Last update: 18/12/2022

Water-Tube industrial burners (WT– Series)

From 3200 kW up to 60000 kW

More than

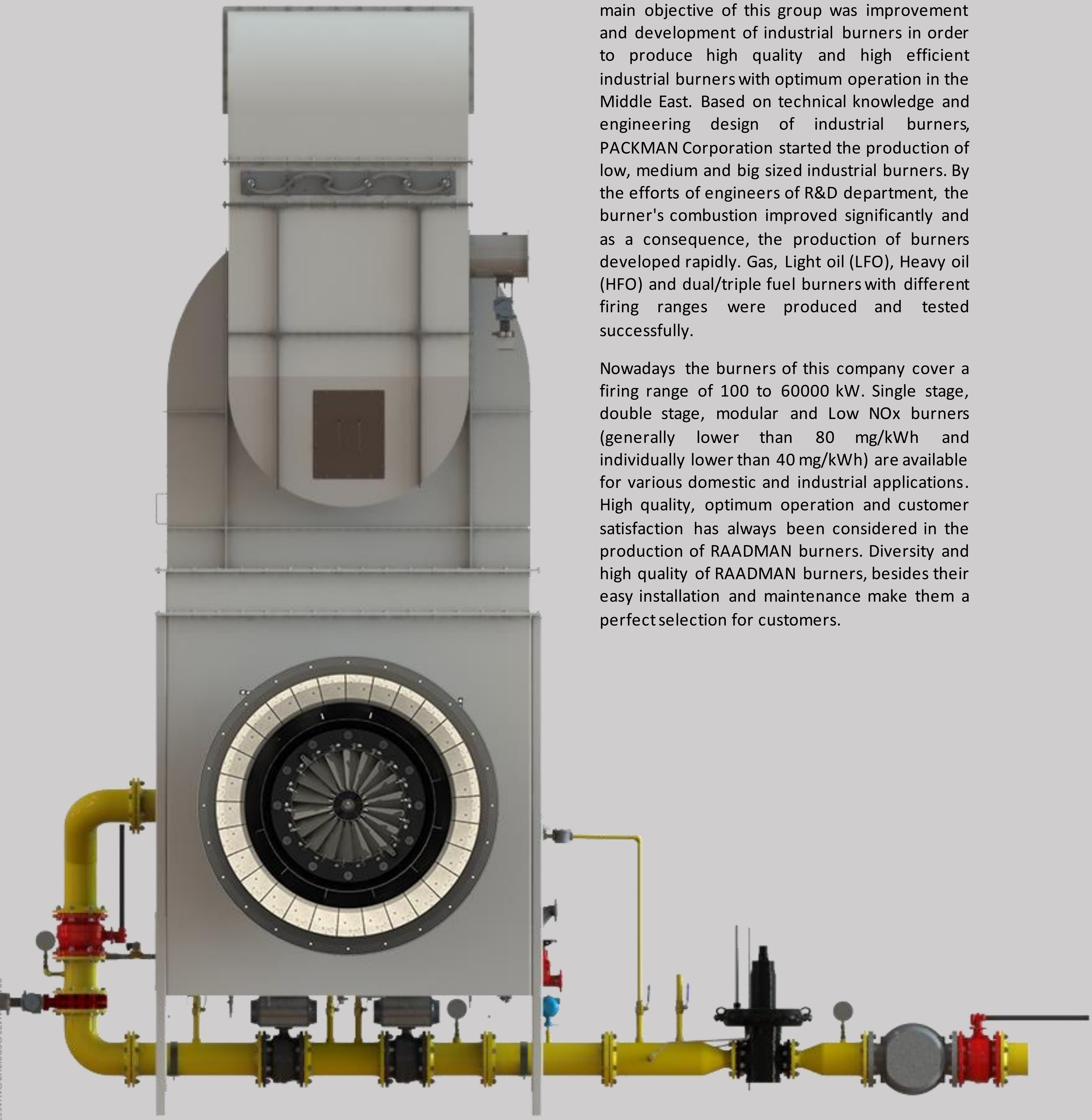
48 Years of Reliability

History

The PACKMAN Company was established in February of 1975. This company started its official activity in the field of construction of High-Pressure Vessels such as Hot-Water Boilers, Steam Boilers, Pool Coil Tanks, Softeners and Heat Exchangers from 1984. As the first supplier of Hot water boilers with high quality and standard mark, PACKMAN has started exporting its products to countries such as Uzbekistan, United Arab Emirates and other countries in the region. Currently, PACKMAN honorfully is one of the largest producers of hot-water and steam boilers in the Middle East..

After 40 years of experience in the field of heating industry, especially boilers and burners, this group started his activity on January 2011 in the area of burners with brand of RAADMAN. The main objective of this group was improvement and development of industrial burners in order to produce high quality and high efficient industrial burners with optimum operation in the Middle East. Based on technical knowledge and engineering design of industrial burners, PACKMAN Corporation started the production of low, medium and big sized industrial burners. By the efforts of engineers of R&D department, the burner's combustion improved significantly and as a consequence, the production of burners developed rapidly. Gas, Light oil (LFO), Heavy oil (HFO) and dual/triple fuel burners with different firing ranges were produced and tested successfully.

Nowadays the burners of this company cover a firing range of 100 to 60000 kW. Single stage, double stage, modular and Low NOx burners (generally lower than 80 mg/kWh and individually lower than 40 mg/kWh) are available for various domestic and industrial applications. High quality, optimum operation and customer satisfaction has always been considered in the production of RAADMAN burners. Diversity and high quality of RAADMAN burners, besides their easy installation and maintenance make them a perfect selection for customers.



A computer rendered picture of a 5 MW extremely short flame burner. For a 6 ton/hour, 30 bar, water-tube packaging boiler

Water tube boilers

The ability of water tube boilers to be designed without the use of excessively large and thick-walled pressure vessels makes these boilers particularly attractive in applications that require dry, high-pressure, high-energy steam, including steam turbine power generation.

Owing to their superb working properties, the use of water tube boilers is highly preferred in the following major areas:

- Variety of process applications in industries
- Chemical processing divisions
- Pulp and Paper manufacturing plants
- Refining units
- Power Plants

Besides, they are frequently employed in power generation plants where large quantities of steam (ranging up to 500 kg/s) having high pressures i.e. approximately 16 megapascals (160 bar) and high temperatures reaching up to 550°C are generally required.

A water tube boiler can be defined as a Steam boiler in which the flow of water in the tubes, as well as hot gases, enclose the tubes. Not like fire tube boilers, this boiler attains high-pressures, as well as high-steam capabilities, can be achieved. This is because of condensed tangential pressure on tubes which is known as hoop stress.

