Slide 4

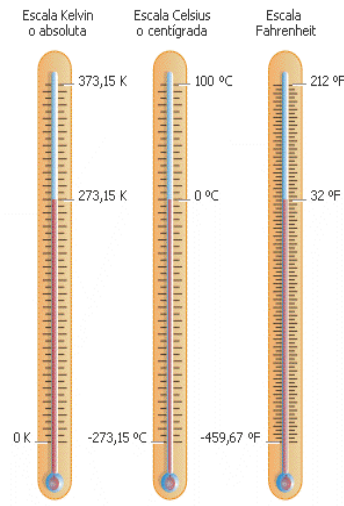
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Cenni storici

- Nel 1714 G. D. Fahrenheit perfeziona i termometri ad alcol e mercurio simili agli attuali termometri a liquido-in-vetro in essi comincia ad essere usata la scala Fahrenheit
- Nel 1740 Anders Celsius introduce la scala centigrada
- William Thomson – 1st Baron of Kelvin (1824-1907) Nel 1848 viene definita la scala Kelvin minima temperatura (zero assoluto) = -273°C



Unita' di misura

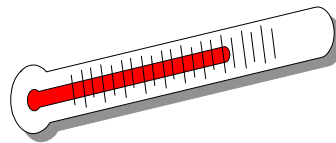
- Scala Celsius: che assegna 0 al punto di fusione del ghiaccio e 100 al punto di ebollizione dell'acqua. L'intervallo e' diviso in 100 parti ($^{\circ}\text{C}$)
- Scala Kelvin: è una scala assoluta riferita alla scala Celsius: lo zero della scala coincide con lo zero assoluto $0^{\circ}\text{K} = -273,15^{\circ}\text{C}$
- Scala Fahrenheit: scala che assegna 32 al punto di fusione del ghiaccio e 212 al punto di ebollizione dell'acqua: l'intervallo è diviso in 180 parti ($^{\circ}\text{F}$)
- Scala Rankine: é una scala assoluta riferita alla scala Fahrenheit: lo zero della scala coincide con lo zero assoluto $0^{\circ}\text{R} = -459,67^{\circ}\text{F}$

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Unita' di misura

■ La temperatura si indica solitamente con:

- T per le temperature su scale assolute
 - Kelvin (sistema internazionale)
 - Rankine (sistema inglese)
- t per le temperature su scale relative
 - Celsius (sistema internazionale)
 - Fahrenheit (sistema inglese)



Slide 7

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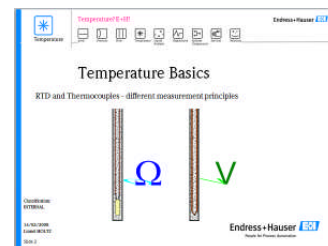
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Misure di Temperatura

- Cenni storici
- Teoria RTD e TC
- Complessi Termometrici /Pozzetti
- Applicazioni Skin Point
- Applicazioni TC alta temperatura
- Applicazioni Multipoint / Octoplus



Slide 8

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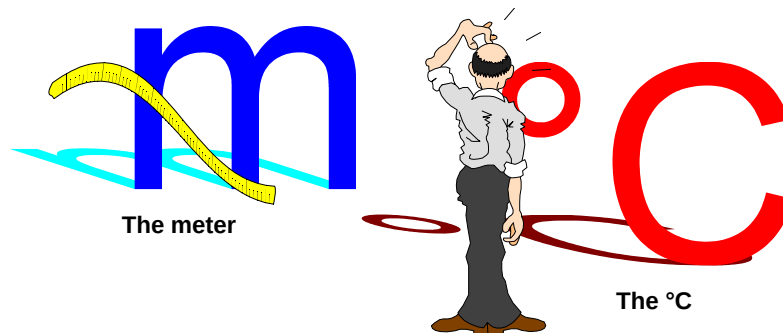
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Definizione e misurazione

- La TEMPERATURA è il livello termico di un corpo quindi lo stato di freddo e di caldo che viene raggiunto dopo la somministrazione o meno di calore
- La t non può essere materializzata.
- Non è possibile la misurazione diretta della Temperatura



Slide 9

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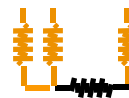
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Principio fisico: RTD e TC

- Trasduttori tradizionali per la misura della Temperatura
 - Termometri a dilatazione di liquidi (mercurio)
 - Termometri a dilatazione di solidi (bimetalli)
 - Termistori (PTC-NTC)

Termometri a resistenza



Termocoppie



Slide 10

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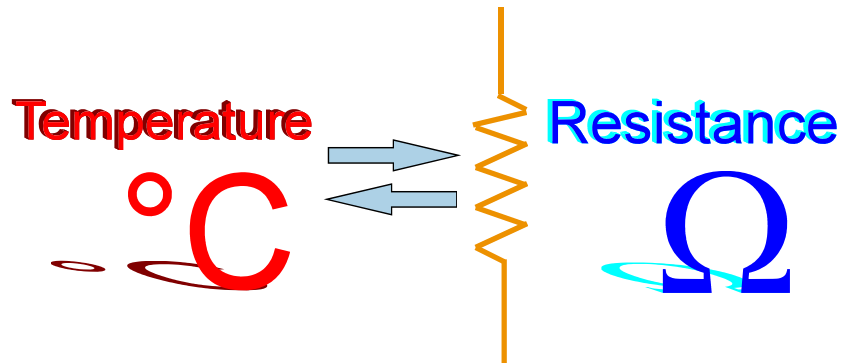
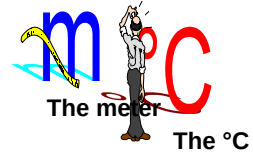
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Principio fisico - RTD

- E' possibile la misura indiretta della temperatura...
- Misurando il valore della resistenza



Slide 11

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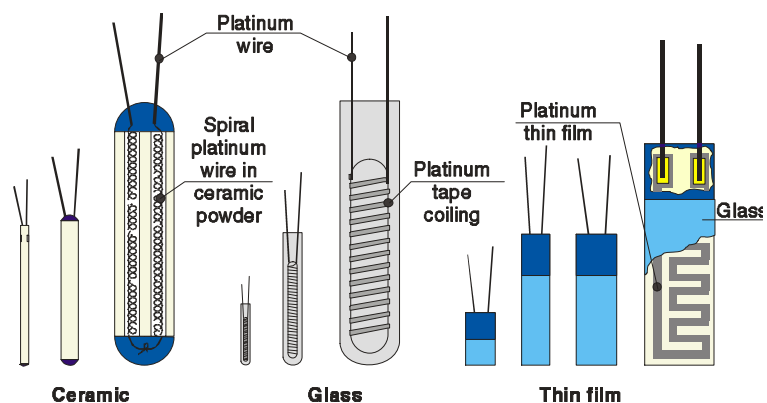
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Elementi sensibili - RTD

Temperature measurements "Platinum - measuring resistance"



Slide 12

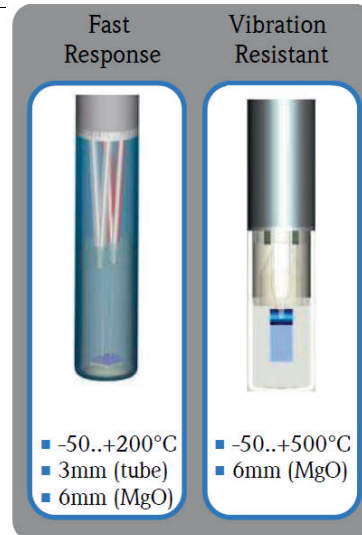
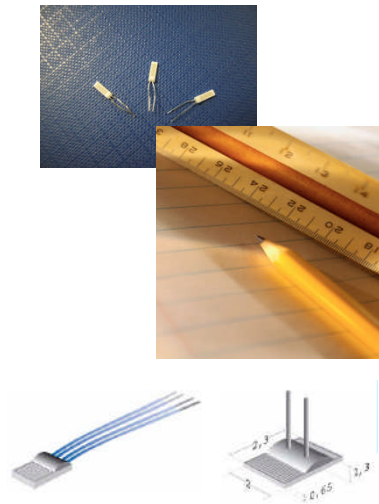
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Elementi sensibili - RTD



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Slide 13

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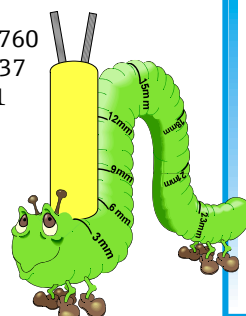
Normative e Tolleranze RTD

