LIGHT YEARS AHEAD

WONDER®

ABOUT US

Wonder® Engineering Technologies Ltd is a professional team who provide state-of-the-art technologies, reliable fit-for-purpose solutions and excellent service consistently to our clients. Focusing on critical temperature measurement applications with innovative solutions in Asia, with offices in Singapore, Malaysia, China, Taiwan & Thailand, we serve the refining, petrochemical, and chemical industries in the region.

We are an ISO 9001 certified engineering & technology-based Solution and Service Provider, equipped with 'Best-in Class' temperature monitoring instruments and experience, specializes in developing different measurement solutions for challenging processes:

- Sulphur Recovery Units [SRU]
- Gasification Units [Gasifier]
- Flare Monitoring
- Reformer Heaters Thermal Imaging System
- Reactor Multipoint Thermocouple Assembly
- Furnace Tube Skin Temperature

Global resources, local service. We work with top notch suppliers and partners to ensure we deliver the most reliable solutions. Our technology partners include leading instrument manufacturers in different refining processes:

- LumaSense Technologies, USA - E^2T Pyrometer and Flare Stack monitoring system
- Delta Controls Corporation, USA - HTX Thermocouple for Acid Gas and SRU Claus Furnaces
- Syntemp Thermocouples, USA - Gasifier Thermocouples
- Daily Thermetrics, USA - Reactor Multipoint thermometry system - Repair free

The technology leadership of Wonder Engineering Technologies, coupled with process application expertise, is driving our growth to become a regional leader in instrumentation solution provider in Asian Oil&Gas industry.

Wonder® is a registered Instrument and Service Brand in Singapore.

Should you need any support, please contact Wonder® at
support@wonder.com.sg

PRODUCTS

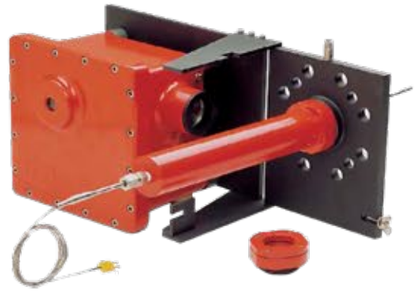
With our experience in serving the Oil&Gas industry in the last decade, Wonder Engineering Technologies strives to use Root Cause Failure Analysis to help our clients determine the root cause of any instrument failure and eliminating recurrence.

We also keep critical stocks for our clients to meet urgent needs.

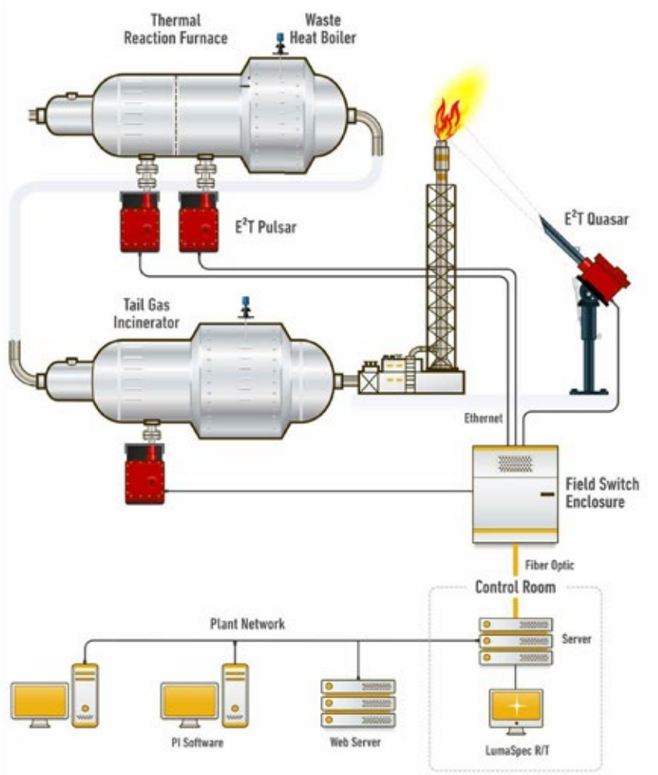
Our products:

1. Wonder® Smart Controller
2. Furnace Tube Skin Thermocouples/ Vessel Skin Thermocouples
3. Reactor Multipoint Thermocouple Assembly
4. SRU / Gasifier Thermocouples & Pyrometers
5. Flare Monitoring Remote Detectors & Cameras
6. Reformer Thermal Imaging System
7. Truck/Marine Loading & Tank Storage Instrumentations
8. ATEX Explosion Proof LED Lightings
9. Others – Sight Glass/Magnetic Level/ I/P converters/ Air Regulators /Pneumatic Controllers
10. Clamp Connectors - Clampsets / Sealrings

You have a challenging application? Wonder® has a solution.



SULPHUR RECOVERY UNIT (SRU) MONITORING

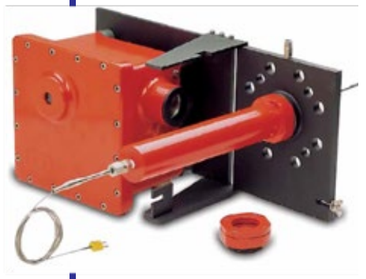


Optimal operation of Sulphur Recovery Unit (SRU) furnaces require accurate process Gas (Flame) measurement and Refractory measurement for operational safety (high temperature alarms). Of particular importance is control of the furnace process temperatures to prevent damage to the furnace refractory and assurance that reaction or destruction temperatures are reached and maintained.

There are essentially two types of devices suitable for monitoring the temperature of Claus Thermal Reactor refractory:

- Ceramic Thermocouple
- Infrared Radiation Pyrometer

A combination of Infrared Pyrometer E2T and 6” HTX thermocouple is a proven solution for SRU temperature monitoring. Wonder® Engineering exclusively supply all 6” thermocouples and Pyrometers for all SRU vessels in our region, our installed-base including ExxonMobil, Shell, Chevron, Petronas, ThaiOil, Bangchak Refinery Thailand, Singapore Refining Company [SRC] etc.



Pyrometers

Thermocouples used in measuring temperature in SRU(s) applications either fail prematurely or needing additional protection such as multiple thermowells and sweep air systems that make thermal transmission to the actual thermocouple inaccurate and/or slow. They also only provide the refractory temperature readings instead of the sulphur gas hence not useful for the process control.

Pyrometer is designed to provide an average/Gas/ Refractory temperature measurement to provide an early warning by use of the Gas (Flame) temperatures, allows time for operators to make process changes and reduce potential refractory thermal events before they become critical and trigger a high temperature alarm.

E2T Pulsar is a single system installation with two independent IR filtered detectors that provides both Gas (Flame) and Refractory measurements simultaneously, produced by LumaSense(Mikron) with over 1,700 successful installations worldwide.

HIR is an alternative solution by Delta Controls Corporation who focuses on accurate refractory temperature measurements, which is maintenance free. The lens, sighting window, and nozzle are kept at a high temperature to avoid sulphur build-up and the completely eliminate any need to perform frequent periodic maintenance. It also uses stable electronics, which do not require cooling or frequent re-calibrations at the factory.

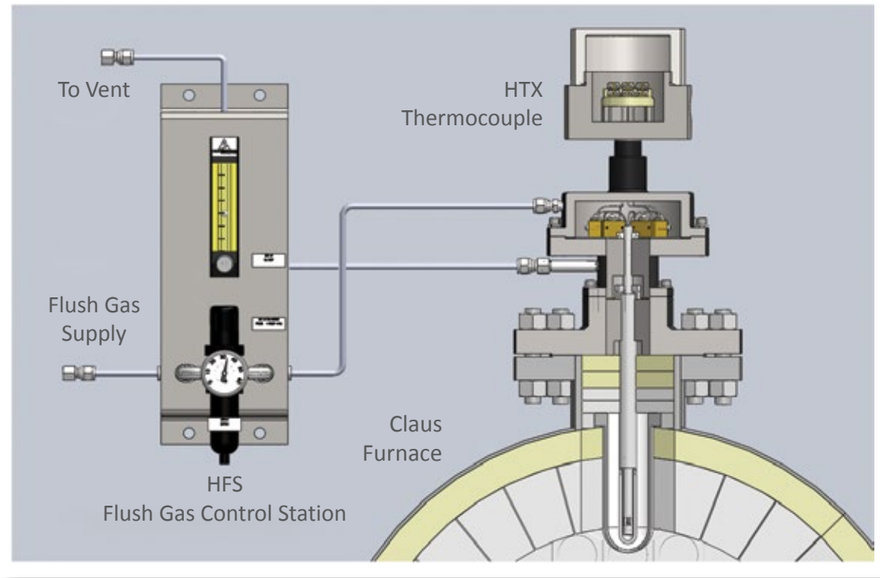
Wonder® Engineering Technologies provide exclusively support on both solutions to end users in South East Asia. Please contact Wonder® for your SRU(s) - calibration, upgrade and service your Pyrometer installation today.

SRU THERMOCOUPLES

Thermocouple design advancements have overcome the problems associated with corrosion and high temperature found in Thermal Reactors. The thermocouple still has a lingering poor reliability reputation with some users. There are still some failures, which are normally the result of improper installation or result from shifting refractor that damaging the ceramic well. Such damage exposes the metallic thermocouple element to corrosion and eventually causes it to fail.

Choosing a large refractory well thermocouple specifically designed for Claus Thermal Reactors, installing it properly and operating it within the published guidelines will provide accurate temperature measurement for years with no maintenance.

Wonder® Engineering Technologies provide exclusive support for SRU thermocouples for all major SRU(s) in the region with proven records, which can result in the thermocouples lasting more than one turnarounds. Our installed base in the region includes ExxonMobil, Chevron, Petronas, Singapore Refining Company and a few others.



HTX Thermocouples

HTX Thermocouple - “large-refractory well” type is designed to withstand the vibration and shifting refractory normally encountered in the Claus Furnace. The most common application is to protect the refractory in Claus thermal reactors and sulfur burners in sulfur acid plants. Other applications include hydrogen burner systems, water gas generators, coal gassifiers and various POX units.

The design of the Model HTX is a result of careful attention to design detail, 40 years of experience, and many field installations. Materials used in the HTX are critical to provide long term accuracy and reliability.

Properly installed and operated, HTX will provide years of accurate maintenance free temperature measurement.