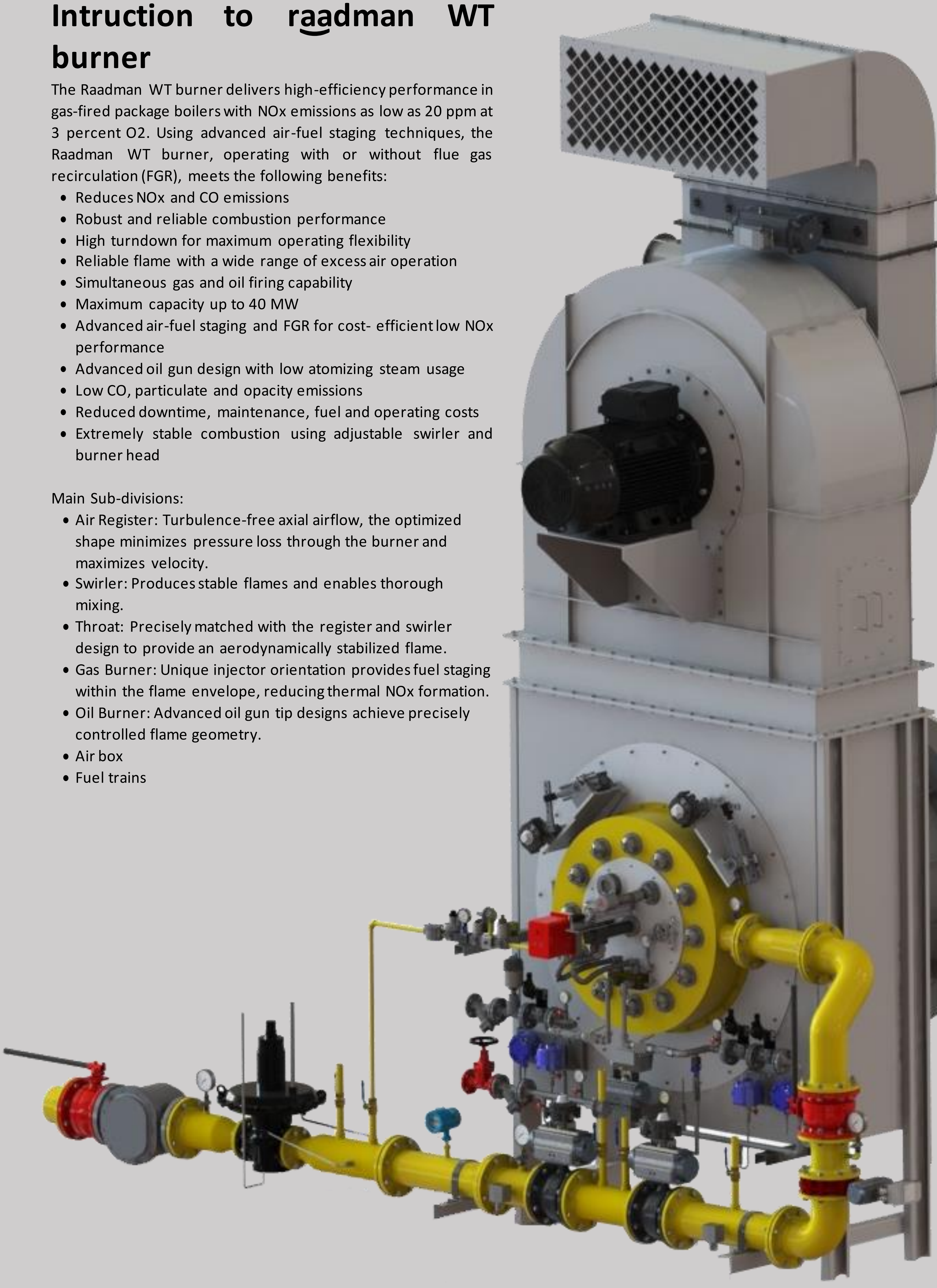
Intruction to raadman WT burner

The Raadman WT burner delivers high-efficiency performance in gas-fired package boilers with NOx emissions as low as 20 ppm at 3 percent O2. Using advanced air-fuel staging techniques, the Raadman WT burner, operating with or without flue gas recirculation (FGR), meets the following benefits:

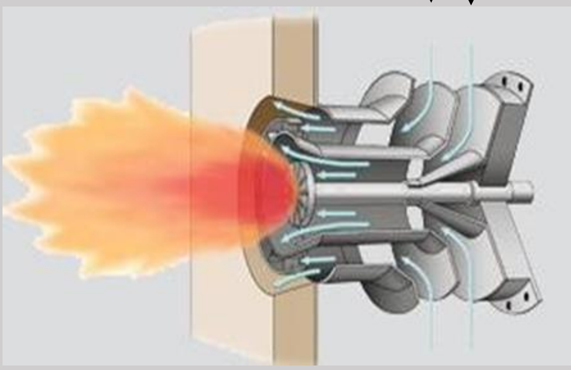
- Reduces NOx and CO emissions
- Robust and reliable combustion performance
- High turndown for maximum operating flexibility
- Reliable flame with a wide range of excess air operation
- Simultaneous gas and oil firing capability
- Maximum capacity up to 40 MW
- Advanced air-fuel staging and FGR for cost- efficient low NOx performance
- Advanced oil gun design with low atomizing steam usage
- Low CO, particulate and opacity emissions
- Reduced downtime, maintenance, fuel and operating costs
- Extremely stable combustion using adjustable swirler and burner head

Main Sub-divisions:

- Air Register: Turbulence-free axial airflow, the optimized shape minimizes pressure loss through the burner and maximizes velocity.
- Swirler: Produces stable flames and enables thorough mixing.
- Throat: Precisely matched with the register and swirler design to provide an aerodynamically stabilized flame.
- Gas Burner: Unique injector orientation provides fuel staging within the flame envelope, reducing thermal NOx formation.
- Oil Burner: Advanced oil gun tip designs achieve precisely controlled flame geometry.
- Air box
- Fuel trains



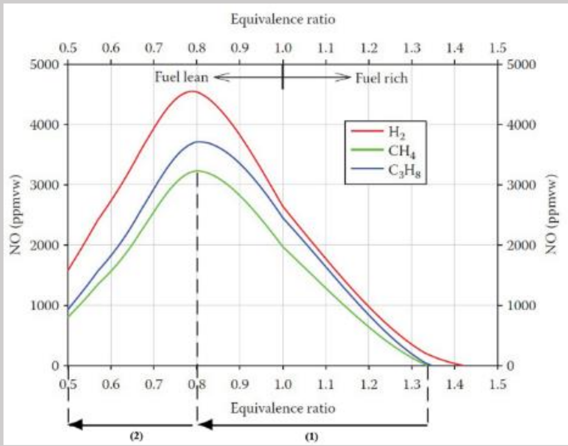
Primary-secondary air and air registers



The basis of design is to develop a stratified flame structure with specific sections of the flame operating fuel-rich and other sections operating fuel-lean. The burner design thus provides for the internal staging of the flame to achieve reductions in NOx emissions while maintaining a stable flame.

Staging of the air into the combustion zone serves to slow down the combustion process and separate the flame into different zones, some that operate fuel-rich and some that operate fuel-lean.

The fuel-rich and fuel-lean zones both combust at lower peak temperatures than a uniform fuel air mixture, resulting in lower thermal NOx formation. The combustion products from these two zones then combine to complete the combustion process and result in the completed oxidation of the fuel. By creating a fuel-rich zone in the front part of the flame, one can also reduce the conversion of fuel-bound nitrogen to NOx and thereby lower fuel NOx formation as well.

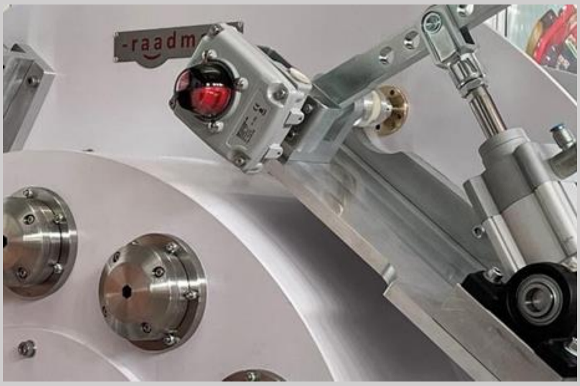


Raadman WT burners are equipped with two air registers suitable for any kind of liquid and/or gaseous fuel with the possibility to fire one or more fuels at the same time. Combustion air is divided into “primary” and “secondary” flows resulting in stratified combustion

This solution allows a general reduction of combustion temperature and therefore lowers thermal NOx generation. They are provided with a series of gas lances made from stainless steel which can be adjusted during the operation. These lances injected the larger part of fuel gas; a small quantity is injected trough a central gas gun to ensure the flame stability.