Tolleranze e precisioni

- DIN B
- DIN A
- DIN AA (1/3 DIN)
- 1/5 DIN
- 1/10 DIN

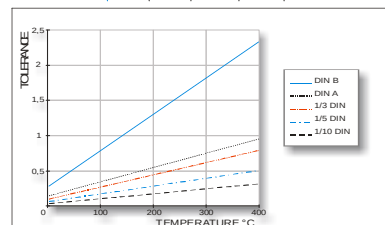
Normative

- DIN 43760
- UNI 7937
- IEC 751



TOLERANCE VALUES OF THERMORESISTANCE AS A FUNCTION OF THE TEMPERATURE

°C	DIN B	DIN A	1/3 DIN	1/5 DIN	1/10 DIN
0	0.3	0.15	0.1	0.06	0.03
100	0.8	0.35	0.27	0.17	0.1
200	1.3	0.55	0.44	0.28	0.17
300	1.8	0.75	0.61	0.39	0.24
400	2.3	0.95	0.78	0.5	0.31



SENSOR	CLASS B	CLASS A	CLASS 1/3 B
Pt 100	0.3+0.005 t	0.15+0.002 t	0.1+0.0017 t
Pt 500	0.3+0.005 t	0.15+0.002 t	
Ni 120	0.4+0.007 t		

SENSOR	CLASS 1/3 B	CLASS 1/5 B	CLASS 1/10 B
Pt 100	0.1+0.0017 t	0.06+0.0011 t	0.03+0.0007 t
field		0...+650°C	

Slide 14

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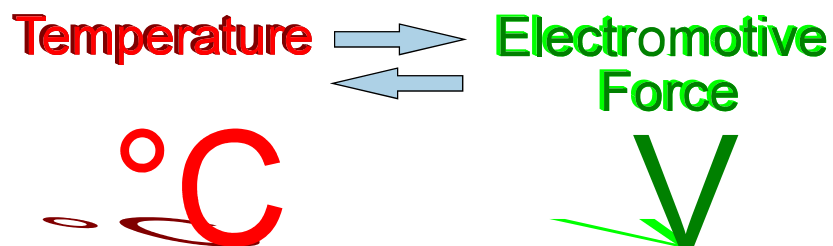
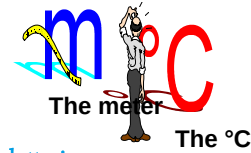
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Principio fisico - TC

- E' possibile la misura indiretta della temperatura...
- E' misurata la forza elettromotrice generata da due conduttori



Slide 15

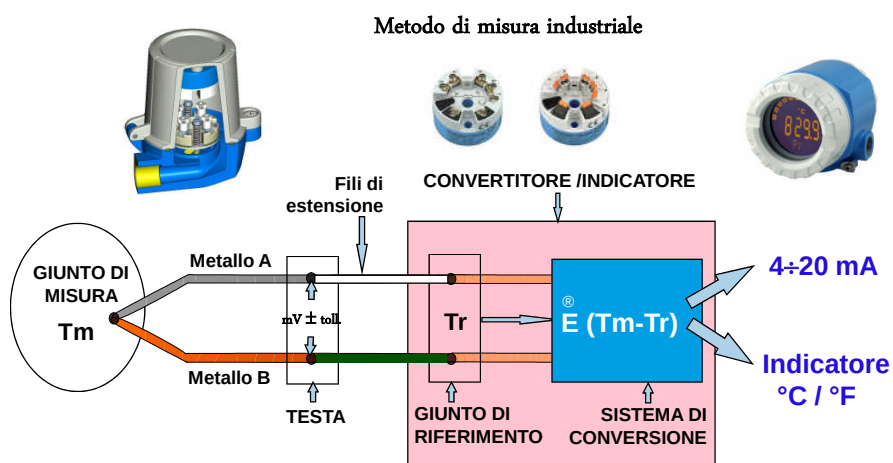
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Collegamento elettrico -TC



Slide 16

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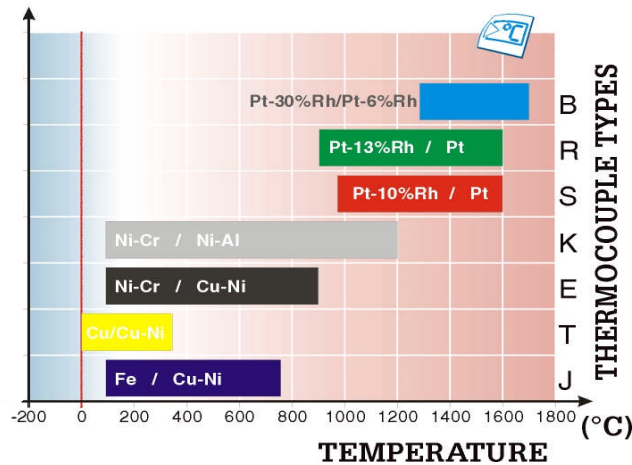
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Tipi di termoelementi-TC

USEFUL TEMPERATURE RANGE



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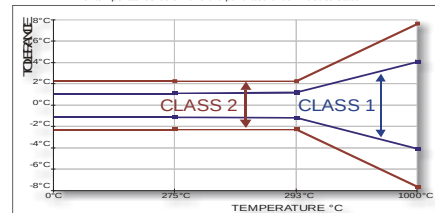
Normative e Tolleranze TC

- Tipi di termocoppie
 - S, R, B, E, J, K, T, N, L, U, W3, W5
- Tolleranze e precisioni
 - tolleranza STD Gr II
 - tolleranza SPECIAL Gr I
- Normative
 - IEC584.2, ASTM
 - DIN 43710
 - ANSI C96.1

TOLERANCE VALUES OF THERMOCOUPLE AS A FUNCTION OF THE TEMPERATURE

Type	Temperature range °C	Tolerances	
		Standard °C (whichever is greater)	Special °C (whichever is greater)
T	0 to 370	±1 or ±0.75%	±0.5 or ±0.4%
J	0 to 760	±2.2 or ±0.75%	±1.1 or ±0.4%
E	0 to 870	±1.7 or ±0.5%	±1.1 or ±0.4%
K	0 to 1260	±2.2 or ±0.75%	±1.1 or ±0.4%
R or S	0 to 1480	±1.5 or ±0.25%	±0.6 or ±0.1%
B	870 to 1700	±0.5%	±0.25%
T*	-200 to 0	±1 or ±1.5%	
E*	-200 to 0	±1.7 or ±1%	
K*	-200 to 0	±2.2 or ±2%	

* Thermocouples and thermocouples materials are normally supplied to meet the tolerances specified in the table for temperatures above 0°C. If materials are required to meet the tolerances stated for temperatures below 0°C the purchase order must so state.



CLASS 2 (STANDARD) and CLASS 1 (SPECIAL) in comparison

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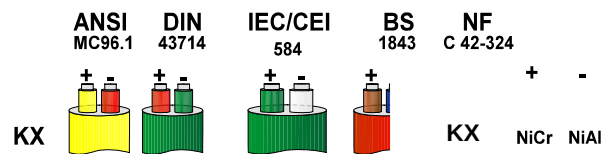
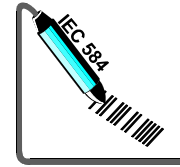
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Cavi compensati e d'estensione TC

Building blocks

- ➔ L'inserto-
- ➔ the connecting wires (IEC 584)

IEC 584, ANSI MC96.1, DIN 43714, BS 1843,
NF C 42-324, etc. standards identify the extension cables (X)
and the compensating cables (C) of TC.



Colorazione Cavi compensati e d'estensione TC

IDENTIFICATION SYSTEM FOR EXTENSION AND COMPENSATING CABLES OF THERMOCOUPLES

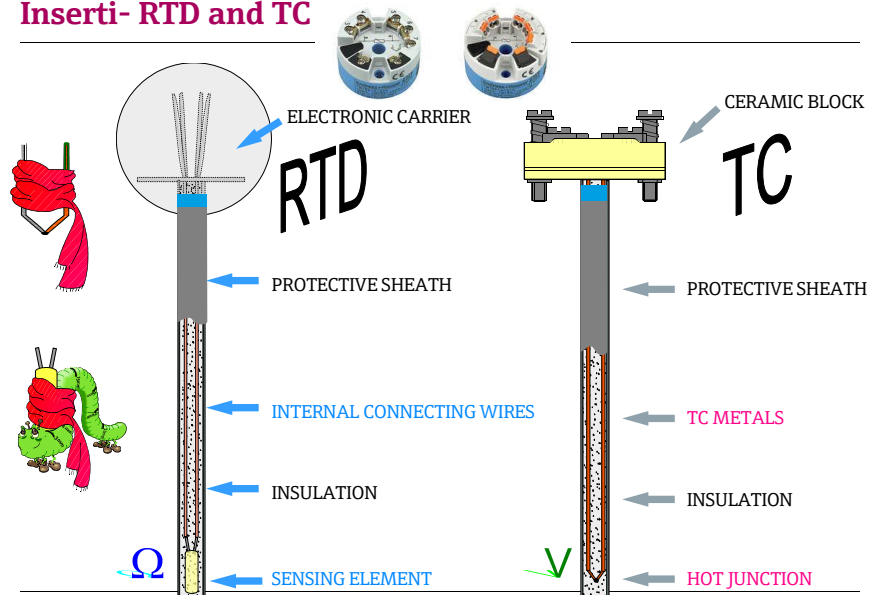
	ANSI MC96.1	DIN 43714	IEC/CEI 584	BS 1843	NF C 42-324	
JX						Fe ⁺ CuNi ⁻
KX						NiCr ⁺ NiAl ⁻
TX						Cu ⁺ CuNi ⁻
EX						NiCr ⁺ CuNi ⁻
WX						Fe ⁺ CuNi ⁻
VX						Cu ⁺ CuNi ⁻
SX						Cu ⁺ Cu11 ⁻