Hand-held Pyrometer

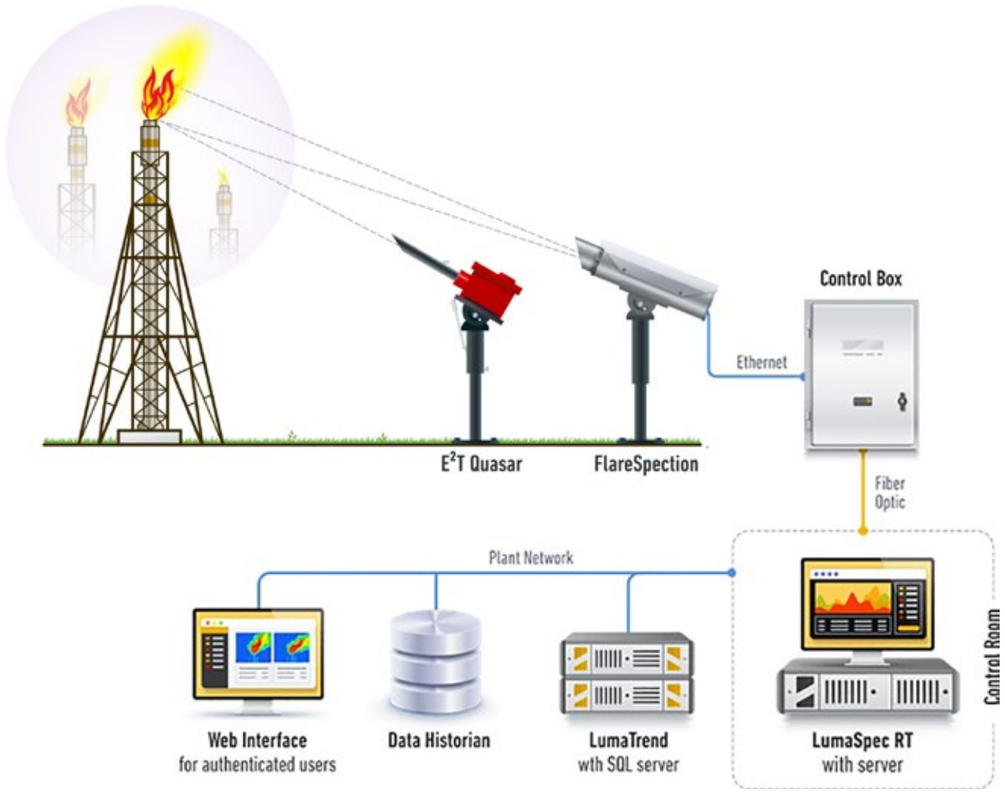
When calibrating or troubleshooting a pyrometer in an SRU, a typical method has been to insert temporary thermocouple through the sight port. While this can give some indication of temperature, there are many potential problems:

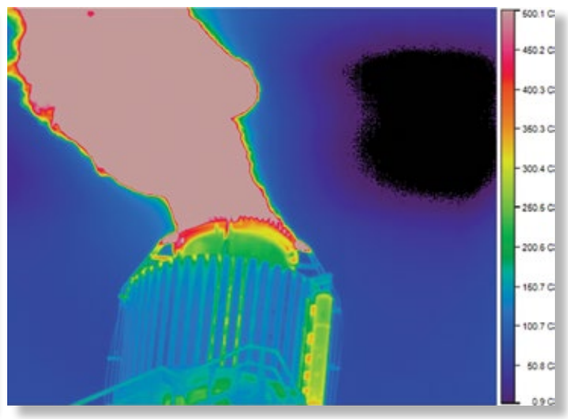
- Safety
- Stuck thermocouple,
- Toxic gas release,
- Measuring the wrong part of the furnace.

In a Claus furnace, the best method to calibrate a pyrometer is with another pyrometer. A general-purpose IR gun typically has too wide of a viewing angle to accurately see down a valve, nozzle, and borehole into the furnace. And it may be sensitive to hot gases as well as refractory temperature.

HIP pyrometer is specifically designed to read the refractory temperature in an SRU. It uses infrared wavelengths that are unaffected by combustion gases, allowing the pyrometer to measure refractory temperature and ignore the effects of hot gas and flame. Dual wavelength sensing allows accurate temperature measurement even if the sight path is partially blocked by buildup or debris.

FLARE MONITORING





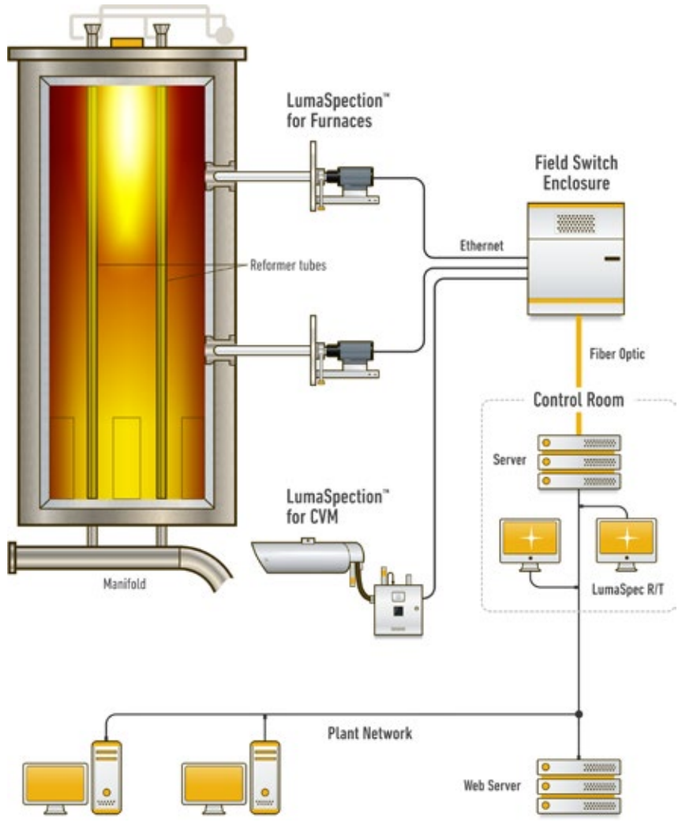
Continuous monitoring of pilot flames and flared gases is critical to ensure that the gases will be ignited and to confirm compliance with government-set pilot status recording requirements.

Thermocouple failure, flame movement, varying luminosity and adverse climatic conditions are just a few of the obstacles which have to be overcome to gain long-term monitoring reliability without false alarms.

FlareSpection thermal imaging system designed to provide the clearest image monitoring of flare tips, which provides clear images of the flare tip for pilot monitoring of multiple pilots and flare tips with a single camera system. Regional points of interest can be manually input by the operator and alarms assigned and linked to relays.

The system can be deployed into either a full thermal imaging system or a single unit of flare detector with a 4mA & 20mA input. It is a remote installation can be easily maintained online.

REFORMER THERMAL IMAGING SYSTEM

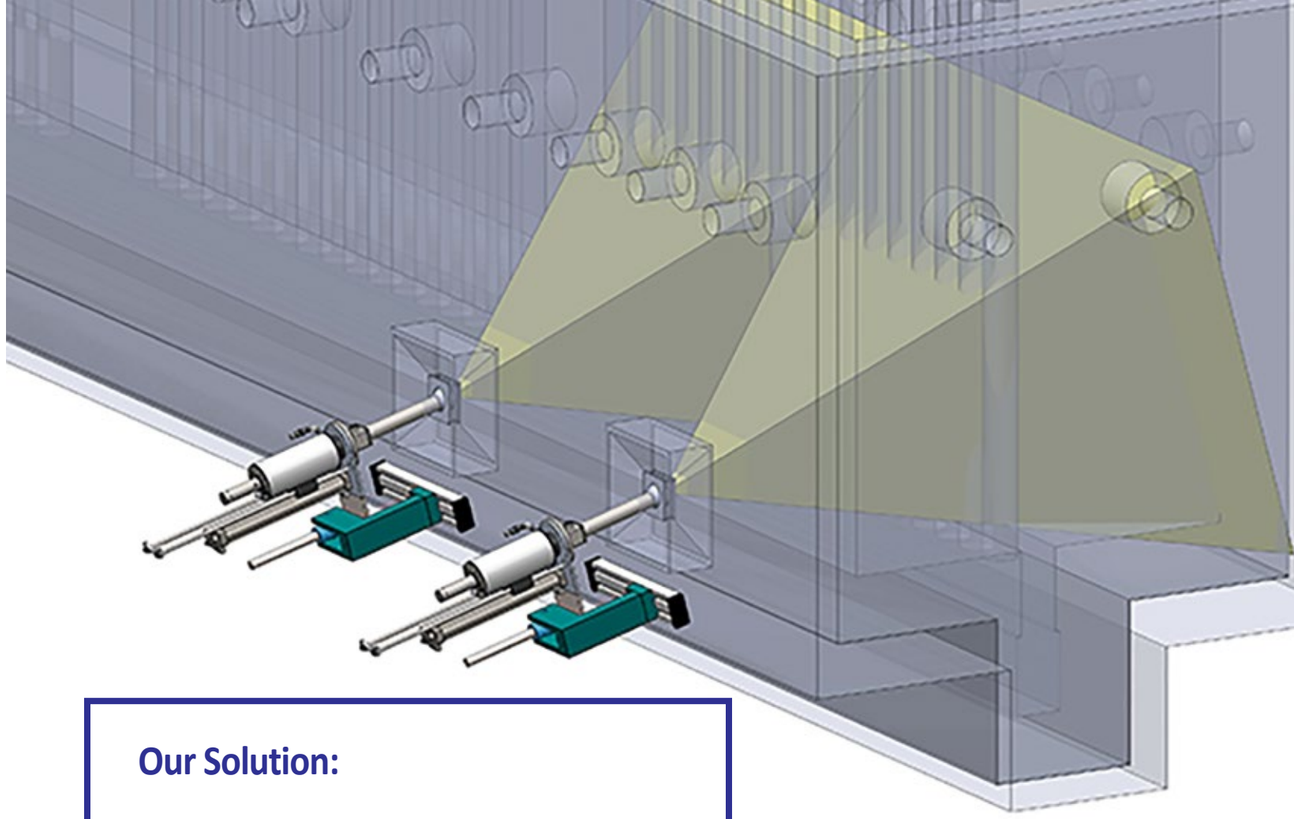


Reformer and Cracker furnaces are critical equipments in petrochemical & refining processes. Maximizing production efficiencies, while minimizing system downtime and eliminating safety issues, are primary concerns for any plant operator.