When a mixed gas/oil application is requested, a liquid atomizer replaces the central gas gun.

Air vorticity is generated and guaranteed by the vanes which formed each air register. The position of such vanes is set during the start - up phases and is important to control the flame intensity and shape which are different from one combustion chamber to another or from one fuel to another. The air registers vanes can be controlled manually or motorized or pneumatically. depending on the type of hazardous area to adjust the amount of combustion air

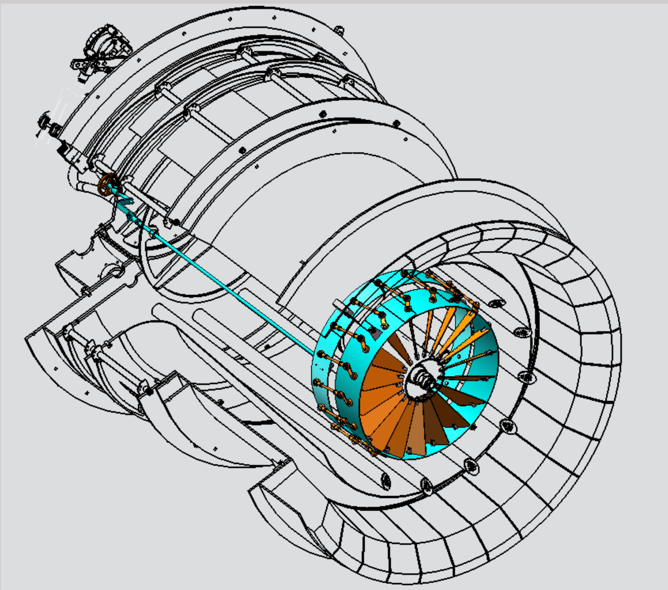


Gas fuel is distributed through an external plenum and a series on gas lances each of which is provided with a skew faced “multi jets” nozzle which can be adjusted and rotated to optimize gas distribution without halting burner operation.

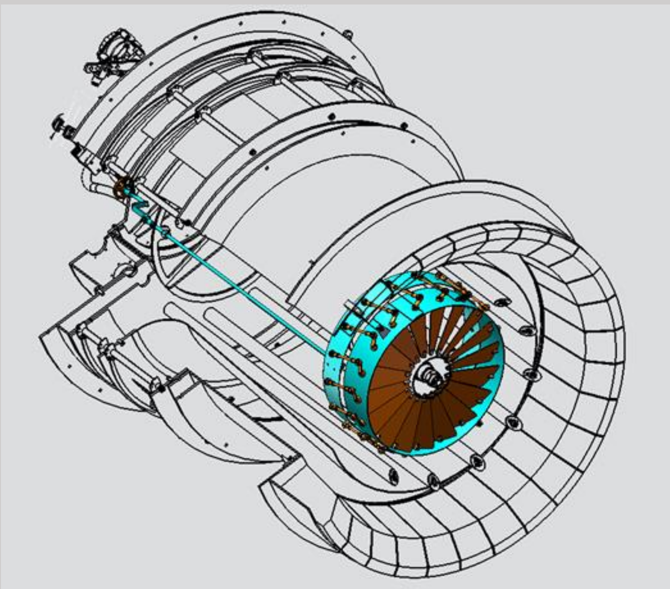
Raadman WT burners are designed to meet low NOx requirements while providing high combustion efficiency and extreme versatility. Typical applications of these type burners include forced or balance draft boilers as and process heaters.

Blade adjustment

A small amount of primary air, typically 10 to 20% of the total combustion air, is routed down the center of the burner. New burner designs employ a curved bladed swirler, to impart rotational momentum to this primary air. This swirled primary air creates a rotational vortex in the front of the burner, which serves several functions. It entrains a portion of fuel, creating a fuel-rich region immediately in front of the burner. The swirling primary air also generates a reverse flow in the form of a self-generating annular vortex that helps recirculate hot combustion gases from within the flame zone, thereby providing additional ignition energy to the fuel-air mixture and increasing the mass flow in this region to limit peak temperatures. In addition to controlling NOx formation, operating under fuel rich conditions results in the production of combustion intermediates that can result in the destruction of previously formed NOx. In a reducing environment, NO can act as an oxidizer to react with these combustion intermediates, resulting in the reduction of NO to N2. As such, NO, necessarily formed to satisfy the requirements of establishing a strong flame front, can be scavenged by this mechanism. to achieve complete fuel burnout at minimum excess air, the burner design must provide for fuel-lean zones to directly interact with the center fuel-rich sections. Creating a secondary air zone where the majority of the combustion air is introduced (65 to 90%) accomplishes this. The air injected into this zone is typically injected axially, with little or no swirl. Blade angle is adjusted with axial movement of the rod connected to an annular plate. Annular plate is linked with swirler vanes that adjust their angle. also adjusted blades can control the flame dimensions.



Opened blade: low swirl;
For longer flame shapes



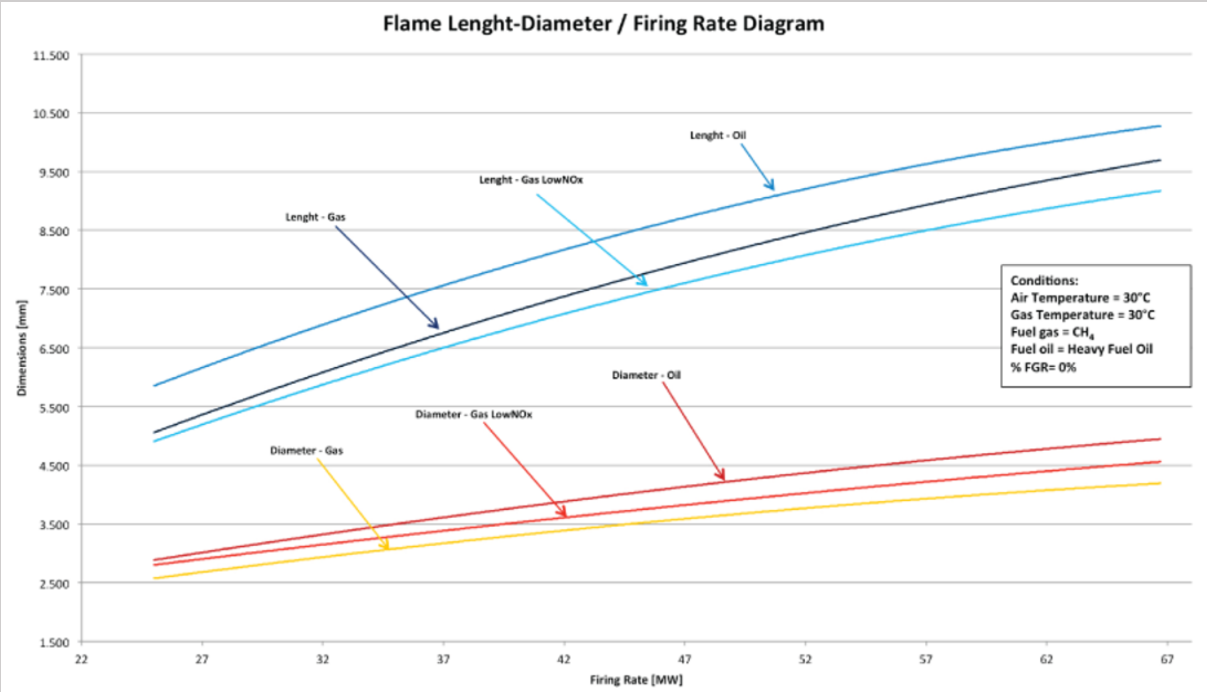
Closed blade: High swirl;
For much shorter flame shapes