DIN 43714 IEC/CEI 584

You can find the JX and SX and TX cables.
Extension and compensating cables are used for the electrical connection between the open ends of a thermocouple and the reference junction in those installations where the conductors of thermocouples are not directly connected to the reference junction.
Extension cables are manufactured from conductors having the same nominal composition as those of the corresponding thermocouples.
Compensating cables are manufactured from conductors having a composition different from the corresponding thermocouples.
They are designed by a factor of 2 following the direction of the thermocouple.
Cables follow the same color coding as the corresponding thermocouples.
Cables follow the same color coding as the corresponding thermocouples.
Cables follow the same color coding as the corresponding thermocouples.

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Inserti- RTD and TC



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Misure di Temperatura

- Cenni storici
- Teoria RTD e TC
- Complessi termometrici /Thermowell
- Applicazioni Skin Point
- Applicazioni TC alta temperatura
- Applicazioni Multipoint / Octoplus



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Complessi termometrici

- I vari componenti e materiali devono soddisfare e proteggere l'inserto termometrico dalle criticità del processo:

- temperatura
- pressione
- corrosione
- abrasione
- velocità
- certificazioni ambientali e di sicurezza
-



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Complessi termometrici igienici



ASME
SETTING THE STANDARD
Bioprocessing
Equipment

FDA

CERTIFIED
ehedc
HYGIENIC ENGINEERING & DESIGN

A3

Slide 24

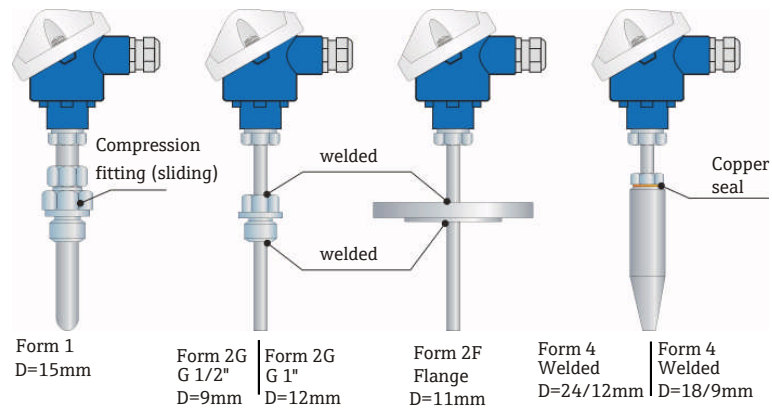
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Compressi termometrici-Thermowell design



Thermowell design according to DIN 43772: tube and round bar thermowell.

Slide 25

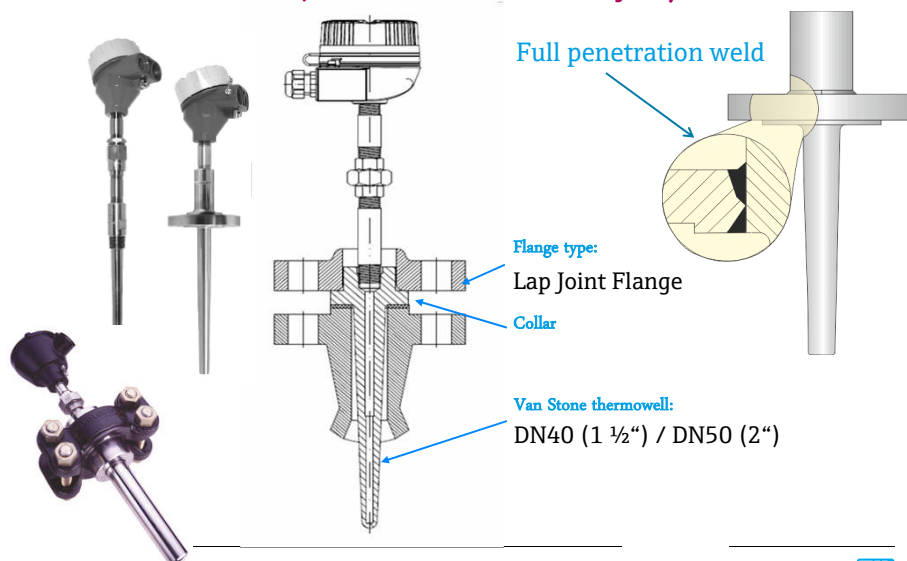
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Compressi termometrici Heavy Duty Construction ASME (ENI- MEU-Shell-API- Grayloc)



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Standard philosophies for branch

Temperature EU-style



- DIN standard (new DIN 43772)
- Pipe thermowells (9, 11, 13 mm)
- Intrinsic safety protection mode (ATEX)
- Stainless steel 316Ti (1.4571)
- Mainly dedicated to light chemical, pharma
- NAMUR recommendations for RFI and insets
- Head transmitters in DIN housings
- Profibus PA Fieldbus



Temperature U.S.-style



- ANSI/ASME standards
- Bar stock thermowells
- Explosion proof protection mode (FM, CSA)
- Stainless steel 316/316L (W. 1.4404)
- Dedicated to Petrochemical, heavy chemical
- Field transmitter (HART) mainly stand alone / remote
- Foundation Fieldbus



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Sicurezza e osservanza delle norme

PUZZLE della sicurezza in impianto



Integrità meccanica
IP, PED, WPS, ..

Hygienic design
3-A, EHEDG, FDA

Corretta applicazione

Sicurezza funzionale:
SIL, SIS, WH&G

Compatibilità ambientale
ATEX, FM, CSA



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Calcolo Verifica Pozzetti

Key Features and Customer Value:

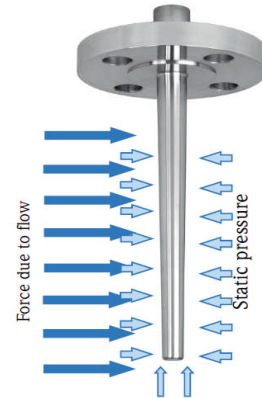
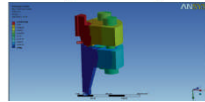
Thermowell calculation according to:

- ASME PTC 19.2 TW-2010
- DIN 43772

Additional calculation of:

- DIN 43772 E+H Extended (more accurate calculation of the natural frequency)
- Check of the Process Connection
- Check of the Buckling Load

→ Safety due to proven mechanical stability of complete thermowell



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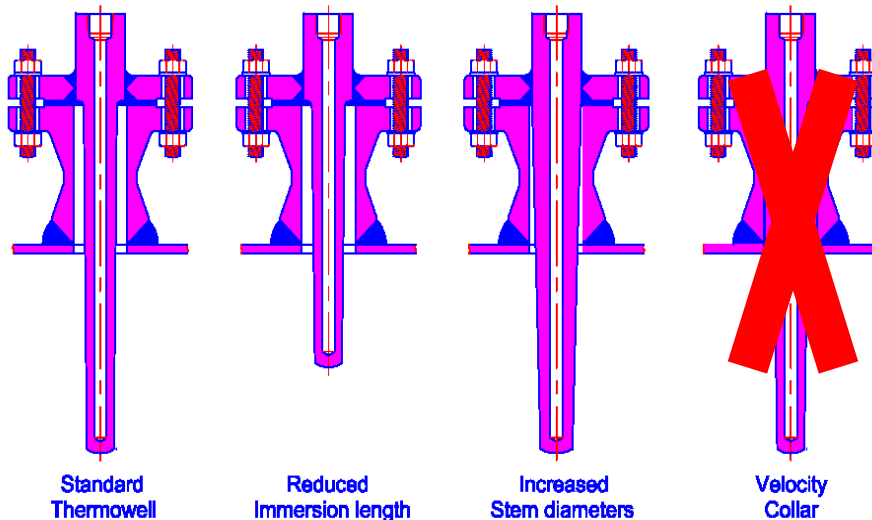
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Calcolo di verifica ASME 19.3-2010 e design pozzetti



