

### CTE Technology

Developed from direct contact water heating science which was first introduced more than two decades ago, Complete Thermal Exchange (CTE) technology has revolutionized high efficiency water heating methods. Today CTE enjoys a proven record and has rapidly become the new standard in high efficiency water heating and energy savings.

While traditional direct contact water heating can offer significant energy savings when compared to a conventional steam boiler system, the Armstrong Flo-Direct® CTE gas fired water heater offers an unparalleled, 99.7% high heat value (110% approx. low heat value) efficiency rating\* throughout each phase of its operation cycle.

The sustained operational efficiency of Flo-Direct® CTE gas fired water heaters creates the most energy efficient method of hot water production currently available.

### No Scale Build-Up

The Flo-Direct® CTE gas fired water heater's unique design prevents scale build-up because there are no "hot spots" internally or externally, and because calcium is prevented from completely falling out of suspension during operation. As a result, the mineral content of the influent water and the effluent water will be equal.

### Armstrong Flo-Direct® CTE gas fired water heaters achieve CTE Standards

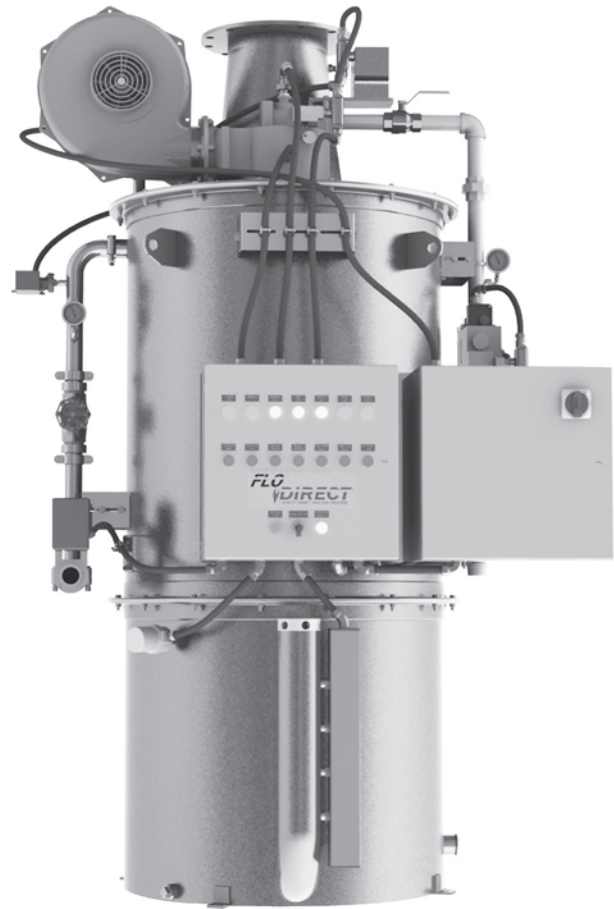
The Flo-Direct® CTE direct contact water heaters, meet five standards not available with the older designs and traditional methods of direct contact water heater technology:

1. CTE units maintain a minimum of 99.7% high heat value (110% approx. low heat value) efficiency in all modes of operation, not just under optimal conditions.
2. CTE units have multiple thermal passes. Water and the combustion gasses (or heat from the combustion) repeatedly come in contact. This ensures that the maximum amount of heat or energy from combustion is transferred to the water.
3. CTE units have a dry combustion chamber. This is vital to maintaining complete combustion at all times during operation.
4. CTE units maintain complete combustion at all times.
5. CTE units must have an integral water quality integrity system. Operational procedures must be in place to ensure that effluent water quality is equal to the influent water quality.

### Complete Combustion = Complete Water Quality

While many traditional-method direct contact water heaters spray water directly on the flame – sometimes called "flame quenching" – Flo-Direct®, using CTE technology, avoids this process altogether. According to the Industrial Heating Equipment Association's "Combustion Technology Manual," flame quenching promotes incomplete combustion, and produces alcohols, aldehyde, formic acid, higher order acids, carbon monoxide, as well as carbon dioxide and water vapor. With CTE technology, Flo-Direct® maintains 99.7% high heat value\* (110% approx. low heat value) combustion efficiency, while maintaining water quality at all times.

\*See page 530 for high heat value (HHV) and low heat value (LHV) explanation.



### Global Water Quality Standards

Flo-Direct® Complete Thermal Exchange (CTE) Gas Fired Water Heating Technology significantly limits the effluent water chemical additives typically attributed to other process water heating systems.

Our unique CTE water heating process deaerates the water significantly. Independent third party testing has verified CTE technology can actually remove some chemical constituents from the influent water.