Flame shape and dimension

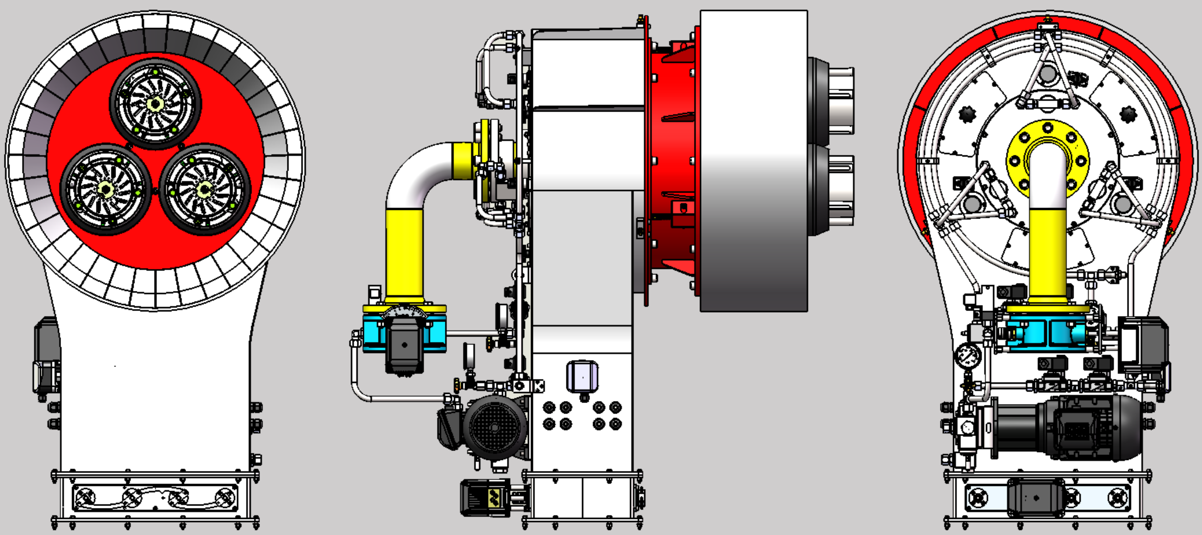
Burners have different flames depending on their utilizations. While fire tube boilers require a long flame with a small diameter, water tube boilers often require short flame but large diameter burners. In general, the flame length of water tube burners is 2 to 2.5 times the flame diameter.

Raadman WT burners have a ball shaped flame with substantial swirl (swirl number is higher than 0.6). The flame has hot reverse flow into the center and cold forward flow at sides. There is intense mixing and the secondary jet velocity is more than the primary jet velocity. The flame is used for combustion chambers which are more or less cubicle in shape.

Estimated flame dimensions



Using the unlimited subdivide flames, with a single combustion air register, we can offer any flame shapes for a much better combustion fitted the chamber of the target boiler.

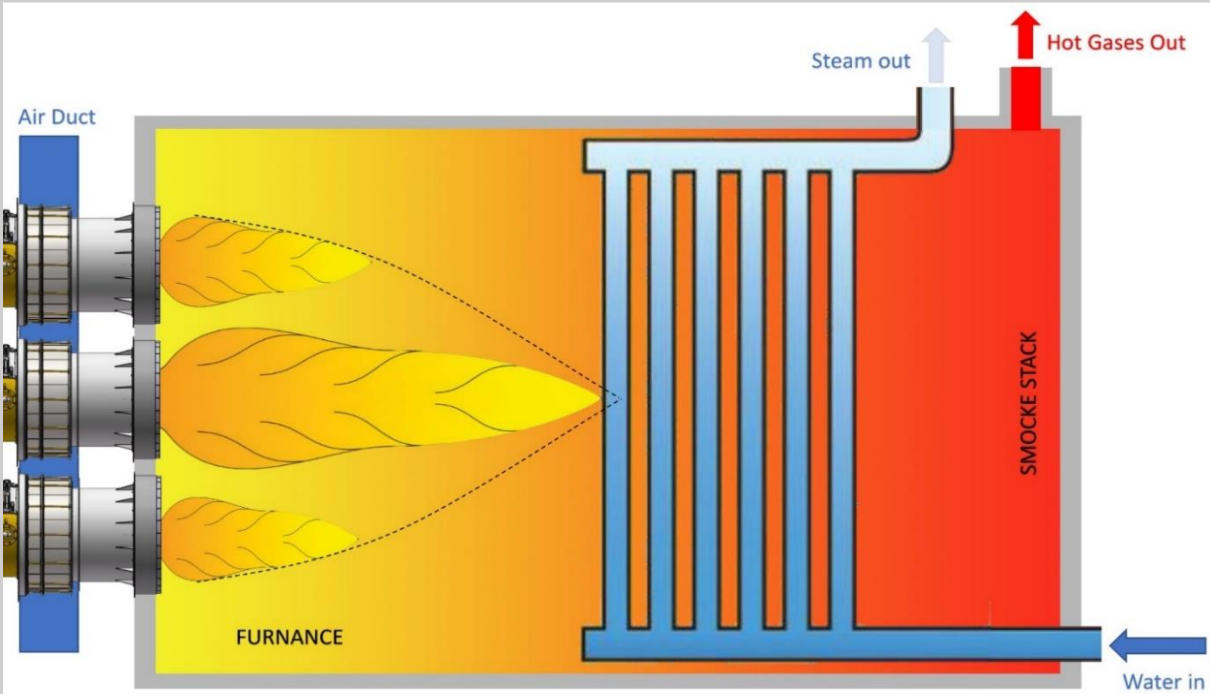


raadman WT burner for multi-burner boilers

To achieve higher capacities, use several burners in industrial water tube burners. In Industrial boilers, the simultaneous use of two burners is common, the flame shape of each is adjusted using air register vanes and swirler. These boilers have a common air box that the whole boiler air enters this air box and by adjusting theair register and swirler the shape of flame and the heat capacity of each flame will be adjusted.

The shape of the flame is such that each burner has a separate small flame, but eventually all burners will have a single large flame.

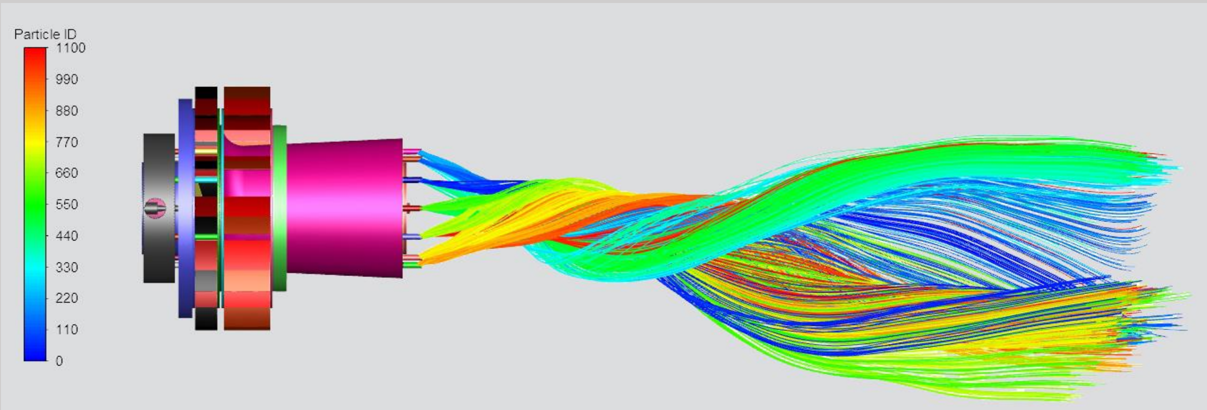
As a result of many observations of multiple-burner, oil and gas firing equipment, on a wide range of boiler designs, it has been concluded that the proper airflow distribution to each burner is essential in order to control fame shape, fame length, excess air level, and overall combustion efficiency. Proper airflow distribution consists of equal combustion airflow between burners, uniform peripheral velocity distributions at the burnerinlets, and the elimination of tangential velocities within each burner. If the unit has been designed with windbox FGR, the O2 content must be equal between the burners, and this is accomplished by balancing the FGR distribution to each burner.