Furnaces are operated to the highest efficiency by optimizing the burners firing and maintaining furnace tubes at ideal temperatures to prolong the life of the heater tubes. The objective is to minimize variations in Tube Wall Temperatures (TWT) and operate at a higher Outlet Temperature (ROT) without violating maximum allowable TWT.

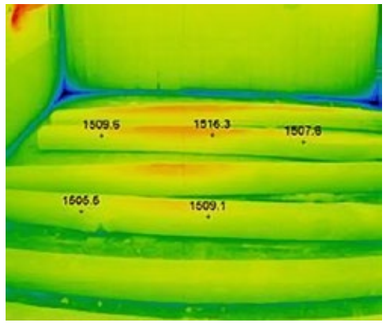
Conventional methods of monitoring the tubeskin temperatures include portable pyrometers, portable thermal imagers, and shielded thermocouples. However, these methods have been proven to be unreliable, expensive to implement, prone to operator variations, and do not provide comprehensive ability to detect hot spots.

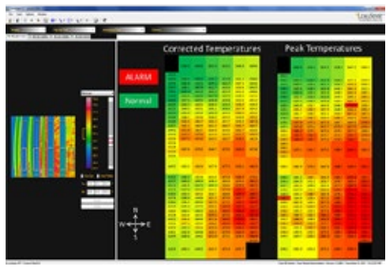
Wonder® Engineering has introduced FurnaceSpection to tremendously improve the ability to monitor the tubeskin temperatures. It helps operators monitor process temperatures uniformity through streaming images and employing powerful software to enable data analysis and historical trending, bringing outputs to DCS, and even able to broadcast live images on the plant's local network with a real-time web server.



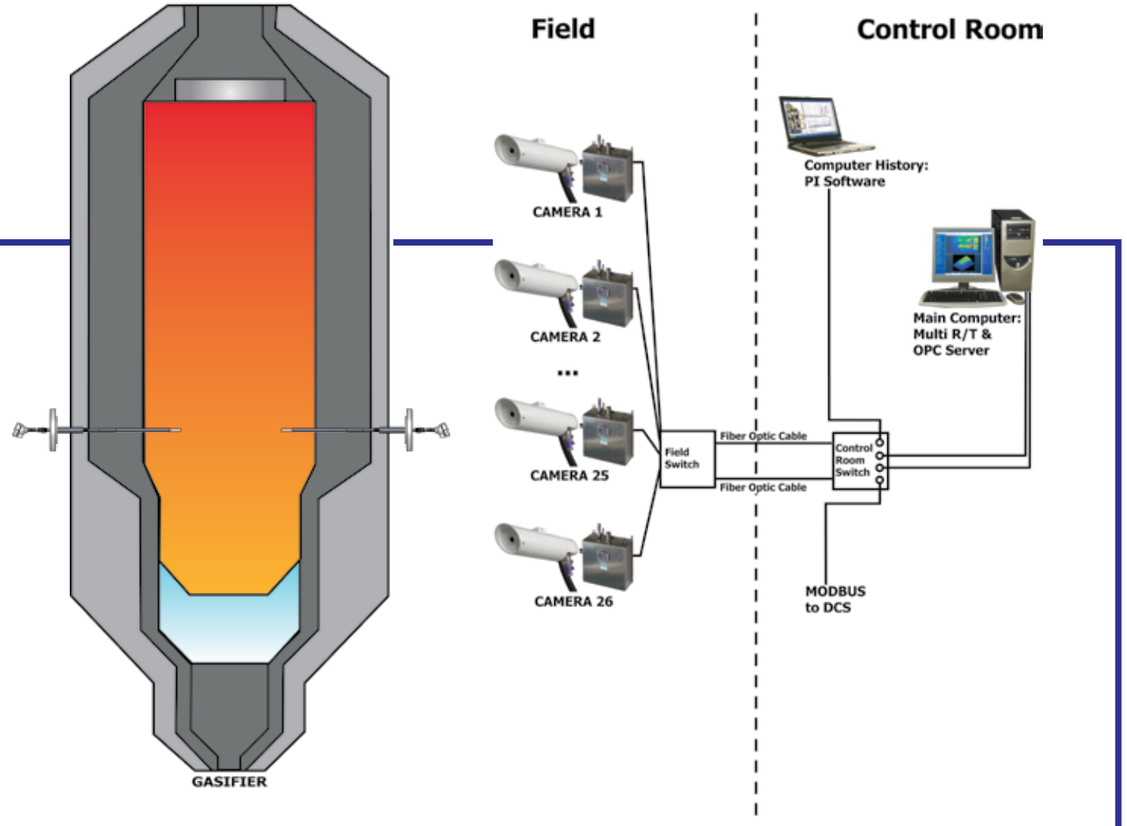
Our Solution:

1. Direct measurements
2. Continuous monitoring tubeskin temperatures in the furnaces
3. Precise measurements of the temperature distribution on every components
4. High camera resolution of 640 by 480 pixels
5. Real-time analysis and display of temperature data (e.g. HotSpots, Isotherms).
6. Graphic thermal data used to calculate real-time TWT on DCS
7. Automated alarm modes for user-defined limits.





GASIFIERS/CRITICAL VESSEL MONITORING

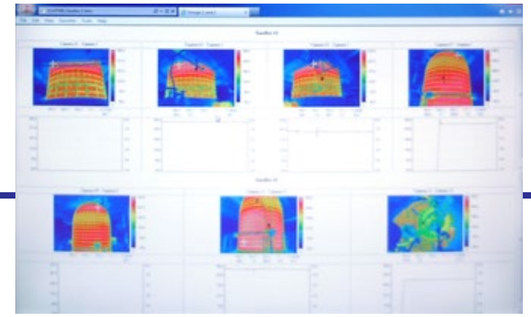


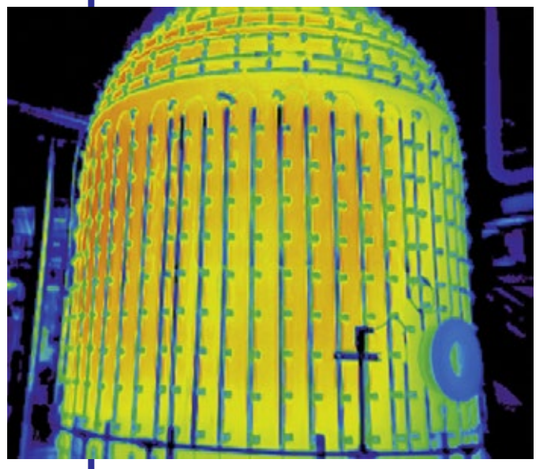
Critical vessels in refineries operate at high temperature and pressure and are at risk of failure as joints and refractory degrade. The consequences of undetected failures can be very serious. Conventional methods like vessel skin thermocouple or Fibre Optic sensors are typically utilize wired or fibre optic networks and employ point sensors which only monitor the temperature of discrete points on the outside of a vessel. This can result in inaccurate measurements due to skin temperature gradients.

In addition, failures of traditional sensors leave dangerous holes in overall monitoring schemes until replacement can be made. Missing points in the monitoring scheme put the critical vessel at risk when unexpected hot spots arise.

Our solution

Non-contact infrared thermal imaging is more robust, more reliable and easier to maintain. It is more modern with technological advantages such as graphical visual displays, historical archiving and trending, and easy integration to DCS. It allows operators of high-temperature and high-pressure vessels to see, in colour, real-time thermal behaviours of equipment. This insight is unavailable with traditional system like Fibre Optic or Skin Thermocouples, giving infrared thermal imaging an edge when it comes to early detection of possible failures. Thermal imaging systems go further by providing a more complete look at the temperature profile of the vessel- highlighting where potential dangers are.





At a Glance

- Automated fault detection for critical vessel monitoring
- Proven technology from the leader in the thermal imaging systems
- Easy-to-use software with automated analysis
- Easy integration into DCS

Benefits

- Better alarm response time to reduce risk and emergencies
- Enhanced predictive abilities reducing unplanned outages
- Improved information availability with auto "hot spot" tracking
- Software provides advanced features in a user-friendly interface

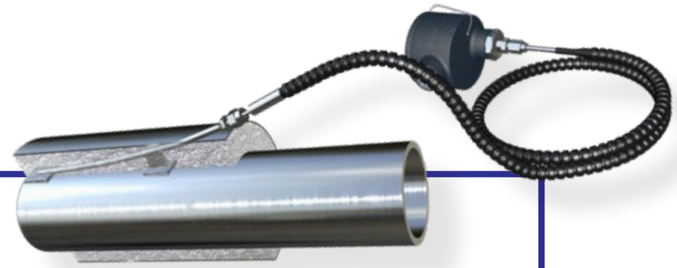
TUBE SKIN THERMOCOUPLES

Proper tube skin thermocouple installation is paramount in ensuring the success of an application. There is no universal tube skin thermocouple design that may fit all furnaces. Wonder® tube skin thermocouple installation is a result of paying careful attention to design details:

- Measurement locations
- Sheath routings
- Expansion loops
- Process connections
- Metallurgy & Corrosion
- Heat Expansion

With our extensive site experience in South East Asia and China, we provide a one-stop full design, supply and installation of the tube skin thermocouple solutions. Contact Wonder® Engineering Technologies today and we will show you how it's done!

VESSEL SKIN TEMPERATURE MONITORING



Historically, identifying reliable methods to increase vessel skin temperature monitoring without increased risk to the integrity of the vessel (most commonly the avoidance of welding sensors directly to the vessel's surface) have been challenging. Attempts have been made to avoid welding to the vessel's while still accurately measuring surface temperature, but each option has proven to contain significant drawbacks.