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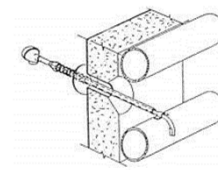
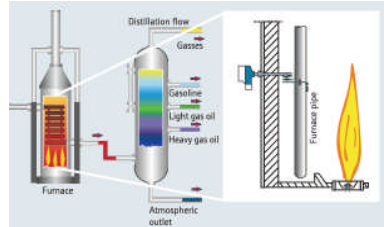
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AIS 17/09/2015 - Temperature Engineered solution, Skin Point, High Temperature TC, Multipoint

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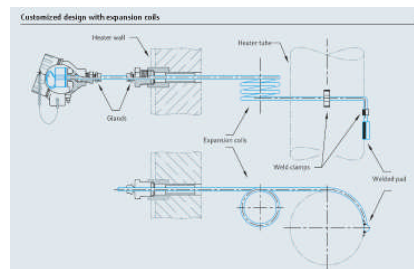
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AIS 17/09/2015 - Temperature Engineered solution, Skin Point, High Temperature TC, Multipoint

SkinPoint-Furnaces-fired heaters

- Per monitorare la **temperatura di superfici** calde di reattori o tubazioni
- Vantaggi: **misura non invasiva**, non perturba il flusso del fluido di processo del cliente
- Punto di misura tenuto **a contatto con la superficie** da misurare tramite saldatura o clamps
- **Compensazione delle dilatazioni termiche** tramite extra-lunghezze (coil)



Slide 32

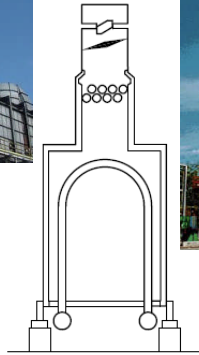
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Dino Mariani

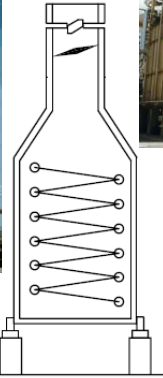
Endress + Hauser 

AIS 17/09/2015 - Temperature Engineered solution, Skin Point, High Temperature TC, Multipoint

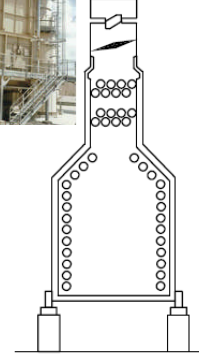
SkinPoint-Furnaces-fired heaters



a) Box heater with arbor coil



b) Cylindrical heater with helical coil



c) Cabin heater with horizontal tube coil

Slide 33

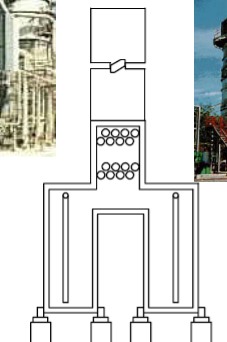
07/16/2015

Dino Mariani

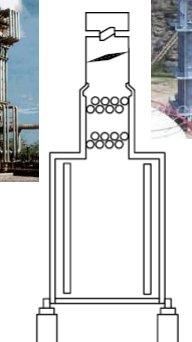
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AIS 17/09/2015 - Temperature Engineered solution, Skin Point, High Temperature TC, Multipoint

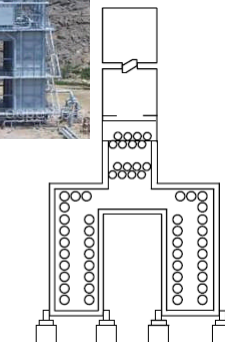
SkinPoint-Furnaces-fired heaters



d) Box heater with vertical tube coil



e) Cylindrical heater with vertical coil



f) Box heater with horizontal tube coil

Slide 34

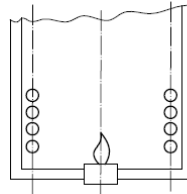
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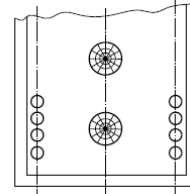
Endress + Hauser 

AIS 17/09/2015 - Temperature Engineered solution, Skin Point, High Temperature TC, Multipoint

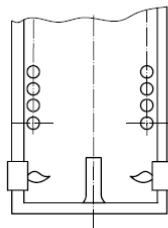
Typical Burner Arrangement



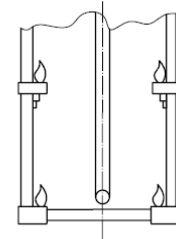
a) Up-fired



b) Endwall-fired



c) Sidewall-fired



d) Sidewall-fired multilevel

Slide 35

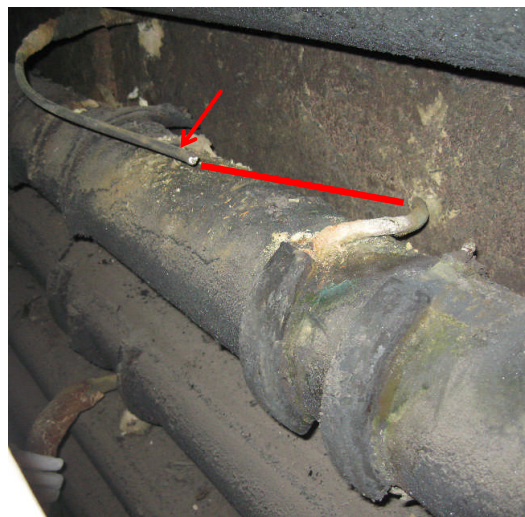
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Corrosion Attack on MgO Cable



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SkinPoint Sheat Material

Materiali

* Verificare il contenuto di Vanadio
 ♦ Verificare la temperatura di lavoro

Tipo di bruciatore	Tipo di combustibile	446 SS	Inconel600	Hastelloy X	HR160 (NiCo)	310 SS	316 SS
Oil Fired	Fuel Oil #2 (Diesel)	✓	✓	✓	✓	✓	✓♦
	Fuel Oil #5	X	X	X*	✓*	X	X
	Fuel Oil #6	X	X	X*	✓*	X	X

Si deve conoscere:

- Processo produttivo del cliente
- Applicazione del prodotto richiesto

Questo permetterà di selezionare al meglio le materie prime e definire il corretto design per costruire il termometro richiesto.

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Temperature – SkinPoint thermometers materials



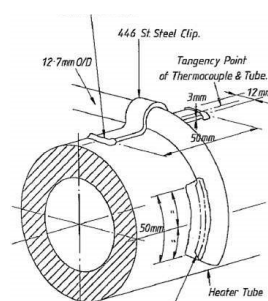
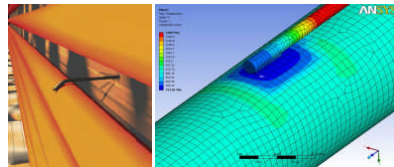
Fan Type



Pad Style



Knife-edge



Thermocouple sheath material	Material used			
	Fan tip	Weld type	Knife-edge type	clips
316 SS	316 SS	316 SS	316 SS	316 SS
310 SS	310 SS	310 SS	310 SS	310 SS
446 SS	446 SS	446 SS	446 SS	446 SS
Inconel 600	Inconel 600	Inconel 600	Inconel 600	Inconel 600
HR160	On request	On request	On request	On request
Hastelloy X	Hastelloy X	Hastelloy X	Hastelloy X	Hastelloy X

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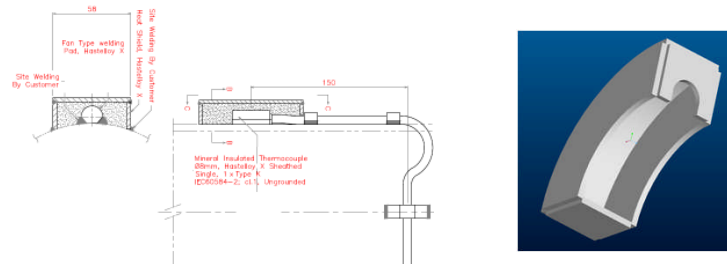
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AIS 17/09/2015 - Temperature Engineered solution, Skin Point, High Temperature TC, Multipoint

Temperature – SkinPoint thermometers

Quando la conduzione non è l'unica ragione di variazione di temperatura, ma sono presenti anche fenomeni di radiazione e convezione, si possono prevedere delle coppelle di protezione.