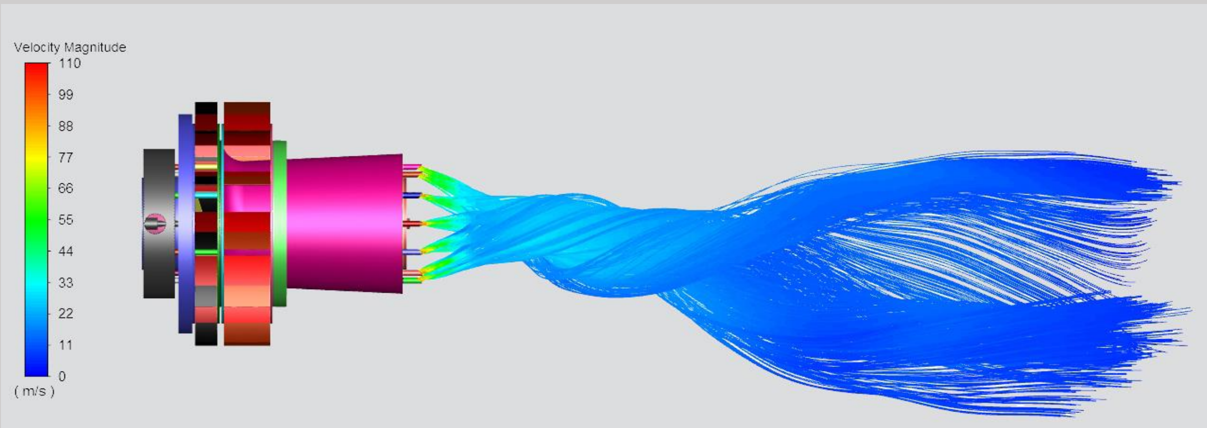


CFD experts in R&D department

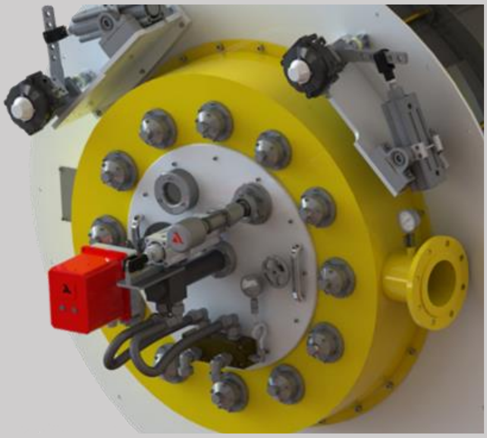
Industry relies on heat from the burners in all combustion systems. Optimizing burner performance is critical to complying with stringent emissions requirements and to improve industrial productivity. Engineers involved in designing and building advanced combustion equipment for the hydrocarbon process industries routinely use Advanced CFD to advance new burner technology. The science and technology of CFD has matured to the point where performance predictions are made with a degree of confidence from models covering a wide range of complex furnace, burner, and reactor geometries. While tremendous advances have been made in understanding the fundamentals of combustion, the remaining challenges are complex. To make improvements, it is critical to understand the dynamics of the fuel fluid flow and the flame and its characteristics. Computational Fluid Dynamics offers a numerical modelling methodology that helps in this regard. Commercial CFD codes utilize a standard approach to simulate chemical kinetics, which approximate the consumption and production of chemical species. This causes the engineer to use simplifying assumptions about the chemistry considered in the simulation. While this simplified chemistry includes adequate information to predict flow patterns and local heat transfer, these models lack sufficient information to accurately predict NOx and CO production. Alternatively, the NOx chemistry is decoupled from the main calculation and obtained using post-processing techniques. CFD coupled with cold-flow physical modeling and hot-flow burner tests provides a powerful analytical tool to develop accurate, timely, and cost-effective burner designs.

Packman R&D Department is accustomed to working on custom engineered solutions, and our sales applications and thermofluidic engineering department are ready to assist with complex applications. As part of our design and engineering process, we have the ability to use Computational Fluid Dynamics (CFD) modeling to predict product performance or adjust product design prior to burners being installed in the field.





Igniting technology



The most powerful ignitors are based on high energy systems developed over decades of experience in applications requiring safe and reliable operation, such as power generation plants and steam generating utilities.
The High Energy ignition systems ensure a number of robust intermittent sparks realized by the energy accumulated by a capacitor, providing more powerful ignition capacity than high tension arc electrodes. The Ignitors includes gas electric ignitors, light oil electric ignitors, without or with premixed air, suitable for continuous operation, as well as the direct spark ignitor for light up of heavy oil. Usually, the igniters are an integral part of the supply of burners or combustion systems

The ignitors can be supplied with in-built flame scanners or ionization flame rods, with automatic retraction drivers and with power supply units for installation in any environment and hazardous area. High Energy Electric Ignitor has been capable to withstanding to every temperature which could be present inside wind box and which can be up to 350 °C, and the discharge head itself must withstand to the very high radiation temperature close to the burner flame. The ignitor consists of three main parts, namely: Control Box, in which the power for the discharge is generated High Voltage Armored Cable, used to carry this power to the ignitor itself The Special Ignitor End, at which the discharge occurs across a semiconductor gap We can provide ignitors for a wide range of application and for any kind of industrial process as industrial boilers for steam/ power generation which burners where installed on boilers front wall or at boilers corners (tangential combustion), refinery or industrial furnace, thermal oxidizers and process heaters and so on.

Reliable flame monitoring

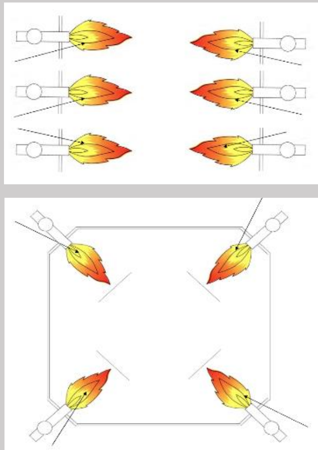
Flame monitoring plays a crucial role when it comes to reliability and safety.
Determination of the best method of flame monitoring takes into account not only the burner and the fuel to be combusted, but also how the system operates and the conditions inside the combustion chamber.
Heat generators with one flame per combustion chamber are easier to monitor than those with multiple flames. In the latter case, it also depends whether the flames are firing into the combustion chamber from the same or opposing directions.
Biomass plant and waste incinerators need a flame monitoring system that is not affected by extraneous flames.