A success design and installation need to meet these three criteria:

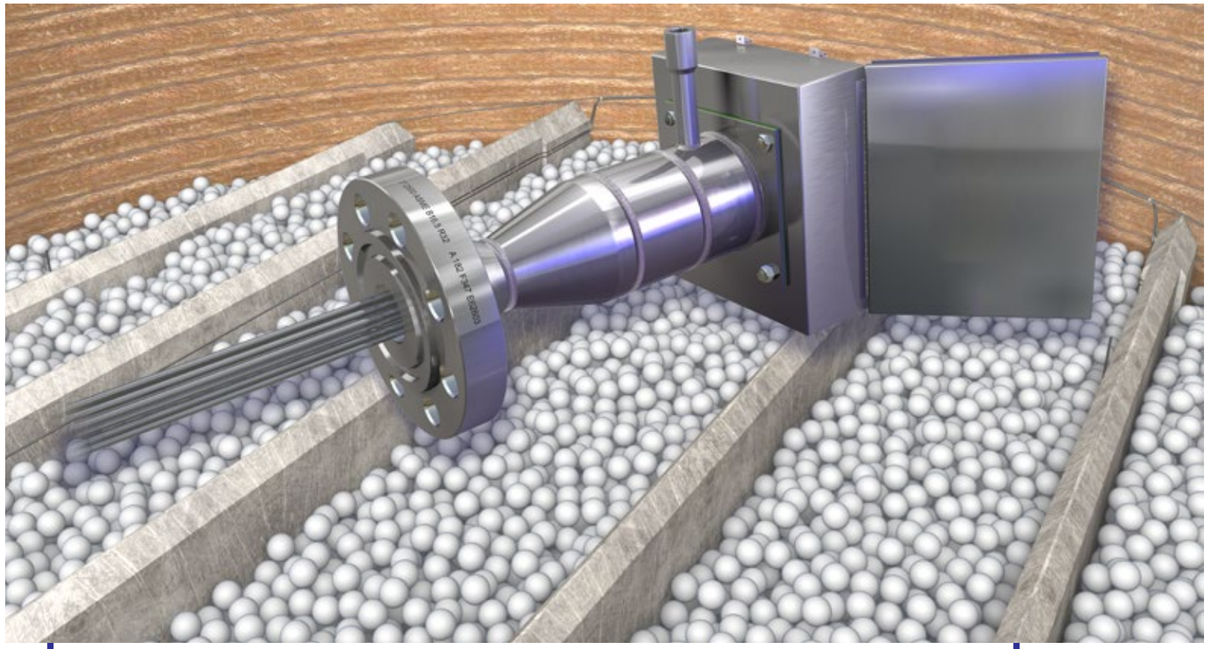
- Avoid welding to vessel surface post vessel fabrication
- Simplify replacement of sensor as required
- Achieve direct surface temperature contact

With working with the lead manufacturers, we supply proprietary design plus customized skin thermocouples that allow for effortless re-placement of the sheathed sensors without the need to remove vessel insulation or hot-work.

Our solution

- Ski-slope type thermocouples
- Banded type thermocouples
- Magnetic type thermocouples
- Customized thermocouples

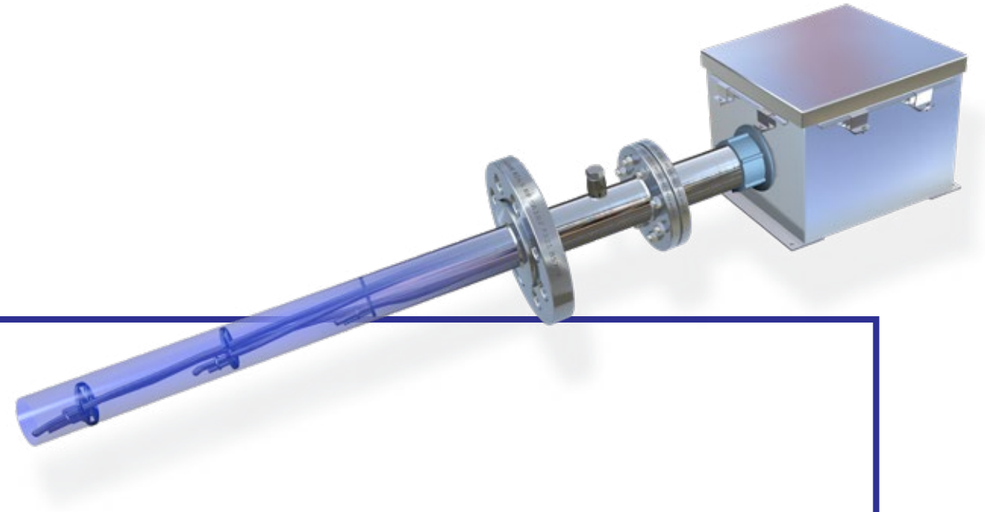
REACTOR MULTIPOINT THERMOCOUPLE ASSEMBLY



With today's high activity catalyst and high-performance distribution tray technologies, upgrading reactor thermometry is critical to a refinery ability to maximize profitability and safety of the operating unit. To stay competitive in today's market conditions, getting the most out of existing reactors and maximizing asset utilization is a top priority.

Optimal operating conditions vary from process to process and even within processes depending upon variables such as the types of catalysts and internals selected. More than ever, ideal reactor performance is achieved within specific temperature ranges. Accurate and Reliable Temperature measurement (Reactor Multipoint) is the most critical factor to ensure profitable operation.

Based on Wonder®'s extensive experience in the reactor multipoint thermocouple technologies, we recommend the use of repair-free multipoint thermocouple assembly from the very beginning.

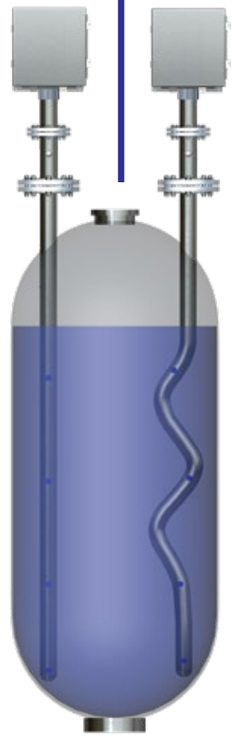


False impressions on field repairable and replaceable multipoint thermometry is a common finding in the industry. We regard field repair impractical, hence stressing on having reliable thermometry from the outset.

Regarding on-site repair of a reactor multipoint thermocouple assembly, always ask:

- Who can provide assurance that its repairable?
- Who is qualified to repair?
- What is the calibration standard/process post repair?
- Reliability of a repaired unit?
- The cost of repair versus new purchase?
- Any proven track record of a successful repair?

Talk to Wonder® Engineering Technologies, we will share our experience on field repairs and recommend a true solution for your reactors.



WONDER SMART CONTROLLER

Wonder Smart Controller is a universal controller that was designed and developed by Wonder® Engineering Technologies to meet the increasing process challenges and needs for easy maintenance with below functionalities:

- Predictive Maintenance for Long Routing Sensors
- Tank-Site Monitoring
- User-friendly Batch Controller for truck loading bays

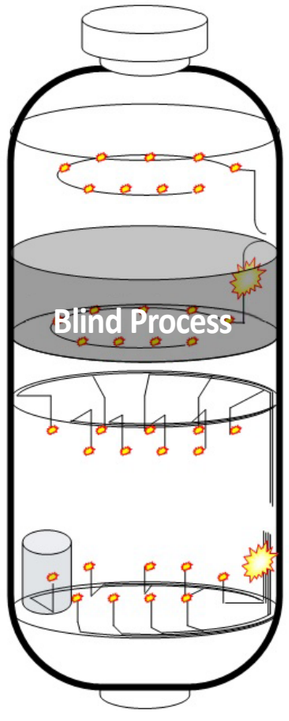
1. Wonder® S30D – Predictive Maintenance

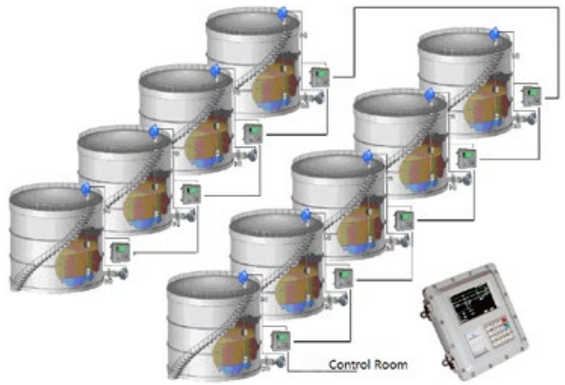
Long routing thermocouples are always the critical temperature instruments in every refining process, like Reactor Multipoint thermocouple assemblies and furnace/heater tube skin thermocouples.

Long lead time and high replacement cost post huge challenges on such critical sensors maintenance. Unfortunately, there is no predictive information available to the operators before the sensors completely failed or losing its signal to the DCS.

Wonder® S30D is a proprietary instrument that was developed to provide predictive information on long routing sensors. The S30D can continuously provide temperature readings and sensor probe characters locally, as well as status indication and historical trends on site.

A technician can easily waive a recordable proximity card on the S30D card reader and download all the required data on the sensors. Analysis, trending and reports can be generated with a Wonder® software for analysis, troubleshooting or records keeping.





2. Wonder® S30D – Tank Site Indicator

Another function of Wonder® Smart Controller is as a Tank Site Indicator, a significant upgrade from any traditional tank side indicator. Employing the same S30D hardware platform, the module can communication via different protocols with any Tank Gauging system, providing a local indication at the ground level. Instead of a typical tank side indicator, Wonder® S30D can provide local and remote tanks information up to a total of 16 tanks, hence we name it Tank Site Indicator.

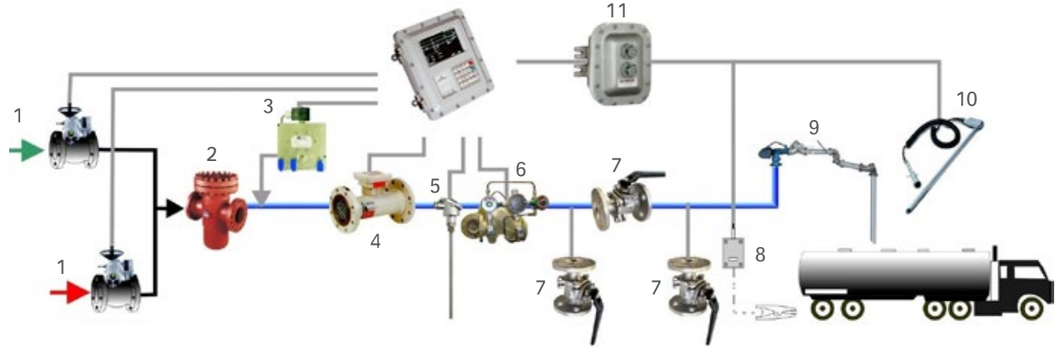
- Local tank indication plus remote tanks, up to 16 tanks
- With local trending display that instead of typical temperature and level numeric indications
- Power supply flexibilities (24VDC, 110VAC or 230VAC)
- Communication compatibility with open protocols like Hart, Modus, Enraf BPM (FSK2)
- Fully configurable for local any calculation