- La stessa protezione è utile anche contro i fenomeni di abrasione

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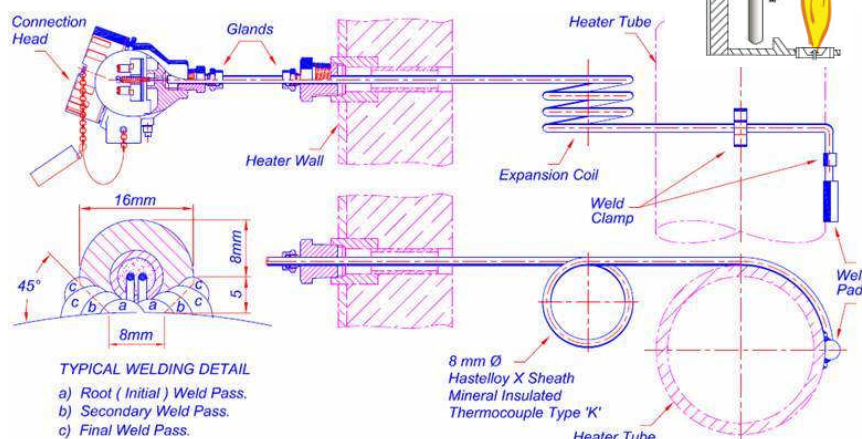
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Temperature – SkinPoint thermometers

SkinPoint Thermometers



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Thermocouple skinPoint - AGIP petroleum patent

Basic Training Temperatura - Applicazioni
Thermocoppie skin-point

TSK100 Caratteristiche tecniche

Questa soluzione permette alla termocoppia di seguire l'espansione dei tubi liberamente nelle 3 direzioni, evitando gli stresses meccanici derivati dal movimento dei tubi di processo

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AIS 17/09/2015 - Temperature Engineered solution, Skin Point, High Temperature TC, Multipoint

TC Skin Quench Ring

Training Temperatura TRC 040 - 060 Engineered Solutions
Customer references: Gasificatore

Installation supervision and results

1. Combustion destructive effects (it's the same ambient where thermocouples work!)

2. Safety chambers before installation

3. Incoloy 825 special bolt installed

4. Thermocouples positioning

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AIS 17/09/2015 - Temperature Engineered solution, Skin Point, High Temperature TC, Multipoint

TC Skin Quench Ring



Temperature

Training Temperatura TRC 040 - 060 Engineered Solutions

Endress+Hauser

Customer references - Italy

2005 - Sarlux - Cagliari (Sardinia) Saras Refinery power generation plant

Nr. 2 measurement temperature systems Octoplus (2 thermocouples per nozzle) for gasifier quench ring (1 reactor IGCC plant)

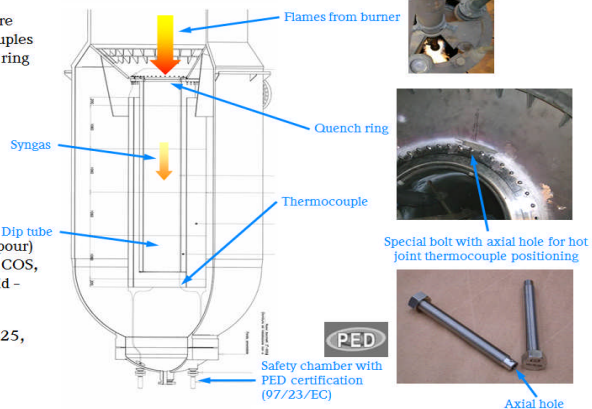
Technical data:

■ TS = $-40 \div +500$ °C

■ PS = 110 barg

■ Process medium: syngas (vapour) containing H_2 , CO , CO_2 , H_2S , COS , NH_3 , HCN , mostly water (liquid - condensate)

■ Material: SS 316L, Incoloy 825, Hastelloy x



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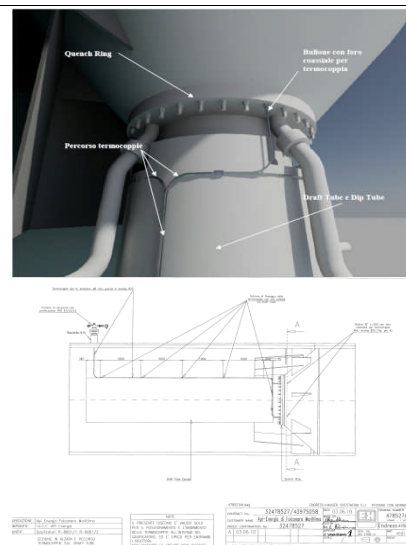
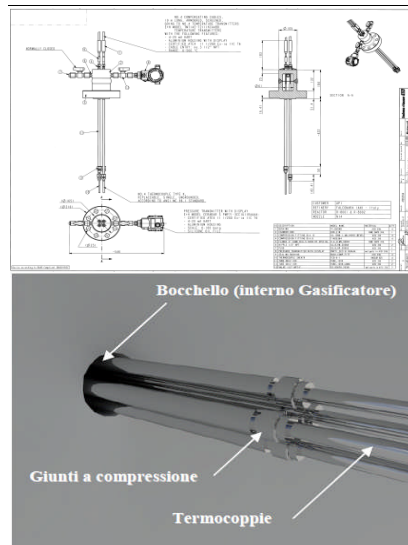
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AIS 17/09/2015 - Temperature Engineered solution, Skin Point, High Temperature TC, Multipoint

TC Quench ring



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TC Skin Quench Ring



Training Temperatura TRC 040 – 060 Engineered Solutions

Endress+Hauser

Customer references: Sarlux

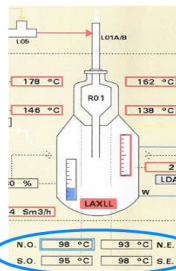
Installation supervision and results



5. Thermocouples crossing process connection



7. Octopus installed



8. Temperatures reading in plants control room and in field

6. E+H Personnel supervision during installation



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AIS 17/09/2015 - Temperature Engineered solution, Skin Point, High Temperature TC, Multipoint

Misure di Temperatura- Claus units, gasificatori, produzione di metalli, cementifici

- Cenni storici
- Teoria RTD e TC
- Complessi termometrici /Thermowell
- Applicazioni Skin Point
- Applicazioni TC alta temperatura
- Applicazioni Multipoint / Octopus



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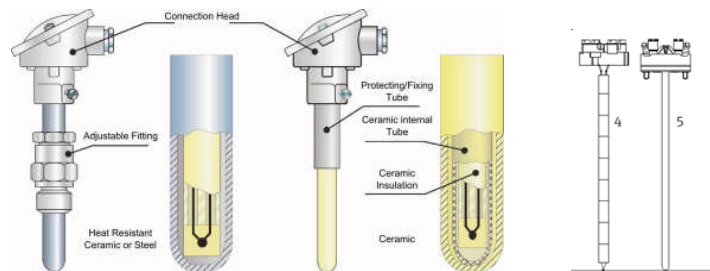
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AIS 17/09/2015 - Temperature Engineered solution, Skin Point, High Temperature TC, Multipoint

Caratteristiche TAF

- **Materiali delle guaine altamente performanti**, sia in termini di resistenza alle alte temperature che a fluidi corrosivi
- Possibilità di **flussaggio con gas inerte** per proteggere i termoelementi
- Termoelementi sostituibili
- Termocoppie con metalli nobili (Platino)



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AIS 17/09/2015 - Temperature Engineered solution, Skin Point, High Temperature TC, Multipoint

Materiali speciali per alte temperature

Cost ↑



Metal materials and specific surface treatments

Ni based alloys, FeCrAl alloys,
Max temp limit: 1200-1300 °C
Porosity: 0%
Thermal Shock resistance: excellent
Machinable materials
Hardness: 185-190 HV



Advanced ceramic materials (SiN, SiC, Kanthal Super):

Max temp limit: 1400 °C (SiN), 1650 °C (SiC), 1700 °C (K. Super)
Porosity: 0% (SiN, K. Super), 8% (SiC)
Thermal Shock resistance: 600 ΔT°C (SiN)
Hardness: >1750 HV/10



Technical ceramics:

Max temp limit: 1700 °C
Porosity: <2 μm
Thermal Shock resistance: good, depending on the porosity grade
Hardness: 8-9 on Mohs' scale



Max
Temp
→

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R&D MAIN ACTIVITIES: HIGH TEMPERATURE

Materials under investigation:

Material	Basic Composition	Temperature Limits	Notes
Kanthal APMT	Cr 22% Al 4-6% Fe Balance	1400°C	Powder metallurgical, dispersion strengthened alloy. High resistant to attack by sulfur. Resist carburization at HT. Better Heat Transfer than ceramic
Kanthal Super	Molybdenum disilicide MoSi ₂	1700°C	Less brittle than ceramic. Excellent in corrosive furnaces. Used for thermowells
Kanthal 333 MA	Cr 25% Ni 35% Si 1.6%	1175°C	Excellent in petrochemical furnaces. Very good resistance to oxidation and carburization.
Haynes HR-160 Alloy	Ni 37% Co 29% Cr 28% Si 2.75% Fe Balance	1205-1260°C	Used for thermocouples protection tubes. Experiences in hazardous waste incinerator, heat exchangers, sulfur plants, cement kilns
Silicon Carbide	SiC>99%	1600°C in oxidizing atmosphere	Excellent thermal shock resistance. High thermal conductivity. Porous but usually with lining refractory for Pt elements