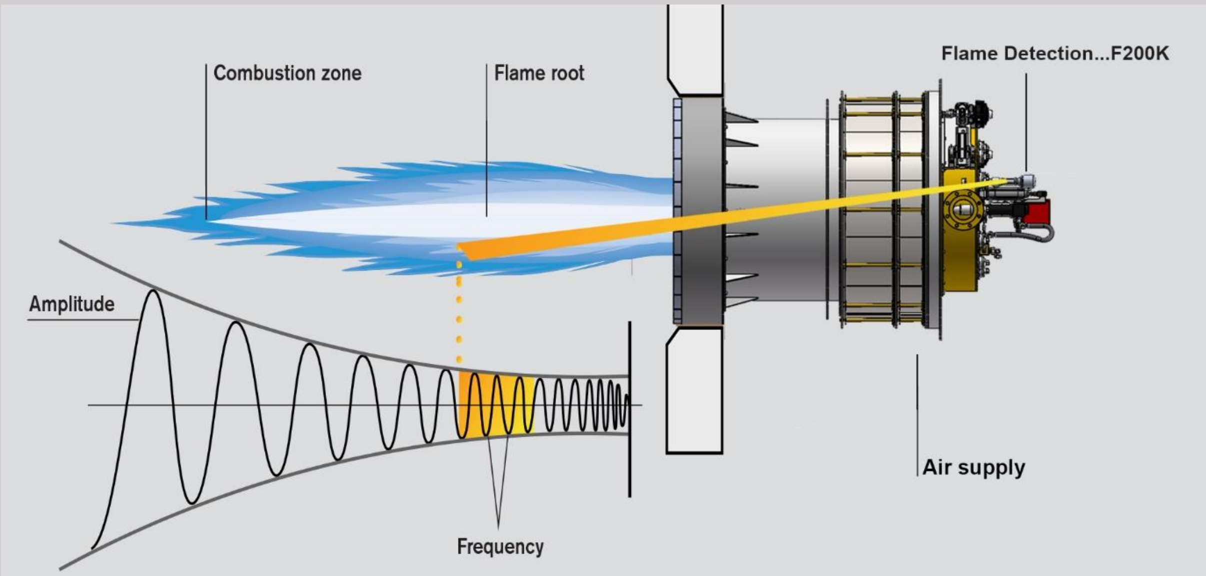
DB series are for plant with multiple burners firing from different directions into a single combustion chamber, and for process plant with various flame sources. The flame scanners monitor each flame separately via up to ten load-dependent switching thresholds for each fuel.

Lamtec - F200K, F300K

The compact flame scanner is composed of a cylindrical casing comprising an axial light incidence aperture, a processing status indicator at the rear of the unit and operational controls which can be accessed by removing the cover.

The device is connected through an integrated standard plug and using a connection cable required for this with coupler.





Thanks to the air/steam atomizing technology as well as the superior design of primary/secondary air registers, we are delighted to gratefully guarantee the best performance of our productions in order to meet our customer demands.

Hazardous area

A major safety concern in industrial plants is the occurrence of fires and explosions. No other aspect of industrial safety receives more attention in the form of codes, standards, technical papers, and engineering design. Regulatory bodies like the Occupational Safety and Health Administration (OSHA) have established systems that classify locations which exhibit potentially dangerous conditions to the degree of hazard presented.

Hazardous locations are areas where flammable liquids, gases or vapors or combustible dusts exist in sufficient quantities to produce an explosion or fire. In hazardous locations, especially designed equipment and special installation techniques must be used to protect against the explosive and flammable potential of these substances.

Hazardous locations can also be described as those locations where electrical equipment might be installed and which, by their nature, might present a condition which could become explosive if the elements for ignition are present. Unfortunately, flammable substances are not always avoidable, e.g., methane and coal dust in mines. Therefore, it is of great importance that a user of electrical equipment, such as push buttons and pilot lights, be aware of the environment in which these products will be installed. The user's understanding of the hazard will help ensure that the electrical equipment is properly selected, installed, and operated to provide a safe operating system.

There are a great variety of applications, especially in the chemical and petrochemical industries, that require explosion protected equipment. As a result, there have been principles and technologies developed to allow electrical instrumentation and control devices to be used even in environments where there is a danger of explosion.

Explosion hazards arising from the handling of flammable gases, vapors, and dust are attributable to normal chemical and physical processes. Regulation on hazardous location by means of the Zone system have now been formulated by the International Electrotechnical Commission (IEC).

The hazardous location areas are defined by taking into account the different dangers presented by potentially explosive atmospheres. This enables protective measures to be taken which account for both cost and safety factors.

Zone 0

In which ignitable concentrations of flammable gases or vapors are

- Present continuously
- Present for long periods of time

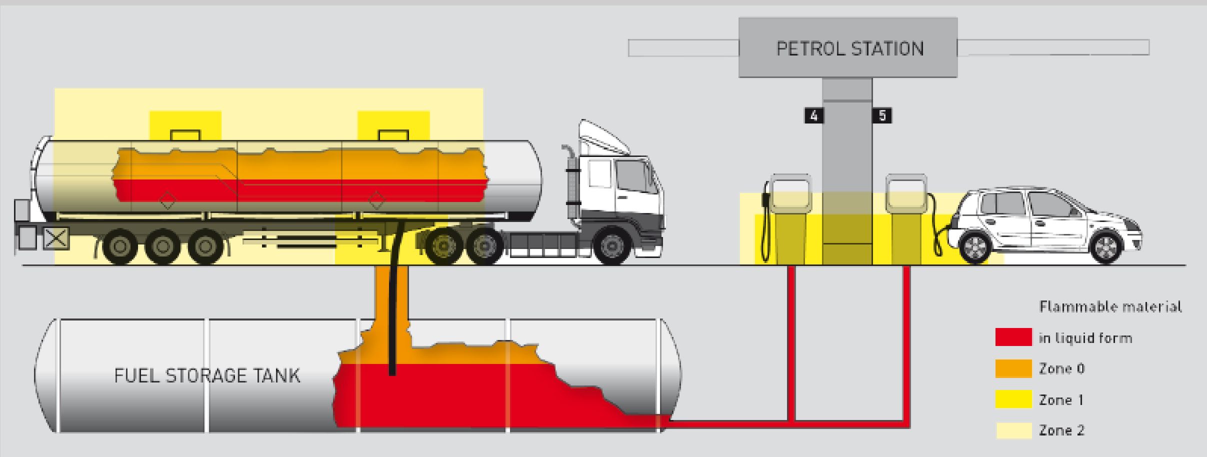
Zone 1

In which ignitable concentrations of flammable gases or vapors are:

- Likely to exist under normal operating conditions
- May exist frequently because of repair, maintenance operations, or leakage

Zone 2

- In which ignitable concentrations of flammable gases or vapors are:
- Not likely to occur in normal operation
- Occur for only a short period of time
- Become hazardous only in case of an accident or some unusual operating condition



Fuel types and simultaneous combustion

Oil Burner: Controlling Precise Flame Geometry

The steam or mechanical atomizers on our low-emission utility boiler-burners achieve precisely controlled flame geometry that creates substantial NOx reductions over conventional oil-fired burners. The low-energy-consuming steam atomizer provides a turndown ratio as high as 8:1, with less than 7% steam-to-fuel oil ratio. This atomizer eliminates the need for a more complex constant differential system and operates at a constant pressure.