3. Wonder® S30D – Batch Controller for Truck/ Marine Loading

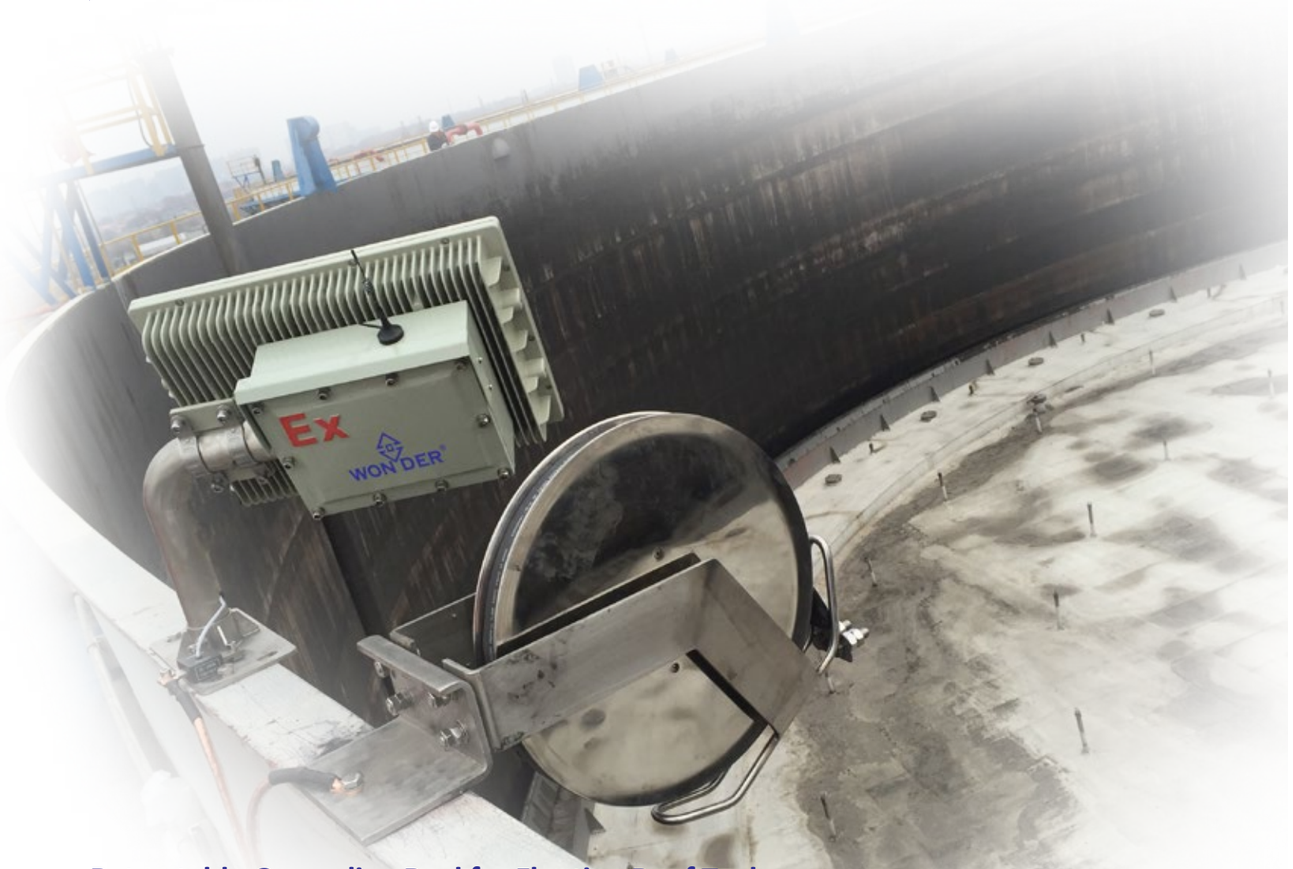
Wonder® Smart Controller accepts process input signals from and provides process control signals to the common instruments and devices used in liquid batch delivery systems or the Tank Storage Units. S30D can be used for single or multi-stream flow and batch control, include various liquid petrochemical products, LPG, LNG etc., up to 8 configurable recipes, allows to predefined loading control operation, for multiple products quantities or blending ratios. It is designed to deliver single component liquids or to blend up to four liquid components in precise ratios, with or without additive injection.

These instruments and devices include:

1. Actuator Valve
2. Filter
3. Dye Injector
4. Flow Meter
5. Temperature Sensor
6. Flow control valves
7. Manual Valve
8. Grounding Clamp
9. Loading Arm
10. Overfill probe
11. Grounding Monitor



TANK STORAGE ACCESSORIES



Retractable Grounding Reel for Floating Roof Tanks

The Retractable Grounding Reel (RGR) is designed to discharge the static electricity of the floating roof tanks, according to API Recommended Practice 545. It is used as the direct electrical connection between the floating roof and tank shell. The lightning current and bound charge will be effectively and rapidly conducted to the earth when lightning happens.

Compared with any conventional bypass conductor, it is more effective in decreasing the possibility of lightning-induced fire, hence achieving higher safe and reliability performance.

Features:

- Corrosion Resistance, the housing is constructed from 316L stainless steel
- Stainless-steel spring is more corrosion resistant than steel spring
- SS304 braided layer out of the tinned braided copper providing high corrosion and wear resistance
- Length option - 20m or 24.4m
- Competitive Pricing – a cost saving enhancement to floating roof grounding

Personal Electrostatic Eliminating Pole

RED for stop and GREEN for go
Under certain conditions, a person's body can be electrostatically charged by friction and natural environmental conditions. The Personal Electrostatic Eliminating Pole is designed to prevent the accumulation and accidental discharge of static electricity from a person's body.

Specifications:

- Voltage: -15KV to +15KV
- Alarm Voltage: >150V
- Height: 1m (3.28ft)
- Certification: ExibIICT4 Gb

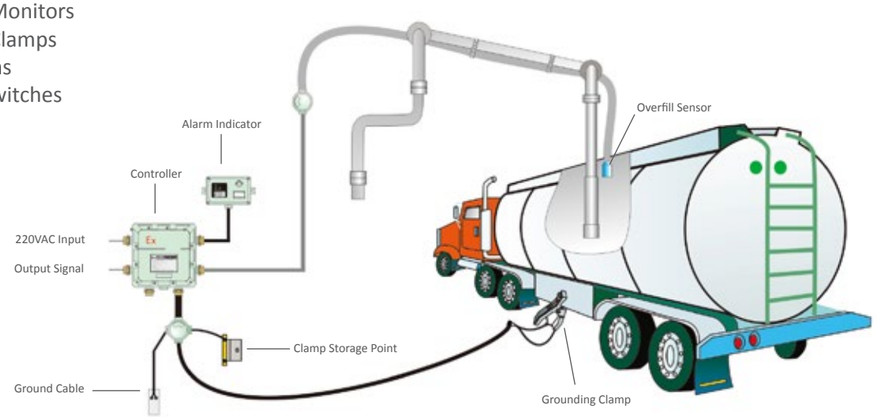
Features & Benefits:

- Handle: Constructed of electrostatic conductive materials
- Static electricity from a person's body will be continuously discharged without any spark or discomfort
- Provides constant monitoring with audible and visible alarms
- Audible voice warning when people are approaching
- OLED Display indicates the resistance value
- Interlock signal output

Trucking Loading Skid Accessories

Wonder® Engineering Technologies also provide many cost-effective equipments required to complete the truck loading bay, including but not limited to:

- Overfill Probes
- Grounding Monitors
- Grounding Clamps
- Loading Arms
- Deadman Switches



EXPLOSION PROOF LED LIGHTINGS

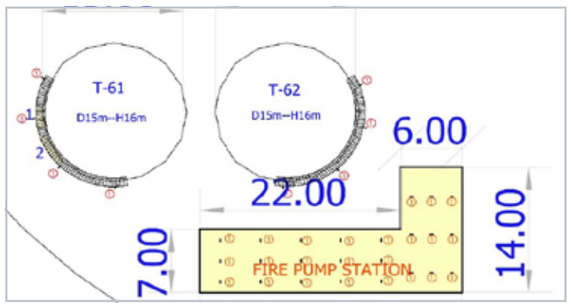
Carefully choosing our partners, Wonder Engineering keep stock and supply cost-effective Explosion Proof LED lightings to suit different lighting applications in the Oil & Gas industry.

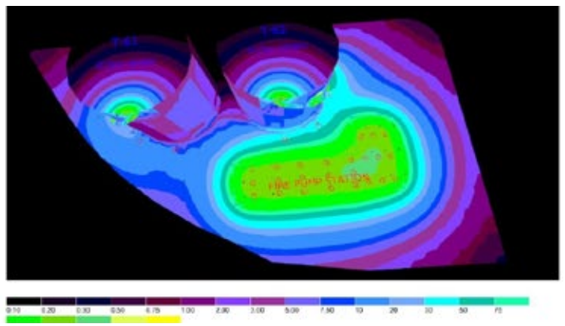
Our solution :

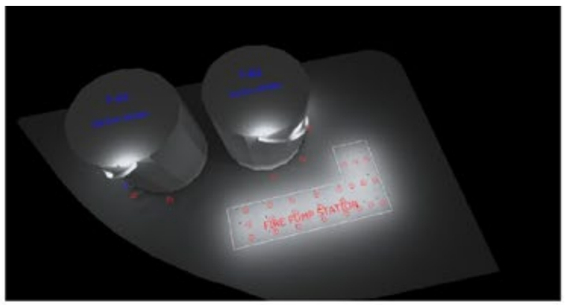
- Competitive cost
- Local stocks
- Replaceable component parts - lowering maintenance costs
- Engineering design with LUX calculations [LUX-LUMENS-WATTS]
- Satisfaction guaranteed

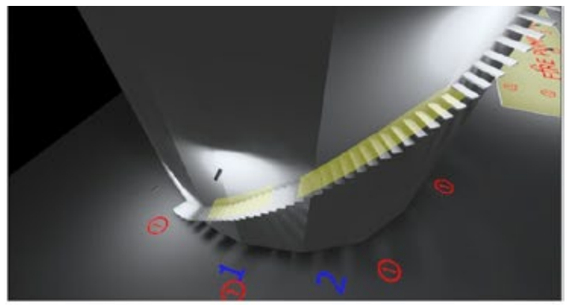
Applicable Standards & Certifications of our LED lightings:

- ATEX
- CNEX
- UL & CUL
- DLC
- SAA & C-TICK
- CQC
- CE & ROHS
- IP68
- ISO 9001
- ISO 14001









WONDER WAREHOUSE®

Partnering with leading instrument manufacturers, Wonder® Engineering Technologies initiates and develops the online platforms and physical warehouse to provide instrumentation stock sharing facilities to our clients within a petrochemical complex. Our stocks cover typical and critical instrumentations. We work closely with our clients to tailor a solution that matches their spare / stocks strategies to meet their operation and business needs.