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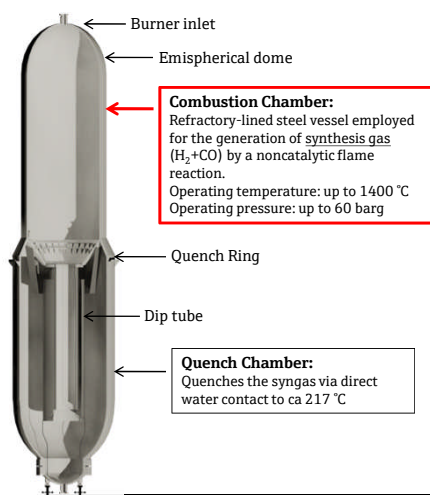
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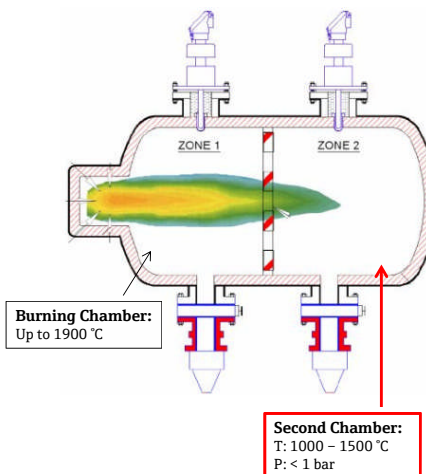
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Special Thermocouples high Temperature

Gasifiers



Sulfur Recovery Units (SRU)



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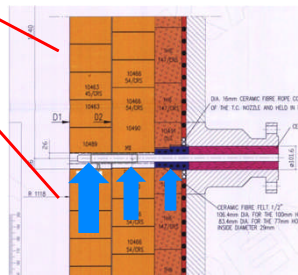
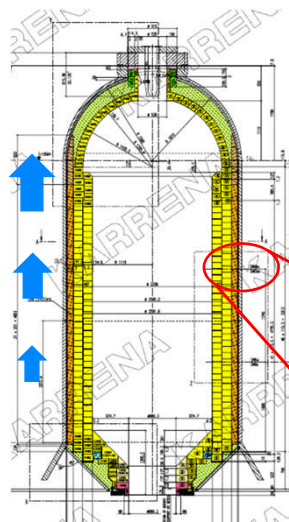
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Special Thermocouples high Temperature

Punti critici: movimento di mattoni

- 3 linee di mattoni refrattari
- Spostamenti diversi creano effetto ghigliottina (ΔT)
- Stress meccanici provocano la rottura delle guaine



Rottura della guaina e perdita del punto di misura



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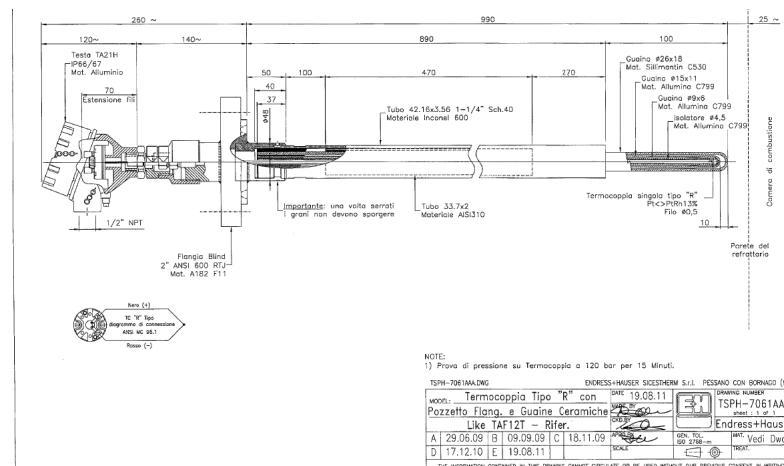
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AIS 17/09/2015 - Temperature Engineered solution, Skin Point, High Temperature TC, Multipoint

Special Thermocouples high Temperature



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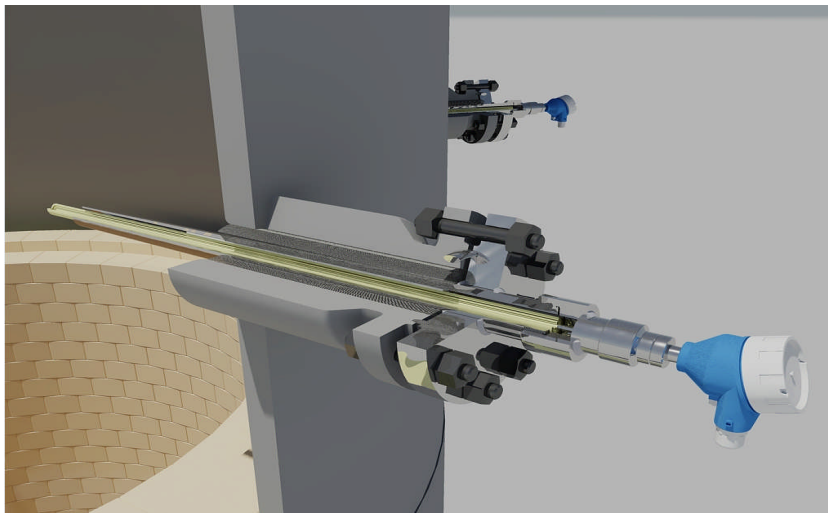
07/16/2015

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Special Thermocouples high Temperature



Slide 53

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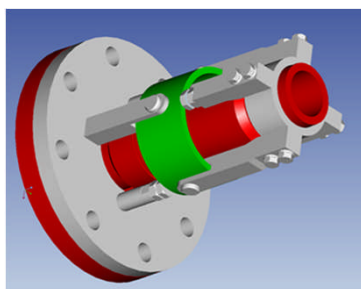
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Special Thermocouples high Temperature

Flexible process connection (field test phase)



ProE model



Real assembly

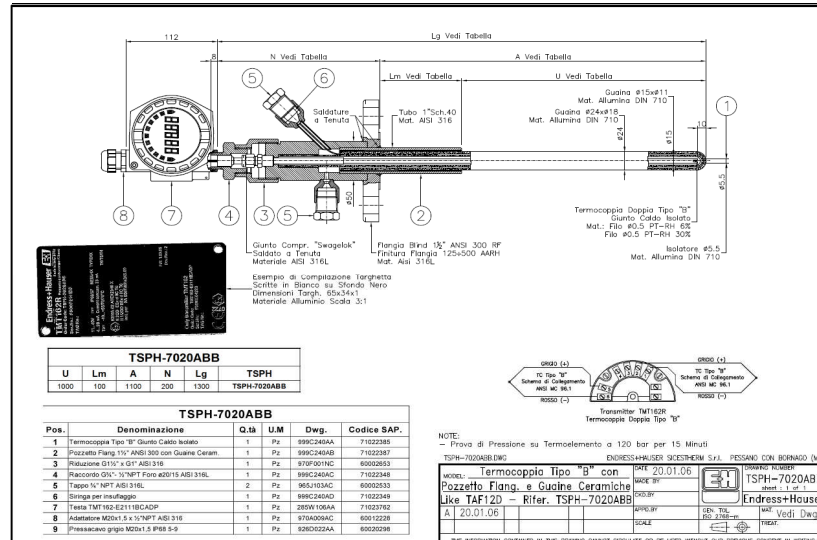
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Special Thermocouples high Temperature



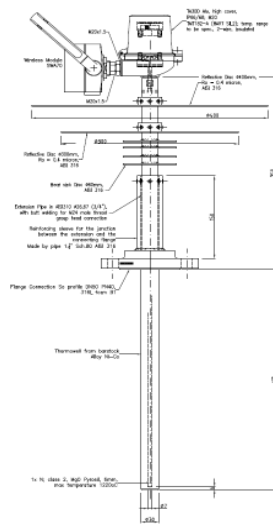
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Prodotti completamente customizzati



TAF + dischi radianti
+
modulo wireless



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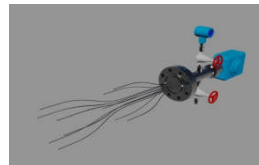
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Multipoint-

- Cenni storici
- Teoria RTD e TC
- Complessi termometrici /Thermowell
- Applicazioni Skin Point
- Applicazioni TC alta temperatura
- Applicazioni Multipoint / Octoplus



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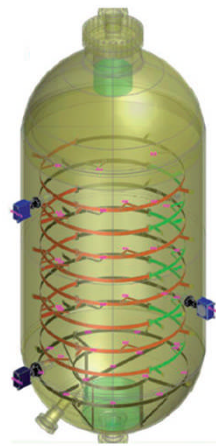
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Multipoint

