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KLM Technology Group #03-12 Block Aronia, Jalan Sri Perkasa 2 Taman Tampoi Utama 81200 Johor Bahru Malaysia	<b>INSTRUMENTATION FOR FURNACES</b>  <b>(PROJECT STANDARDS AND SPECIFICATIONS)</b>	

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## SCOPE

This Project Standard and Specification covers mandatory requirements governing instrumentation for process furnaces, including protection systems.

This Project Standard and Specification does not cover the following:

- Steam system used for purging natural draft process furnaces prior to burner lightoff.
- Pilot gas system supply (burner piping, knock-out drums, filters, LPG vaporizers).
- Instrumentation systems for Inert Gas Generators, Incinerators, Sulfur Furnaces

## REFERENCES

Throughout this Standard the following dated and undated standards/codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date shall be mutually agreed upon by the Company and the Vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

American Petroleum Institute (API)

API RP 550                      Installation of Refinery Instruments and Control Systems  
Part III – Fired Heaters and Inert Gas Generators

## DEFINITIONS AND TERMINOLOGY

**Continuous pilot** - A pilot which burns throughout the entire period the unit is in service whether or not the main burner is firing.

**Reliable gas source** - A pilot gas source meeting the following conditions:

- Separate from the main fuel gas supply such that both supplies will not be simultaneously interrupted by a single contingency such as power or instrument air failure.
- Available during startup.

LPG vaporizers are not considered a reliable gas source.

**Fail-safe design** - Shutdown system logic design which initiates a shutdown upon loss of system actuation power or circuit continuity as well as when off limit operating conditions are present (e.g., design utilizes circuits which are

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energized and contacts which are closed during normal plant operating conditions).

## MEASUREMENTS AND CONTROLS

### Control House

Control house measurements and alarms shall include the following:

1. Measurements:
  - a. Coil inlet temperature
  - b. Individual pass coil outlet temperature
  - c. Total process feed flow
2. Alarms:
  - a. Common coil outlet THA (The THA shall be independent of temperature control instruments)
  - b. Individual pass FLA on furnaces in liquid or vaporizing service
  - c. Main fuel PLA/PHA (downstream of control valves)
  - d. Atomizing steam PLA (downstream of control valves)
  - e. Firebox PHA on forced draft furnaces.

### Temperature

Furnace and Stack. Thermowells and thermocouples shall be provided in the following locations:

- Immediately below the bottom shield row of the convection section.
- In the stack or the ductwork, preferably below the damper, approximately 2 diameters above the stack or duct entrance. The Owner's Engineer shall be advised of any alternate location.

Hoop-tube furnaces shall have only representative measurement of individual pass coil outlet temperature, using skin thermocouples, buried under the tube insulation, between the furnace and outlet header. The location, design, and installation of skin thermocouples shall be approved by the Owner's Engineer.

Tube metal temperature thermocouples shall be provided only when specified. Final number and location shall be reviewed with the Owner's Engineer.

### Pressure

Furnace and Stack:

- Draft gages shall be provided at bridgewalls, above and below stack dampers, and at the floor.

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- A pressure switch for the firebox PHA shall be installed immediately below the convection section of forced draft furnaces.  
The pressure switch shall have a range of 0 to 1 in. H<sub>2</sub>O (0 to 0.25 kPa) and be capable of withstanding an over range pressure of 5 in. H<sub>2</sub>O (1.25 kPa).

A pressure gage shall be provided on the main fuel header to each furnace, downstream of the control valve.

### Analysis

Oxygen analyzers shall use a Zirconia type sensor and be equipped with flame arrestor(s) to prevent flame propagation in the event of ignition by the heated sensor. An oxygen analyzer shall be located below the stack damper. In addition, for multiple cell furnaces, an analyzer shall be provided for each radiant cell. Connections for manual sampling of flue gas shall be provided at stack damper and bridgewalls.

### Connections

Instrument connections will be made with couplings per the following:

FURNACE AND STACK	Connection Size, NPS	
	in.	mm
Draft gage	1/2	15
PHA	1/2	15
Thermowell	1	25
O <sub>2</sub> Analyzer	(Connections per O <sub>2</sub> Analyzer mfr. requirement)	
Flue Gas Sampling	1/2	15

Connections shall be oriented for self-draining into the furnace.

### Control

Forced and Induced draft furnaces. Control systems for the regulation of fuel or air, or both, shall maintain airfuel ratio at or above the design excess air rate under all conditions.

## PROTECTIVE INSTRUMENTATION

### Requirements Common to All Furnaces

1. Each burner in a furnace shall be equipped with either a continuous gas pilot or flame scanners, except for furnaces having a large number of small burners and a constant firing rate.

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A flow indicator for each pilot will be specified for those cases where the pilot flame will not be visible, or will not be distinguishable from the main flame.

The use of flame detectors as an alternative to continuous pilots requires approval of the Owner's Engineer.

2. A pilot gas manifold which is not supplied by a reliable gas source shall have a PLI(CO) with PLA/PHA which shuts off all fuels and pilot gas on low pilot manifold pressure.
  - a. For furnaces firing gas only or a combination of gas and oil see Figure 1.
  - b. For furnaces firing fuel oil only, see Figure 2.
3. A pilot gas manifold supplied by a reliable gas source independent of the main fuel gas supply requires only a PLA/PHA on the pilot gas. See Figure 3.
4. Furnaces which have a large number of small burners (making pilots impracticable) and a constant firing rate, shall have a PLI(CO) with PLA for shutoff of all fuel on main fuel low pressure. See Figure 4.
5. The PLI(CO) local instrument for pilot gas or main fuel shall be force or motion balance type, indicating pneumatic type ON/OFF controller. The instrument range will be specified, suitable for the type burner used.
6. All furnaces shall have a FL(CO) with FLA which shuts off all fuels (excluding pilot burners) on low process feed flow. The FL(CO) shall be located such that only feed flow entering the furnace is measured.
7. Where liquid fuels having a flash point of 100°F (38°C) or less are used, a PLI(CO) with PLA shall be provided downstream of atomizing steam control valve to shut off this fuel flow on low atomizing steam pressure.
8. Shutdown signals are to originate from their own process taps and are to be completely divorced from transmitters used for control and pre-alarms.
9. A switch shall be provided in the control house which closes all fuel and pilot gas shut off valves.
10. All fuel and pilot gas valves in safety shutoff services and their installation shall be per the following:
  - a. Valves shall be single seated. A bleed valve shall be installed between the shutoff valve and its block valve.
  - b. Valves shall be equipped with lock-out device requiring manual reset from a locally mounted reset station.
  - c. If air actuated, valves shall close on air failure.
  - d. Valves shall be dedicated solely for shut off service and not used for regulatory control.
  - e. Valve closure time shall not exceed 10 seconds.