With Wonder® Warehouse programme, we can increase stocking efficiencies hence reducing operating costs. Detailed plans for calibrations of instruments and management of product warranty can be organized accordingly if required.

Please contact Wonder® Engineering Technologies today should you need any a critical field instrument urgently, or willing to setup virtual storage to reduce warehouse cost.

Let's work together to empty your warehouse!

Our stocks include but not limited to:

- Pressure/Temperature Transmitters
- Pressure/Temperature Gauges
- Thermocouples
- Pyrometers
- Sight Glass
- I/P converters
- Air Regulators
- Manifolds
- Stellite 6B Bar
- Flame Rods
- Clamp Connectors - Clampsets / Sealrings
- LED Lights

ENGINEERING SERVICE

Wonder® Engineering Technologies offers wide varieties of field inspections/diagnostics, on-site supervision, instrumentations installation & commissioning and maintenance services.

Our service team is experienced in installations of critical field instruments on Temperature/Flow measurements. Under our supervision, we will ensure the instruments you have purchased will give you the data that you need and expect, reliably, for many years.

- Drawing design for existing furnaces where records and drawings are incomplete
- Onsite survey, design, customized, supervision, installation, diagnostics, modification for reactor multipoint, heater tube / vessel skin sensors,
- Infrared Pyrometer/ thermal imaging cameras Installation, commissioning & on-site calibration, Repair
- Trucking Loading Skid Design, Assembly, Installation, Commissioning & Maintenance Support

Wonder® Engineering Technologies' field calibration & services is ISO 9001 certified.

END USER REFERENCE

Install Base of Wonder Engineering include but not limited to:

- ExxonMobil (SCP/PAC/Pioneer/ SAR2 /Sriracha/Banyu Urip), Singapore/Thailand/Indonesia
- Shell (Bukom/Seraya/Brunei), Singapore/Brunei
- Chevron Oronite, Singapore
- Singapore Refining Company, Singapore
- Singapore LNG, Singapore
- PETRONAS Melaka / RAPID, Malaysia
- ThaiOil, Thailand
- Bangchak Refinery, Thailand
- PetroChina Jambi, Indonesia
- SECCO Shanghai, China
- Qatar Petroleum, Qatar
- GPPC Petrochem, Taiwan

In the region, Wonder Engineering exclusively supply, install, and support for all Sulphur Recovery Unit required HTX Sensors and E2T Pyrometers, support temperature instruments for all Gasifier process in Singapore.

Contact Wonder® Engineering Technologies for a detail reference list.

TABLES

THERMOCOUPLE CHARACTERISTICS

ANSI Code	Alloy Combination		Maximum Useful Temperature Range	Maximum TheThermocouple Grade Temperature Range	EMF (mV) Over Max.emperature Range	Standard Limits of Error (above 0°C)	Special Limits of Error (above 0°C)
	+Lead	-Lead					
E	Nickel-Chromium Ni-Cr	Constantan Copper-Nickel Cu-Ni	Thermocouple Grade -328 to 1652°F -200 to 900°C Extension Grade 32 to 392˚F 0 to 200°C	-454 to 1832°F -270 to 1000°C	-9.835 to 76.373	greater of 1.7°C or 0.5%	greater of 1.0°C or 0.4%
K	Chromel Nickel-Chromium Ni-Cr	Alumel Nickel-Aluminum Ni-Al (magnetic)	Thermocouple Grade -328 to 2282°F -200 to 1250°C Extension Grade 32 to 392°F 0 to 200°C	-454 to 2501°F -270 to 1372°C	-6.458 to 54.886	greater of 2.2°C or 0.75%	greater of 1.1°C or 0.4%
J	IRON Fe (magnetic)	Constantan Copper-Nickel Cu-Ni	Thermocouple Grade 32 to 1382°F 0 to 750°C Extension Grade 32 to 392°F 0 to 200°C	-346 to 2193°F -210 to 1200°C	-8.095 to 69.553	greater of 2.2°C or 0.75%	greater of 1.1°C or 0.4%
T	Copper Cu	Constantan Copper-Nickel Cu-Ni	Thermocouple Grade -328 to 662°F -250 to 350°C Extension Grade -76 to 212°F -60 to 100°C	-454 to 752°F -270 to 400°C	-6.528 to 20.872	greater of 1.0°C or 0.75%	greater of 0.5°C or 0.4%
N	Nicrosi Ni-Cr-Si	NISIL Ni-Si-Mg	Thermocouple Grade -450 to 2372°F -270 to 1300°C Extension Grad 32 to 392°F 0 to 200°C	-450 to 2372°F -270 to 1300°C	-4.345 to 47.513	greater of 2.2°C or 0.75%	greater of 1.1°C or 0.4%
R	Platinum- 13% Rhodium Pt-13% Rh	Platinum Pt	Thermocouple Grade 32 to 2642°F 0 to 1450°C Extension Grade 32 to 300°F 0 to 150°C	-58 to 3214°F -50 to 1768°C	-0.226 to 21.101	greater of 1.5°C or 0.25%	greater of 0.6°C or 0.1%
S	Platinum- 10% Rhodium Pt-10% Rh	Platinum Pt	Thermocouple Grade 32 to 2642°F 0 to 1400°C Extension Grade 32 to 300°F 0 to 150°C	-58 to 3214°F -50 to 1768°C	-0.236 to 18.693	greater of 1.5°C or 0.25%	greater of 0.6°C or 0.1%
B	Platinum- 30% Rhodium Pt-30% Rh	Platinum 6% Rhodium Pt-6% Rh	Thermocouple Grade 32 to 3092°F 0 to 1700°C Extension Grade 32 to 212°F 0 to 100°C	32 to 3308°F 0 to 1820°C	0 to 13.820	0.5% over 800°C	Not Established

TOLERANCE CLASSES FOR EXTENSION AND COMPENSATING CABLES (IEC-60584)

Type	Tolerance class		Cable temperature range	Measuring junction temperature
	1	2		
JX	±85µV(±1.5°C)	±140µV(±2.5°C)	-25°C to +200°C	500°C
TX	±30µV(±0.5°C)	±60µV(±1.0°C)	-25°C to +100°C	300°C
EX	±120µV(±1.5°C)	±200µV(±2.5°C)	-25°C to +200°C	500°C
KX	±60µV(±1.5°C)	±100µV(±2.5°C)	-25°C to +200°C	900°C
NX	±60µV(±1.5°C)	±100µV(±2.5°C)	-25°C to +200°C	900°C
KCA		±100µV(±2.5°C)	0°C to +150°C	900°C
KCB		±100µV(±2.5°C)	0°C to +100°C	900°C
NC		±100µV(±2.5°C)	0°C to +150°C	900°C
RCA		±30µV(±2.5°C)	0°C to +100°C	1000°C
RCB		±60µV(±5.0°C)	0°C to +200°C	1000°C
SCA		±30µV(±2.5°C)	0°C to +100°C	1000°C
SCB		±60µV(±5.0°C)	0°C to +200°C	1000°C

TOLERANCE CLASSES FOR THERMOCOUPLES

Thermocouple		ASTM E230-03/ANSI MC96.1				IEC EN60584-2 & JIS C1602		ASTM E230-03/ANSI MC96.1				IEC EN60584-2 & JIS C1602	
32°F to 1472°F 0°C to 800°C		Standard Limits				Class 2		Special Limits				Class 1	
E	Temp. Range	> 0 to 900°C		> 32°F to 1652°F		-40°C to 333°C	-333°F to 900°F	> 0 to 900°C		> 32°F to 1652°F		-40°C to 375°C	-375°C to 800°C
	Tolerance	± 1.7°C	0.50%	± 3.0°F	0.50%	± 2.5°C	0.75%	± 1.0°C	0.4%	± 1.8°F	0.4%	± 1.5°C	0.4%
32°F to 2012°F 0°C to 1100°C		Standard Limits				Class 2		Special Limits				Class 1	
K	Temp. Range	> 0 to 1250°C		> 32°F to 2282°F		- 40°C to 333°C	-333°F to 1200°F	> 0 to 1250°C		> 32°F to 2282°F		-40°C to 375°C	-375°C to 1000°C
	Tolerance	± 2.2°C	0.75%	± 4.0°F	0.75%	± 2.5°C	0.75%	± 1.1°C	0.4%	± 2.0°F	0.4%	± 1.5°C	0.4%
32°F to 2012°F 0°C to 1100°C		Standard Limits				Class 2		Special Limits				Class 1	
N	Temp. Range	> 0 to 1300°C		> 32°F to 2372°F		-40°C to 333°C	-333°F to 1200°F	> 0 to 1300°C		> 32°F to 2372°F		-40°C to 375°C	-375°C to 1000°C
	Tolerance	± 2.2°C	0.75%	± 4.0°F	0.75%	± 2.5°C	0.75%	± 1.1°C	0.4%	± 2.0°F	0.4%	± 1.5°C	0.4%
32°F to 1382°F 0°C to 750°C		Standard Limits				Class 2		Special Limits				Class 1	
J	Temp. Range	> 0 to 750°C		> 32°F to 1382°F		-40°C to 333°C	-333°F to 750°F	> 0 to 750°C		> 32°F to 1382°F		-40°C to 375°C	-375°C to 750°C
	Tolerance	± 2.2°C	0.75%	± 4.0°F	0.75%	± 2.5°C	0.75%	± 1.1°C	0.4%	± 2.0°F	0.4%	± 1.5°C	0.4%
-301°F to 572°F -185°C to + 300°C		Standard Limits				Class 2		Special Limits				Class 1	
T	Temp. Range	> 0 to 350°C		> 32°F to 662°F		-40°C to 133°C	-133°F to 350°F	> 0 to 350°C		> 32°F to 662°F		-40°Cto 125°C	-125°C to 350°C
	Tolerance	± 1.1°C	0.75%	± 1.8°F	0.75%	± 1.0°C	0.75%	± 0.5°C	0.4%	± 1.0°F	0.4%	± 0.5°C	0.4%

TOLERANCE CLASSES FOR RTD

(IEC-60751-2008)