- Nuove regolamentazioni e l'ottimizzazione dei processi rendono necessario l'incremento del numero di punti di misura per avere più informazioni sul processo
- Controllo/regolazione di sistemi d'allarme sicurezza



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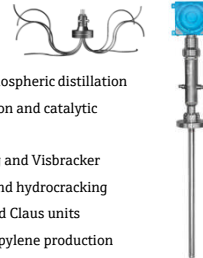
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Multipoint assembly - Typical applications

- Reattori nell'Oil&Gas, Chimico, Petrolchimico
- Tanks, Silos
- Mappare il profilo di temperatura:
 - lungo un asse (straight)
 - nello spazio 3D (Octop(l)us)



- Desalter and Atmospheric distillation
- Vacuum distillation and catalytic reforming
- Catalytic cracking and Visbracker
- Delayed coking and hydrocracking
- Hydrotreating and Claus units
- Ethylene and propylene production
- Any other similar application



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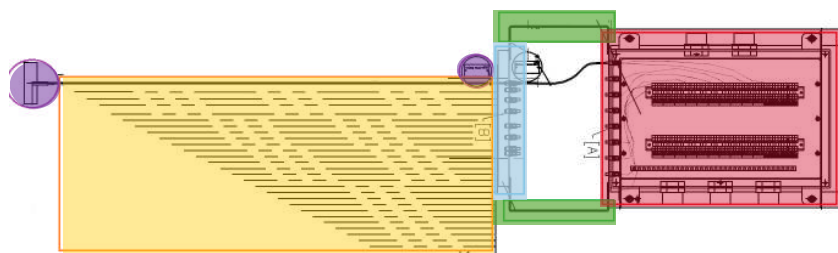
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Struttura generale Multipoint



Multipoint:

Inserto + Connessione al processo + Estensione + Testa
 (+ accessori opzionali)

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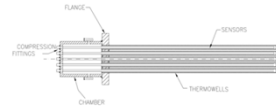
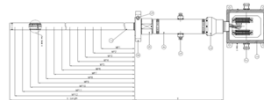
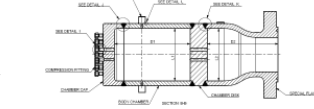
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Multipoint

Caratteristiche aggiuntive:

- Camera diagnostica
- Singoli pozzetti o tubi guida
- Pozzetto primario
- Manometri/valvole/trasduttori di pressione
- Sistemi di flussaggio/drenaggio
- Certificazioni ATEX/PED/GOST/TRCU



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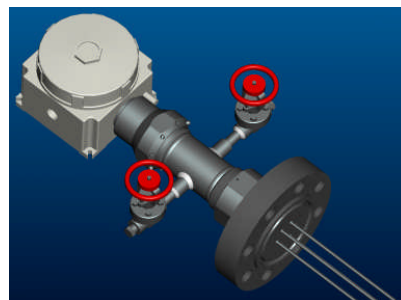
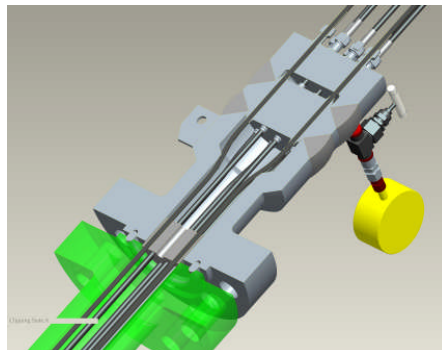
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System reliability & Diagnostic chamber

1st FUNCTION

- Seconda barriera di tenuta
- Contenimento di perdita a causa di fenomeno imprevedibile



2nd FUNCTION

- Monitoraggio continuo del sistema, controllo temperatura di superficie, della pressione e analisi composizione dei fluidi

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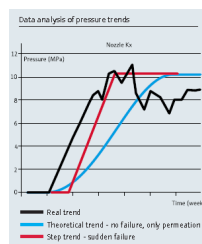
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System reliability – Diagnostic chamber: 2nd FUNCTION

Analisi dei trend di pressione

- Monitorare le performance delle tenute
- E' necessaria una stretta collaborazione da parte del cliente – scambio di informazioni



Analisi della composizione chimica

- Stimare la vita residua del prodotto



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System reliability – Diagnostic chamber: 2nd FUNCTION

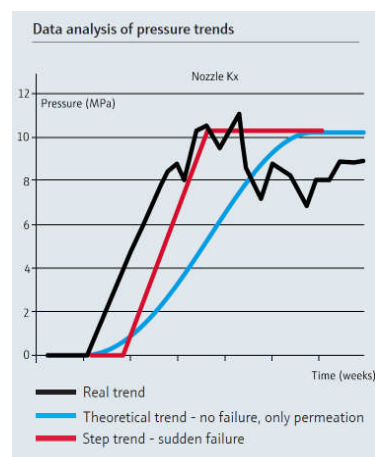
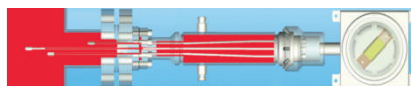
Continuo monitoraggio della strumentazione e gestione del ciclo di vita

Vantaggi

- Sicurezza in impianto
- Pianificazione di attività di manutenzione corretta
- Ottimizzazione di parti di ricambio
- Costi e risparmio di tempo

Dove:

- Per prodotti montati in ambienti corrosivi
- Per prodotti montati in condizioni critiche



Diagnostic concept – Additional features

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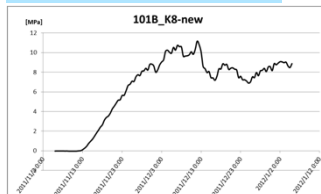
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AIS 17/09/2015 - Temperature Engineered solution, Skin Point, High Temperature TC, Multipoint

System reliability – Diagnostic chamber: 2nd FUNCTION

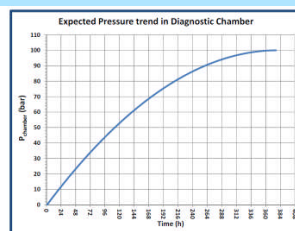
Detected pressure trend



Detected fluid composition

Sampling date		1	2	3
Nozzle		A	B	C
Chemical Element	C5+	1,56	0,33	0,31
	Metano	0,68	0	0,02
	Etano	0,99	0	0,16
	Propano	1,32	0	0,42
	Propilene		0	0
	Isobutano	0,37	0	0,14
	Butano	0,78	0,01	0,32
	Isopentano	0,13	0,02	0,14
	Pentano		0,03	0,15
	Ossigeno	0,54	0,25	0,37
	Azoto	21,51	1,45	2,07
	Idrogeno	72,11	97,9	95,91
	CO2		0	0
	CO		0	0
	H2S		0	0
	somma	100	100	100

Expected pressure trend (Fick's law)



$$J = -D \frac{\partial \phi}{\partial x}$$

$$D = D_0 e^{\frac{E_A}{RT}}$$

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Endress + Hauser

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System reliability – Diagnostic chamber: 2nd FUNCTION

Sapendo come
la Multipoint
sta
comportandosi
è possibile
reagire

Importanti attività di
manutenzione: definire i
ricambi

Manutenzione
programmata: quando
sostituire il ricambio

Programmare le fermate:
evitare fermate non
previste

Overall
plant cost
savings

Slide 66

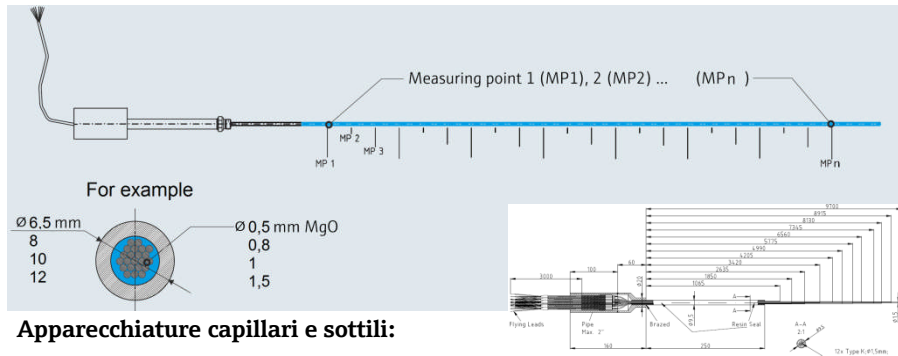
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Endress + Hauser

AIS 17/09/2015 - Temperature Engineered solution, Skin Point, High Temperature TC, Multipoint

Multipoint families – Thin multipoint cable



Apparecchiature capillari e sottili:

Quando

- Dimensioni ridotte, bassa invasività
- Richiesti numerosi punti di misura
- Applicazioni tipiche: Chimico e Petrochimico
-

Come

- Il design prevede una guaina di protezione (TW) di piccolo diametro
- Il TW contiene un alto numero di Termocoppie