Gas Burner: Setting New Standards in Staging

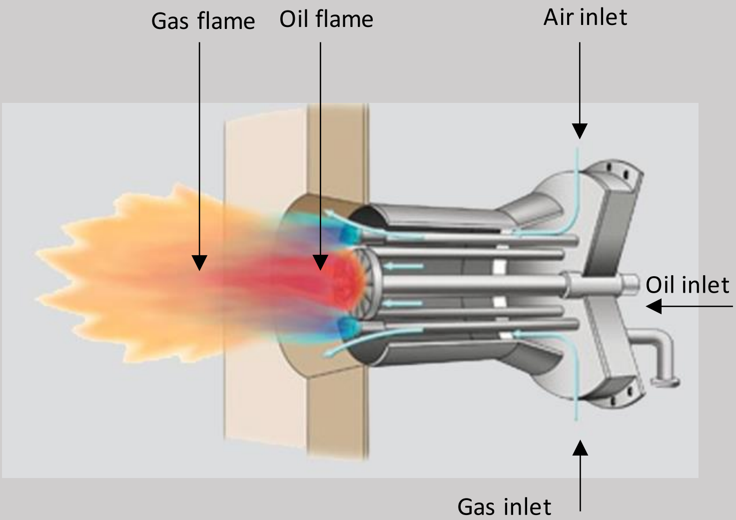
Raadman WT burners effectively control NOx by staging fuel and air. Using both a multi-poker injector and center-fired gas burner, fuel-rich and fuel-lean zones are created within the flame envelope. The ratio of center-fired gas to poker gas, together with poker orientation and location, is carefully optimized for each application.

Simultaneous gas and oil firing

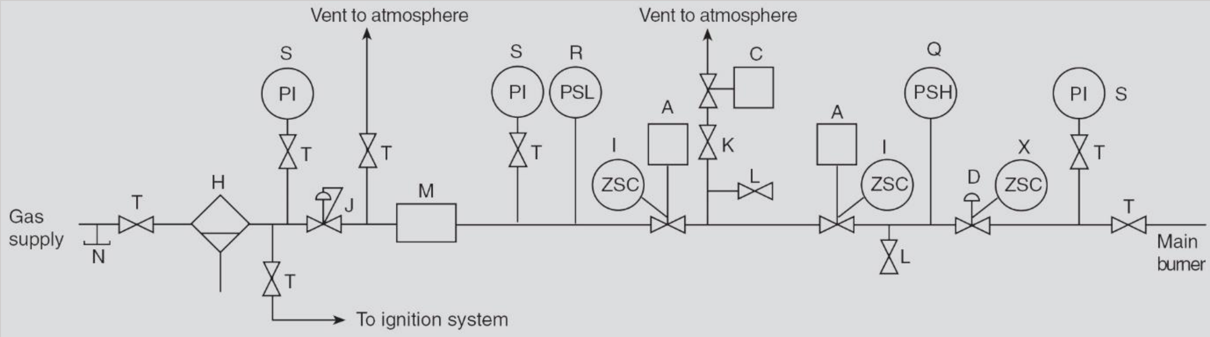
Raadman WT burners offer the flexibility of simultaneous gas and oil firing. This gives you the options of firing oil and gas in the same burner, or gas in some and oil in others based on your specific needs. Our burners allow you to switch fuels at various loads without affecting the boiler operation.

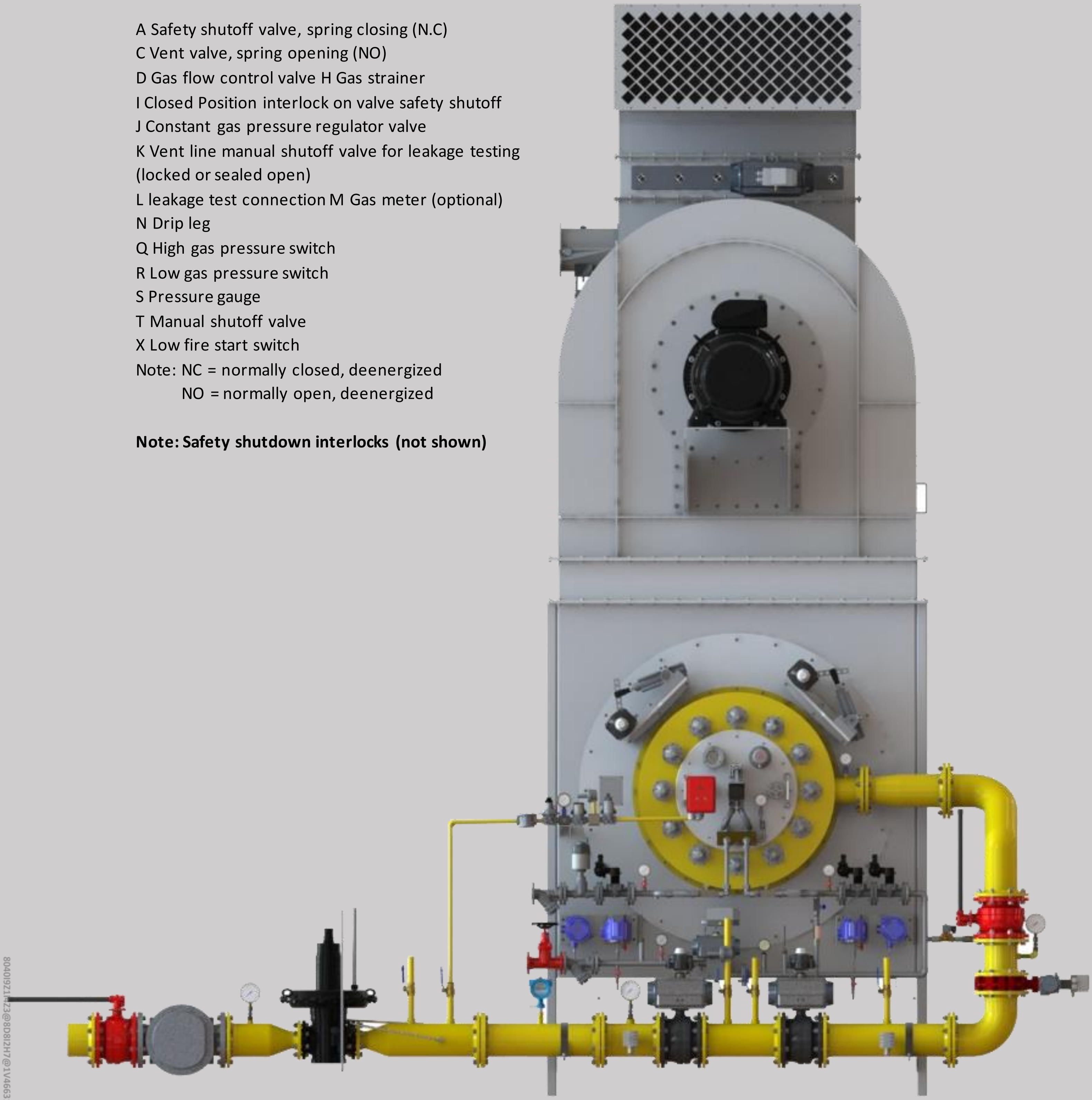
In the center of the register, the fuel oil sprayer with swirler is furnished. Surrounding the exterior of this swirler, multiple gas spuds (Spoke nozzle) are furnished, where intimate air/gas mixing is facilitated by primary air flows from outside the swirler.

- Wide turn down range 8:1
- Oil and gas firing in combination available
- LNG, LPG, HFO, and LFO gases fuel singular burning available
- Low NOx option available



Gas train – meeting the requirements of NFPA-85





A Safety shutoff valve, spring closing (N.C)
C Vent valve, spring opening (NO)
D Gas flow control valve H Gas strainer
I Closed Position interlock on valve safety shutoff
J Constant gas pressure regulator valve
K Vent line manual shutoff valve for leakage testing (locked or sealed open)
L leakage test connection M Gas meter (optional)
N Drip leg
Q High gas pressure switch
R Low gas pressure switch
S Pressure gauge
T Manual shutoff valve
X Low fire start switch
Note: NC = normally closed, deenergized
NO = normally open, deenergized

Note: Safety shutdown interlocks (not shown)

Pressure based spill back lances/atomizers:

The burner-lance is especially suitable for use in or on an oil burner and is designed to operate spill back atomizers with integrated shut-off needle. The strong spring on the actuating rod pushes the needle in closed position. This ensures a reliable shut-off under all circumstances.