For wire wound resistors		For film resistors		Tolerance value[a] (°C)
Tolerance class	Temperature range of validity (˚C)	Tolerance class	Temperature range of validity (˚C)	
W0.1	-100 to +350	F0.1	0 to +150	±(0.1+0.0017[t])
W0.15	-100 to +450	F0.15	-30 to +300	±(0.15+0.002[t])
W0.3	-196 to +660	F0.3	-50 to +500	±(0.3+0.005[t])
W0.6	-196 to +660	F0.6	-50 to +600	±(0.6+0.01[t])
[a][t]=modulus of temperature in °C without regard to sign				

TOLERANCE CLASSES FOR THERMOMETERS

(IEC-60751-2008)

Tolerance classes	Temperature range of validity (°C)		Tolerance value[a] (°C)
	Wire wound resistors	Film resistors	
AA	-50 to +250	0 to +150	±(0.1+0.0017[t])
A	-100 to +450	-30 to +300	±(0.15+0.002[t])
B	-196 to +600	-50 to +500	±(0.3+0.005[t])
C	-196 to +600	-50 to +600	±(0.6+0.01[t])
[a][t]=modulus of temperature in ℃ without regard to sign			

MATERIAL SELECTION GUIDE

MATERIAL	NOMINIAL COMPOSITION	MAXIMUM TEMP.	MELTING RANGE	CHARACTERISTICS
Carbon Steel	0.22% - 0.29% C 0.17% - 0.37% Si 0.50% - 0.80% Mn	1000°F 540°C	2550~2732°F 1400~1500°C	Low cost materials with little corrosion resistance. Used in low temperature and stress applications where the measured medium protects it from corrosion, oils, petroleum, tars etc.
304SS	18% Cr 8% Ni 2% Mn	1650°F 900°C	2550~2650°F 1400~1455°C	Low cost corrosion resistant material, used extensively in food, beverage and chemical processing where good corrosion resistance is required. A low carbon grade, 304L is available which can be welded without impairing it's corrosion resistance.
310 SS	25% Cr 20% Ni 2% Mn	2100°F 1150°C	2550~2650°F 1400~1455°C	Heat resistant material, which can be used up to 1150°C with useful resistance in sulphur bearing atmospheres. Corrosion resistance is slightly better than 304SS, but not as good as 316SS. Can be welded with caution.
316L SS	18% Cr 12% Ni 2-1/2% Mo	1600°F	2550~2650°F 1400~1455°C	Up to 930°C (1700°F) under oxidizing conditions. Same area of application as 304 plus improved resistance to acids and pitting corrosion.
316SS	18% Cr 12% Ni 2-1/2% Mo	1700°F 925°C	2550~2650°F 1400~1455°C	Best corrosion resistance of the austenitic stainless steels due to the addition of molybdenum, widely used in chemical processing, offers useful resistance to H2S. As with 304, a low carbon grade, 316L is available for welded applications.
321SS	18% Cr 9% Ni Ti Stabilized	1700°F 925°C	2550~2600°F 1400~1425°C	Grade 321 is a stabilized austenitic stainless steel similar to Type 304 but with a titanium addition of at least five times the carbon content. This titanium addition reduces or prevents carbide precipitation during welding and in 800 - 1500°F (427 - 816°C) service. It also improves the elevated temperature properties of the alloy. Grade 321 provides excellent resistance to oxidation and corrosion and possesses good creep strength. It is used primarily in applications involving continuous and intermittent service temperatures within the carbide precipitation range of 800 - 1500°F (427 - 816°C).
347SS	18% Cr 10% Ni Cb + Ta Stabilized	1700°F 925°C	2550~2600°F 1400~1425°C	Grade 347 is the basic austenitic 18/8 steel (Grade 304) stabilized by Niobium (347) additions. These grades are used because they are not sensitive to intergranular corrosion after heating within the carbide precipitation range of 425-850°C.
446 SS	27% Cr	2100°F 1150°C	2600~2750°F 1425~1510°C	Ferritic stainless steel with excellent resistance to sulphurous atmospheres at high temperature, however due to its low strength at high temperature, thermowells made from this material should be mounted vertically. Used in heat treatment processes, iron and steel furnaces, gas production plant and it has some useful resistance to molten lead. Good corrosion resistance to nitric acid, sulphuric acid and most alkalis gives it some limited use in chemical plant.
Inconel 600	77% Ni 15% Cr	2200°F 1215°C	2470~2575°F 1355~1415°C	A very widely used nickel-chromium-ion alloy with excellent high temperature strength and oxidation resistance, however it is very vulnerable to attack in sulphurous atmospheres above 500°C. Good resistance to chlorideion stress corrosion cracking and nitriding environments. Used extensively in chemical industries for its strength and corrosion resistance. Easily welded, can normally be used without post weld heat treatment.
Incoloy 800	32% Ni 20.5% Cr	2000°F 1090°C	2475~2525°F 1360~1385°C	Superior to alloy 600 in sulphur, cyanide salts and neutral salts. Extensively used in steam/ hydrocarbon reforming plants for pigtail piping, manifolds and waste heat boilers and in the internal components of secondary reformers. Widely used in heat treatment equipment and as a heater sheath material.
Monel 400	67% Ni, 30% Cu	1000°F 535°C	2360~2460°F 1293~1349°C	Nickel-copper alloy with very good corrosion resistance, commonly used to handle sea water, hydrofluoric acid, sulphuric acid, hydrochloric acid and most alkalis. Typical applications include marine fixtures, chemical processing equipment, gasoline and water tanks, process vessels and piping and boiler feedwater heaters.
Hastelloy B-3	61% Ni, 28% Mo	2200°F 1200°C	2300~2470°F 1260~1355°C	A development of the well-established B2 alloy with improved thermal stability, fabricability and stress corrosion cracking resistance. It is the alloy of choice for handling hydrochloric acid in all concentrations and temperatures; it also withstands hydrogen chloride, sulphuric, acetic, hydrofluoric and phosphoric acids.
Hastelloy C-22	54% Ni 16% Mo 15.5% Cr 4% W	2200°F 1200°C	2300~2470°F 1260~1355°C	A nickel-chromium-molybdenum-tungsten alloy with outstanding resistance to pitting, crevice corrosion and stress corrosion cracking. It shows exceptional resistance to a wide range of chemical process environments, such as ferric and cupric chlorides, chlorine, hot contaminated solutions, formic and acetic acids and seawater or brine solutions. The material has superior weldability, and retains its properties in the as-welded state.
Hastelloy X	47% Ni 22% Cr 18% Fe 9% Mo 0.5% W	2350°F 1290°C	2300~2470°F 1260~1355°C	A high temperature alloy with excellent resistance to oxidizing, reducing and neutral atmospheric conditions, widely used in aircraft jet engine components. Very good high temperature strength makes it ideal for furnace applications. Resistant to stress corrosion cracking in petrochemical applications.
Nickel	99% Ni	2000°F 1090°C	2650°F 1453°C	Up to 1100°C (2100°F) under oxidizing conditions. Must not be used in sulphur atmospheres above 540°C (1100°F). Applications include: potassium cyanide salt baths; brines; caustics; high temperature chemical exposure.
Tantalum	99% Ta, Chromalized	4200°F 2320°C	5425°F 2996°C	A lightweight material with good strength in the 150° to 470°C range. Excellent resistance to oxidizing acids such as nitric or chromic, it is also resistant to inorganic chloride solutions, chlorinated organic compounds and moist chlorine gas. Its good resistance to seawater and salt spray, allows it to be used in off-shore installations. Can be welded with special precautions to protect from atmospheric contamination.

NPT PIPE END PIPE END PRESSURE RATINGS

(ANSI/ASME B31.3)

	316 STAINLESS STEEL				BRASS				CARBON STEEL			
NPT/ISO Pipe Size	Male		Female		Male		Female		Male		Female	
	psig	bar	psig	bar	psig	bar	psig	bar	psig	bar	psig	bar
1/16"	11050	760	6750	460	5550	380	3350	230	11050	760	6750	460
1/8"	10050	690	6550	450	5050	350	3250	220	10050	690	6550	450
1/4"	8050	550	6650	460	4050	280	3350	230	8050	550	6650	460
3/8"	7850	540	5350	370	3950	270	2650	180	7850	540	5350	370
1/2"	7750	530	4950	340	3850	260	2450	170	7750	530	4950	340
3/4"	7350	510	4650	320	3650	250	2350	160	7350	510	4650	320
1"	5350	370	4450	310	2650	180	2250	150	5350	370	4450	310
1-1/4"	6000	410	5000	350	3000	200	2500	170	6000	410	5000	350
1-1/2"	5000	340	4600	310	2500	170	2300	150	5000	340	4600	310
2"	3900	270	3900	270	1900	300	1900	130	3900	270	3900	270
Reference: bar=.0690 X psig			To obtain ANSI/ASME B 31.1 values,multiply ANSI/ASME B 31.3 values by .94									

STAINLESS STEEL TUBING

MAXIMUM ALLOWABLE WORKING PRESSURE(PSIG)

Tube O.D. Size (in.)	Wall Thickness of Tube(inches)															
	.010	.012	.014	.016	.020	.028	.035	.049	.065	.083	.095	.109	.120	.134	.156	.188
1/16	5600	6850	8150	9500	12100											
1/8						8550	11000						Note:For light gas service, use tubing with wall thickness outside of screened area.			
3/16						5450	7000	10300								
1/4						4000	5100	7500	10300							
5/16							4050	5850	8050							
3/8							3300	4800	6550							
1/2							2450	3500	4750	6250						
5/8								2950	4000	5200	6050					
3/4								2400	3300	4250	4950	5800				
7/8								2050	2800	3600	4200	4850				
1									2400	3150	3650	4200	4700			
1-1/4										2450	2850	3300	3650	4150	4900	
1-1/2											2350	2700	3000	3400	4000	4900
2												2000	2200	2500	2900	3600

Calculation Basis: Annealed, seamless 304 or 316 stainless steel tubing ASTM A-269 or equivalent. System temperature between -20°F and 100°F with allowable stress of 20,000 psi. Ultimate tensile strength of 75,000 psi.Safety factor of 4.

Reference: ANSI B31.3 Code.

Note: For welded and drawn tubing,a derating factor must be utilized.For double welded tube, multiply the above pressure rating by .85; and for single welded tube by .80(ANSI B31,Table A-1B).