Slide 67

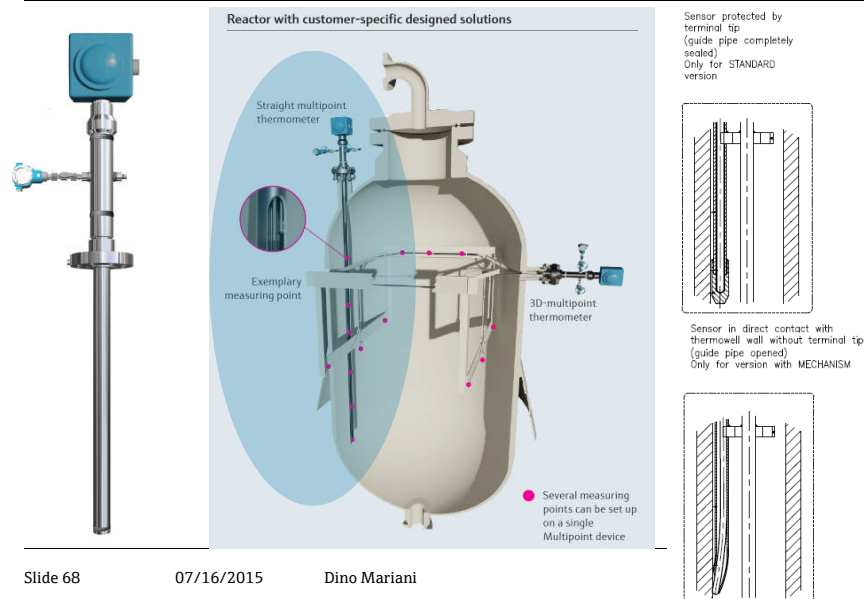
07/16/2015

Dino Mariani

Endress + Hauser

AIS 17/09/2015 - Temperature Engineered solution, Skin Point, High Temperature TC, Multipoint

Multipoint families – Straight layout



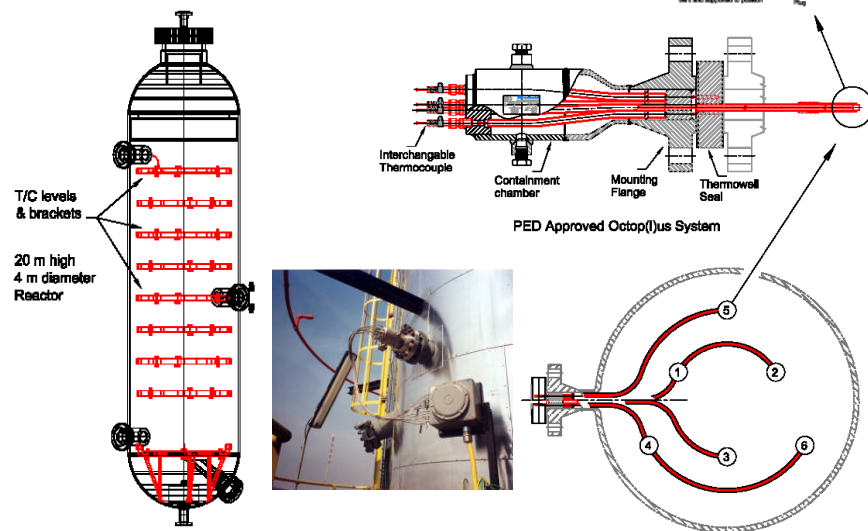
Slide 68

07/16/2015

Dino Mariani

AIS 17/09/2015 - Temperature Engineered solution, Skin Point, High Temperature TC, Multipoint

Octoplus Multipoint



Slide 69

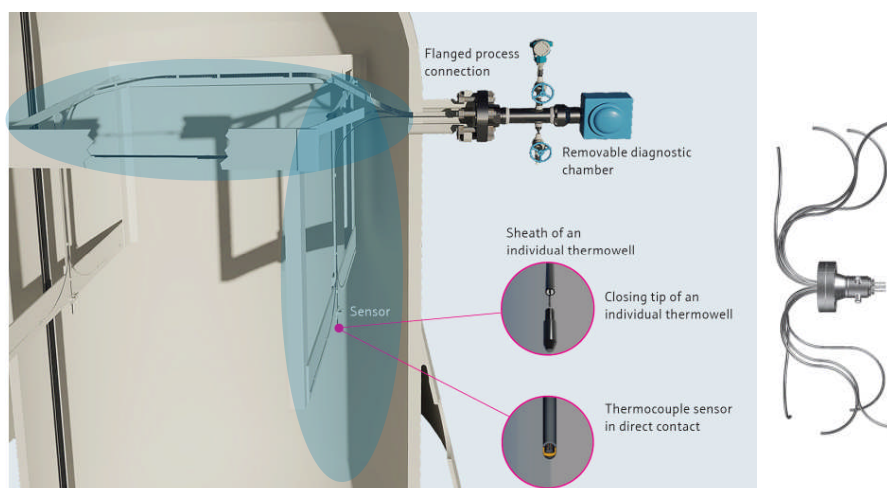
07/16/2015

Dino Mariani

Endress + Hauser 

AIS 17/09/2015 - Temperature Engineered solution, Skin Point, High Temperature TC, Multipoint

Multipoint families - 3D layout OCTOPLUS



Slide 70

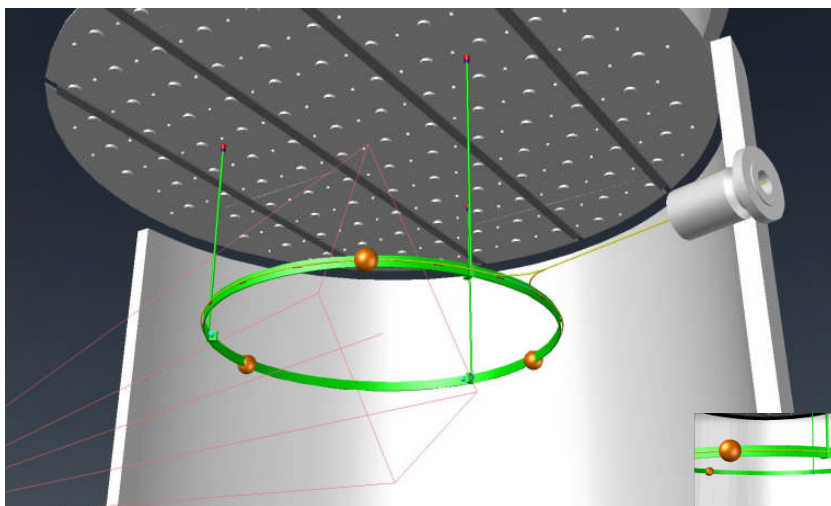
07/16/2015

Dino Mariani

Endress + Hauser 

AIS 17/09/2015 - Temperature Engineered solution, Skin Point, High Temperature TC, Multipoint

Octoplus Reattore HDS 2 – 1811 A/B (anno 2015)



Slide 71

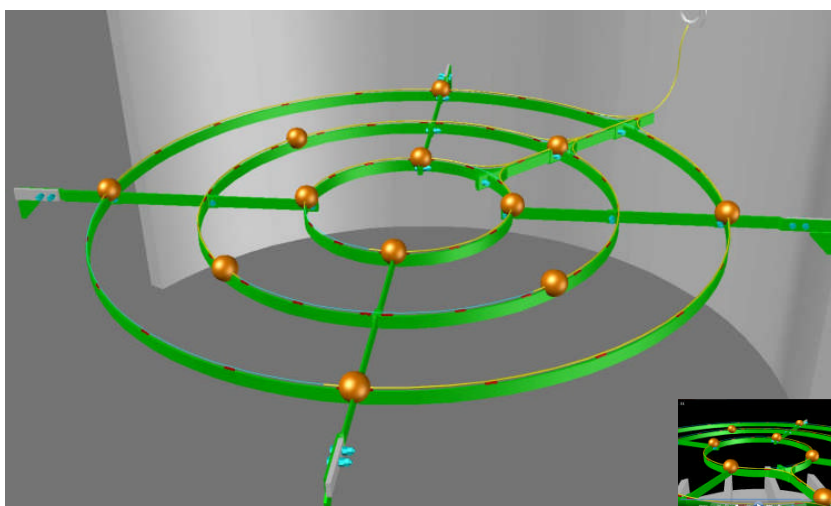
07/16/2015

Dino Mariani

Endress + Hauser 

AIS 17/09/2015 - Temperature Engineered solution, Skin Point, High Temperature TC, Multipoint

Octoplus Reattore HDS 2 – 1811 A/B (anno 2015)



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07/16/2015

Dino Mariani

Endress + Hauser 

ALS 17/09/2015 - Temperature Engineered solution, Skin Point, High Temperature TC, Multipoint

Grazie per l'attenzione, domande?



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07/16/2015

Dino Mariani

Endress + Hauser 