NSF test results show that the effluent water from a Flo-Direct CTE Gas Fired Water Heater meets US, European Union and PRC bottled drinking water standards\* and has been tested and documented as fully compliant with:

- USFDA - The United States Food and Drug Administration, Code of Federal Regulations Bottled Water Standard: Chapter I, Title 21, Part 165, Subpart B, Section 165.110.
- EU-TRW - The European Union Directives(s) - Treated Waters: 98/83/EC.

\* Peoples Republic of China Standards for Drinking Water: GB5749-2006

\*Statement presumes influent water also meets listed standards.



Flo-Direct					
Model	Connections		btu/hr	kW/hr	
	1	2			
	in	in			
1000	1	1	1,000,000	292	
1500	1	1	1,500,000	439	
2000	1-1/2	1-1/2	2,000,000	585	
3000	2	1-1/2	3,000,000	878	
5000	2-1/2	2	5,000,000	1464	
6000	3	2	6,000,000	1757	
7000	3	2	7,000,000	250	
9000	3	2	9,000,000	2635	
10000	3	2	10,000,000	2928	
12000	4	3	12,000,000	3514	
15000	4	3	15,000,000	4392	
16000	4	3	16,000,000	4685	

Specifications	
Gas Supply Pressure	2 - 6 psig / .14 - .41 bar
Dynamic Water Supply Pressure	Constant water pressure (+/-5 psi variation maximum) within a minimum of 30 psig/2 bar and a maximum of 100 psig/6.8 bar range is required for optimum performance.
Maximum Inlet Water Temperature	120°F (49°C)
Minimum Inlet Water Temperature	32°F (0°C)
Maximum Effective Outlet Temperature	185°F (85°C)

Materials	
Upper and Lower Canister	Type 304 Stainless Steel #10 Glass Finish
Inlet Gas Train Piping	Malleable Iron with Standard Yellow Finish
Inlet Water Train Piping	Copper with Brass/Bronze Fittings
Spray Ring	Type 304/316 Stainless Steel
Canister Gaskets	Warco White
Flame Tube	Type 304 Stainless Steel
Pall Rings	Type 304 Stainless Steel

Optional/Custom materials of construction available upon request.

**Standard Sizing Formulas**

$\frac{\text{gpm} \times \Delta T}{2} = \text{AFD Model}$

$(\text{AFD Model}) \times 2 = \text{gpm}$

$(\text{AFD Model}) \times 2 = \Delta T \text{ gpm}$

**Standard Formula Key**

gpm = Gallons per Minute

$\Delta T$  = Temperature rise (°F)

AFD = Armstrong Flo-Direct (e.g., 1000, 5000)

Use the Flo-Direct sizing tool at [armstronginternational.com/flo-direct](http://armstronginternational.com/flo-direct)

**Metric Sizing Formulas**

$\frac{\text{lpm} \times \Delta T}{4.2} = \text{AFD Model}$

$(\text{AFD Model}) \times 4.2 = \text{lpm}$

$(\text{AFD Model}) \times 4.2 = \Delta T \text{ lpm}$

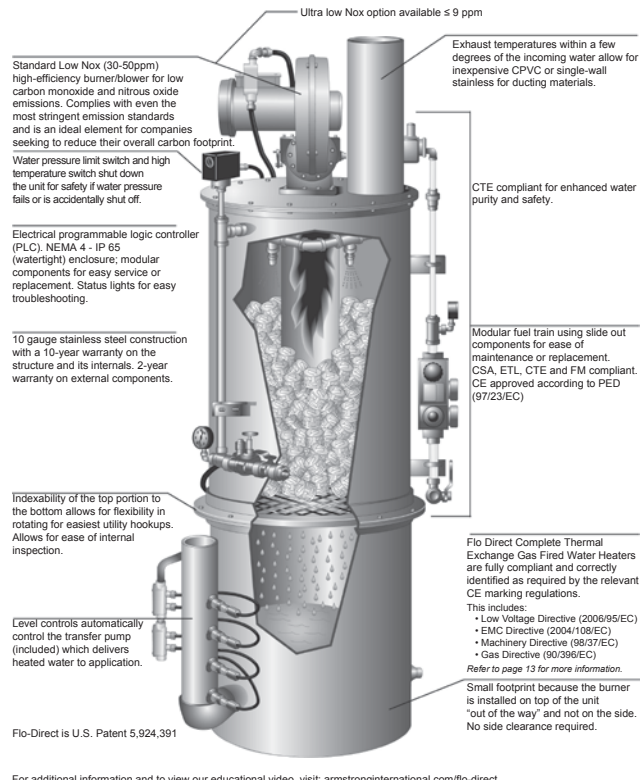
**Metric Formula Key**

lpm = Liters per Minute

$\Delta T$  = Temperature rise (°C)

AFD = Armstrong Flo-Direct (e.g., 1000, 5000)

Use the Flo-Direct sizing tool at [armstronginternational.eu/flo-direct](http://armstronginternational.eu/flo-direct)



\*last updated 11/15