DIMENSIONS OF WELDED AND SEAMLESS WROUGHT

STEEL PIPE/STAINLESS STEEL PIPE (ASME B36.10M / ASME B36.19M)

NPS		Outside Diameter	Nominal Wall Thickness (mm)																	
mm	in	mm	Sch5S	Sch5	Sch10S	Sch10	Sch20	Sch30	Sch40S	STD	Sch40	Sch60	Sch80S	XS	Sch80	Sch100	Sch120	Sch140	Sch160	XXS
6	1/8	10.29	-	-	1.24	1.24	-	1.45	1.73	1.73	1.73		2.41	2.41	2.41	-	-	-	-	-
8	1/4	13.72	-	-	1.65	1.65	-	1.85	2.24	2.24	2.24	-	3.02	3.02	3.02	-	-	-	-	-
10	3/8	17.14	-	-	1.65	1.65	-	1.85	2.31	2.31	2.31	-	3.2	3.2	3.2	-	-	-	-	-
15	1/2	21.34	1.65	1.65	2.11	2.11	-	2.41	2.77	2.77	2.77	-	3.73	3.73	3.73	-	-	-	4.78	7.47
20	3/4	26.67	1.65	1.65	2.11	2.11	-	2.41	2.87	2.87	2.87	-	3.91	3.91	3.91	-	-	-	5.56	7.82
25	1	33.4	1.65	1.65	2.77	2.77	-	2.9	3.38	3.38	3.38	-	4.55	4.55	4.55	-	-	-	6.35	9.09
32	1 1/4	42.16	1.65	1.65	2.77	2.77	-	2.97	3.56	3.56	3.56	-	4.85	4.85	4.85	-	-	-	6.35	9.7
40	1 1/2	48.26	1.65	1.65	2.77	2.77	-	3.18	3.68	3.68	3.68	-	5.08	5.08	5.08	-	-	-	7.14	10.15
50	2	60.32	1.65	1.65	2.77	2.77	-	3.18	3.91	3.91	3.91	-	5.54	5.54	5.54	-	-	-	8.74	11.07
65	2 1/2	73.02	2.11	2.11	3.05	3.05	-	4.78	5.16	5.16	5.16	-	7.01	7.01	7.01	-	-	-	9.53	14.02
80	3	88.9	2.11	2.11	3.05	3.05	-	4.78	5.49	5.49	5.49	-	7.62	7.62	7.62	-	-	-	11.13	15.24
90	3 1/2	101.6	2.11	2.11	3.05	3.05	-	4.78	5.74	5.74	5.74	-	8.08	8.08	8.08	-	-	-	-	-
100	4	114.3	2.11	2.11	3.05	3.05	-	4.78	6.02	6.02	6.02	-	8.56	8.56	8.56	-	11.13	-	13.49	17.12
125	5	141.3	2.77	2.77	3.4	3.4	-	-	6.55	6.55	6.55	-	9.53	9.53	9.53	-	12.7	-	15.88	19.05
150	6	168.28	2.77	2.77	3.4	3.4	-	-	7.11	7.11	7.11	-	10.97	10.97	10.97	-	14.27	-	18.26	21.95
200	8	219.08	2.77	2.77	3.76	3.76	6.35	7.04	8.18	8.18	8.18	10.31	12.7	12.7	12.7	15.09	18.26	20.62	23.01	22.23
250	10	273.05	3.4	3.4	4.19	4.19	6.35	7.8	9.27	9.27	9.27	12.7	12.7	12.7	15.09	18.26	21.44	25.4	28.58	25.4
300	12	323.85	3.96	3.96	4.57	4.57	6.35	8.38	9.53	9.53	10.31	14.27	12.7	12.7	17.48	21.44	25.4	28.58	33.32	25.4
350	14	355.6	3.96	3.96	4.78	6.35	7.92	9.53	-	9.53	11.13	15.09	-	12.7	19.05	23.83	27.79	31.75	35.71	-
400	16	406.4	4.19	4.19	4.78	6.35	7.92	9.53	-	9.53	12.7	16.66	-	12.7	21.44	26.19	30.96	36.53	40.49	-
450	18	457.2	4.19	4.19	4.78	6.35	7.92	11.13	-	9.53	14.27	19.05	-	12.7	23.83	29.36	34.93	39.67	45.24	-
500	20	508	4.78	4.78	5.54	6.35	9.53	12.7	-	9.53	15.09	20.62	-	12.7	26.19	32.54	38.1	44.45	50.01	-
550	22	558.8	4.78	4.78	5.54	6.35	9.53	12.7	-	9.53	-	22.23	-	12.7	28.58	34.93	41.28	47.63	53.98	-
600	24	609.6	5.54	5.54	6.35	6.35	9.53	14.27	-	9.53	17.48	24.61	-	12.7	30.96	38.89	46.02	52.37	59.54	-
650	26	660.4	-	-	-	7.92	12.7	-	-	9.53	-	-	-	12.7	-	-	-	-	-	-
700	28	711.2	-	-	-	7.92	12.7	15.88	-	9.53	-	-	-	12.7	-	-	-	-	-	-
750	30	762	6.35	-	7.92	7.92	12.7	15.88	-	9.53	-	-	-	12.7	-	-	-	-	-	-
800	32	813	-	-	-	7.92	12.7	15.88	-	9.53	17.48	-	-	12.7	-	-	-	-	-	-
850	34	863.6	-	-	-	7.92	12.7	15.88	-	9.53	17.48	-	-	12.7	-	-	-	-	-	-
900	36	914.4	-	-	-	7.92	12.7	15.88	-	9.53	19.05	-	-	12.7	-	-	-	-	-	-
950	38	965.2	-	-	-	-	-	-	-	9.53	-	-	-	12.7	-	-	-	-	-	-
1000	40	1016	-	-	-	-	-	-	-	9.53	-	-	-	12.7	-	-	-	-	-	-
1050	42	1066.8	-	-	-	-	-	-	-	9.53	-	-	-	12.7	-	-	-	-	-	-
1100	44	1117.6	-	-	-	-	-	-	-	9.53	-	-	-	12.7	-	-	-	-	-	-
1150	46	1168.4	-	-	-	-	-	-	-	9.53	-	-	-	12.7	-	-	-	-	-	-
1200	48	1219.2	-		-	-	-	-		9.52	-	-		12.7	-	-	-	-	-	-
1300	52	1320.8	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1350	54	1371.6	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1400	56	1422.4	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1500	60	1524	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1600	64	1625.6	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1700	68	1727.2	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1800	72	1828.8	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1900	76	1930.4	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2000	80	2032	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

DIMENSION OF RING JOINT FACINGS OF FLANGE (ANSI B16.5)

NPS		Groove Number R					Diameter of Groove Circle (Pitch) P (mm)					Outside Diameter of Flange O (mm)					Diameter of Bolt Circle W (mm)				
	Class	150	300	600	900	1500	2500	150	300	600	900	1500	2500	150	300	600	900	1500	2500	150	300	600	900	1500	2500
1/2	-	11	11	11	12	12	13	-	34.14	34.14	39.67	39.67	42.88	-	95	95	120	120	135	-	66.7	66.7	82.6	82.6	88.9
3/4	-	13	13	13	14	14	16	-	42.88	42.88	44.45	44.45	50.80	-	115	115	130	130	140	-	82.6	82.6	88.9	88.9	95.2
1	15	16	16	16	16	16	18	47.63	50.80	50.80	50.80	50.80	60.33	110	125	125	150	150	160	79.4	88.9	88.9	101.6	101.6	108.0
1 1/4	17	18	18	18	18	18	21	57.15	60.33	60.33	60.33	60.33	72.23	115	135	135	160	160	185	88.9	98.4	98.4	111.1	111.1	130.2
1 1/2	19	20	20	20	20	20	23	65.07	68.27	68.27	68.27	68.27	82.55	125	155	155	180	180	205	98.4	114.3	114.3	123.8	123.8	146.0
2	22	23	23	23	24	24	26	82.55	82.55	82.55	95.25	95.25	101.60	150	165	165	215	215	235	120.7	127.0	127.0	165.1	165.1	171.4
2 1/2	25	26	26	26	27	27	28	101.60	101.60	101.60	107.95	107.95	111.13	180	190	190	245	245	265	139.7	149.2	149.2	190.5	190.5	196.8
3	29	31*	31*	31*	31	35	32	114.30	123.83	123.83	123.83	123.83	127.00	190	210	210	240	265	305	152.4	168.3	168.3	190.5	203.2	228.6
3 1/2	33	34	34	34	-	-	-	131.78	131.78	131.78	131.78	-	-	215	230	230	-	-	-	177.8	184.2	184.2	-	-	-
4	36	37	37	37	37	39	38	149.23	149.23	149.23	149.23	161.93	157.18	230	255	255	290	310	355	190.5	200.0	215.9	235.0	241.3	273.0
5	40	41	41	41	41	44	42	171.45	180.98	180.98	180.98	193.68	190.50	255	280	330	350	375	420	215.9	235.0	266.7	279.4	292.1	323.8
6	43	45	45	45	45	46	47	193.68	211.12	211.12	211.12	211.14	228.60	280	320	355	380	395	485	241.3	269.9	292.1	317.5	317.5	368.3
8	48	49	49	49	49	50	51	247.65	269.88	269.88	269.88	269.88	279.40	345	380	420	470	485	550	298.5	330.2	349.2	393.7	393.7	438.2
10	52	53	53	53	53	54	55	304.80	323.85	323.85	323.85	323.85	342.90	405	445	510	545	585	675	362.0	387.4	431.8	469.9	482.6	539.8
12	56	57	57	57	57	58	60	381.00	381.00	381.00	381.00	381.00	406.40	485	520	560	610	675	760	431.8	450.8	489.0	533.4	571.5	619.1
14	59	61	61	61	62	63	-	396.88	419.10	419.10	419.10	419.10	-	535	585	605	640	750	-	476.3	514.4	527.0	558.8	635.0	-
16	64	65	65	65	66	67	-	454.03	469.90	469.90	469.90	469.90	-	595	650	685	705	825	-	539.8	571.5	603.2	616.0	704.8	-
18	68	69	69	69	70	71	-	517.53	533.40	533.40	533.40	533.40	-	635	710	745	785	915	-	577.9	628.6	654.0	685.8	774.7	-
20	72	73	73	73	74	75	-	558.80	584.20	584.20	584.20	584.20	-	700	775	815	855	985	-	635.0	685.8	723.9	749.3	831.8	-
24	76	77	77	77	78	79	-	673.10	692.15	692.15	692.15	692.15	-	815	915	940	1040	1170	-	749.3	812.8	838.2	901.7	990.6	-

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