Fuel, branched off from the supply line actuates the piston for opening, either controlled by two external solenoid valves or by one 3/2 solenoid valve. The piston has a fixed travel. While opening, the needle inside the atomizer is retracted in the correct position by means of a spring at the back of the atomizer against a fixed stop on the needle itself.

During the pre-purge period of the burner, the needle is keeping the orifice closed and the fuel circulates through the lance at pre-set supply and return pressure. On energizing both solenoid valves and the 3/2 solenoid valve, even after long idle intervals, there is immediate atomization guaranteeing perfect ignition.

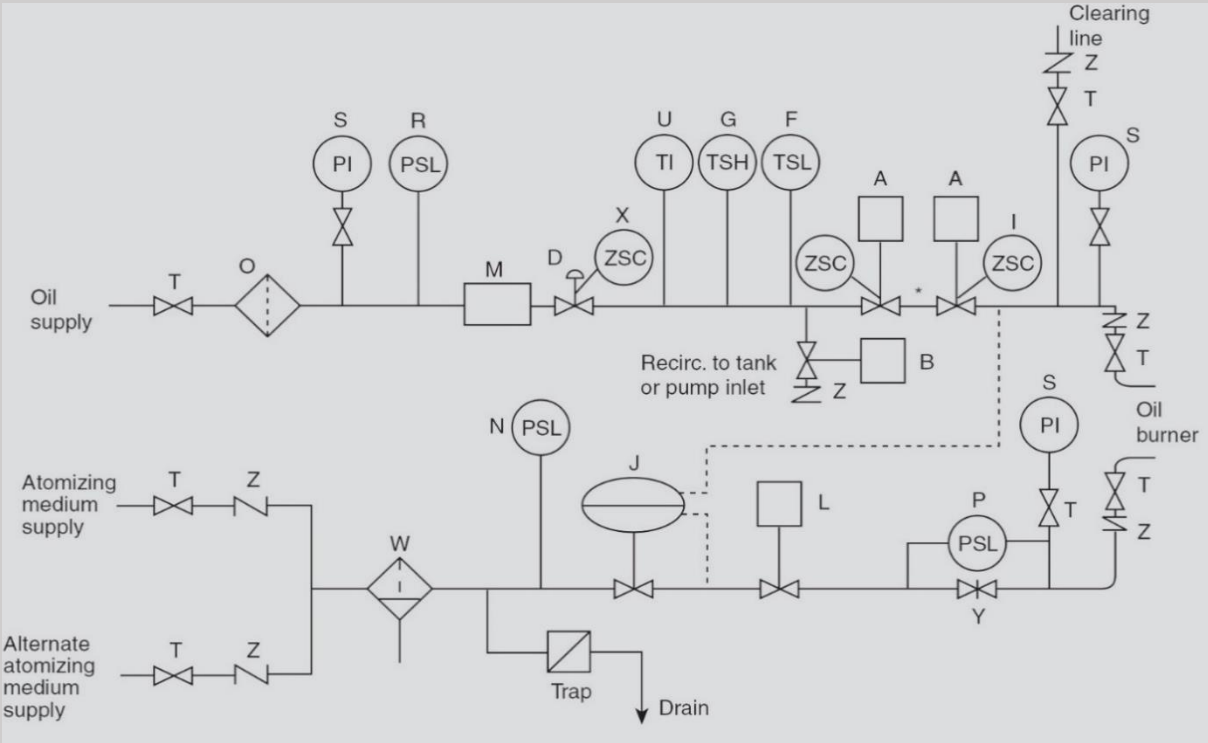
The burner-lance is suitable for supply pressures from 20 up to 40 bar and fuel temperatures up to 140°C.

Air/Steam lances/atomizers

The burner-lance of with shut-off needle is especially suitable for use in or on an oil burner and is designed to operate Y series atomizers with compressed air or steam. The strong spring on the actuating rod pushes the needle in closed position. Compressed air, controlled by an external 3/2 solenoid valve, actuates the piston for opening. The piston has a fixed travel, pulling the needle in the correct position when it opens.

During the pre-purge period of the burner, the needle is keeping the central orifice in the reverse disc closed. On energizing the 3/2 solenoid valve, even after long idle intervals, there is immediate atomization guaranteeing perfect ignition. The burner-lance is suitable for supply pressures up to 16 bar and fuel temperatures up to 140°C.

Typical fuel and atomizing medium supply systems and safety controls for oil burner (Based on NFPA-85)



A Safety shutoff valve, spring closing (NC)
B Oil recirculation valve atomizing (NO) (optional for unheated oil)
D Oil flow control valve
F Low oil temperature switch (not applicable for unheated oil)
G High oil temperature switch (not applicable for unheated oil)
I Closed position interlock on safety shutoff valve
J Atomizing medium differential control valve
L Automatic atomizing medium differential shutoff valve
M Oil meter (optional)
N Low atomizing medium pressure switch
O Oil strainer
P Atomizing medium flow interlock differential switch, or pressure interlock switch
R Low pressure switch
S Pressure gauge
T Manual shutoff valve
U Oil temperature gauge (optional for unheated oil)
W Atomizing medium strainer
X Low fire start switch
Y Atomizing medium flow orifice
Z Check valve

Note: NC= normally closed, deenergized
NO=normally open, deenergized

Note:

Safety shutdown interlocks (not shown)

FGR

One of the first methods of NOx reduction was the use of flue gas recirculation (FGR), whereby a portion of the stackgases was returned and mixed with the combustion air to the burner. This added additional mass flow into the combustion zone across which the heat release was distributed, and thereby lowered the temperature and accompanying thermal NOx formation. The introduction of FGR into the combustion air increases the overall mass of the reactants, and hence the products, in the combustion process. The increased mass, as well as the increased reactant diffusion time requirement, reduces the overall flame temperature. The fact that the flue gases being returned also have very low oxygen levels, typically 2 to 4%, resulted in a lowering of the volumetric oxygen concentration entering the combustion zone, which also helps to retard NOx formation by limiting oxygen availability. FGR was added to many conventional burners, and could result in NOx reduction ranging from 20 to 75%, dependingon the amount added, the fuel being fired, and the initial NOx level. The problems with FGR addition to conventionalburners were three-fold:

(1) additional fan capacity had to be used to transport the hot flue gases to the burner combustion air system, resulting in increased capital and operating costs;

(2) very high levels of flue gases were often required to reduce NOx emissions to acceptable levels;

(3) high rates of FGR, typically over 20%, decreased the flame temperature to the point where burner operation began to become unstable.

Presenting the edge of burner technology at 20th HVAC Exh.
Tehran, 1400

Last but not the least!
Raadman WATER TUBE BURNERS (WT-Series) cover a range of 3200 up to 40,000 kW generally. These types of burners are especially designed based on the customer request and the target plant/boiler considerations.

They can be used wherever in industry or trade, on board ships or for power plant. They are suitable for all commonly available gas and oil types and are notable for their reliability, longevity and great economy. Nearly all burner types over the entire performance range are available in a Low NOx version, with particularly low emission levels.

PACKMAN
Industrial Group

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