

# Boiler Component

## Labeling and Numbering

**Standard**

**101**

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## 1. INTRODUCTION

This guide serves to standardize identification for boiler components and their parts. Throughout the years of boiler inspections, we have experienced many circumstances where different personnel or contractors use different component numbering or labeling system causing confusion and misidentification of such. What makes this worse is that contractors move from one boiler to the next between different companies only to adapt to a different labeling system. Mistakes do happen and those can be costly. Wrong components are replaced, wrong tubes plugged, etc. This additionally causes unnecessary prolonged shutdown times and thus loss of production but also increased costs of a shutdown due to purchases of materials and labor that was not necessary.

The intent of this standard is to minimize, if not eliminate, unnecessary mistakes in component identification by providing guidelines to boiler operation, maintenance, and management personnel and also to outside contractors. The intent is also to create an unambiguous and standardized identification.

## 2. DISTRIBUTION / COPYRIGHT

- a. This document is copyrighted.
- b. It is free to be distributed as long as it is done so in its entirety.
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- d. Endorsement to Fornax Services, LLC shall be maintained.

## 3. SYSTEMIC APPROACH TO THE LABELS

- a. Labels for components shall be made so as to minimize identification mistakes as a primary purpose, and to identify operational component as a secondary purpose.

For example, labeling a component a superheater is unambiguous and serves both the primary and secondary purpose. However, a lower furnace might have two port openings next to each other, one being a camera port opening and another an air port opening. When viewed from the inside of the furnace, these require a certain skill to recognize and distinguish, and a contractor might not know with certainty which port is which. As such, labeling the opening as port opening #2 is less ambiguous and serves the primary purpose.

Another example is drum penetrations. Third row, drum penetration #5 is very clear to identify. Yet the first 3 penetrations might be connected to sidewall waterwall headers and the next 2 connected to generating bank side wall headers. As such, labeling the 5<sup>th</sup> penetration in the drum as 2<sup>nd</sup> generating bank side wall header penetration is not practical, although more correct from the operational point of view.

- b. This guideline labels components with the primary purpose of ease of identification in the field and a secondary purpose of operational use.

#### 4. TRANSITIONING TO THIS STANDARD

- a. If the current identification of boiler components does not match the guidelines of this standard, it is recommended to do the following:
  - i. If practical, revise older identifications to this standard in order to maintain consistency
  - ii. If revision of older identifications is not practical, the following shall be followed:
    - 1. set a date for transition to this standard
    - 2. communicate the transition to all relevant parties
    - 3. Document the transition. The documentation of the differences in the standards shall be clear and unambiguous.

## 5. BASIC ORIENTATION, CARDINAL DIRECTIONS

- a. Orientation shall be designated by six directions, namely: FRONT, REAR, LEFT, RIGHT, BOTTOM and TOP.
- b. Cardinal directions can be used in addition to, but not in lieu of the orientational directions:
  - i. NORTH, SOUTH, WEST, and EAST directions can be used
  - ii. external personnel, such as contractors may not be familiar with the local cardinal directions. As such provide clear instructions about which cardinal direction corresponds with which orientational direction.

**Example:** FRONT side is the same as NORTH side.

**c. All component numbering shall be in the following direction:**

- i. from the FRONT side towards the REAR side**
- ii. from the LEFT side towards the RIGHT side**
- iii. from the BOTTOM towards the TOP**

- d. If components cannot be practically counted in the direction as specified above (for example if one is located at the rear side of a component and cannot count from the front side due to access) then the numbering can be reversed with the MINUS sign in front of the digits. This may be more practical in the field due to access, however documentation in the office shall unambiguously locate the correct numbering and labeling of such a component.

**Example:** PSH, P#4, T#-3. This refers to primary superheater, pendant #4 (counted from the left wall), tube #3 (counted from the rear side as opposed from the front side). Based on a documentation of e.g. 32 tubes at this superheater, this is tube #29 (as counted from the front side).

- e. COLD side of the component is the side that is not exposed to direct furnace heat and usually is covered by insulation.

**Example:** “Cold side corrosion”. Cold side of a tube refers to the part of the tube that is never exposed to the fire and is usually under an insulation and lagging.

- f. FIRE side or HOT side of the component is the side that is directly exposed to furnace heat.

**Example:** Fire side tube failure. Fire side of a tube refers to the part of the tube that is exposed to the flue gas.

- g. WATER side of a component is the part that is wetted by water.

**Example:** “Water side tube deposits on the fire side”. Deposition found inside the tube (water side) on the side of the direct heat exposure.

## 6. FURNACE WALLS AND TUBES

### WALLS

- a. Flue gas flows through the system from the lower furnace towards the ID fan. In the horizontal direction this is identical as from the FRONT side towards the REAR side. If one is standing outside of the furnace in front of the front wall, one is looking in the same direction as the flu gas flows towards the ID fan. As such:
  - i. FRONT WALL is the one that usually turns into a roof
  - ii. REAR WALL is the one that usually has a nose arch
  - iii. Flue gas flows upwards and then over or through the REAR wall
- b. LEFT and RIGHT walls shall be designated as follows:
  - i. Standing outside of the boiler and facing the front wall
  - ii. LEFT wall is on the left-hand side
  - iii. RIGHT wall is on the right-hand side

- c. Wall orientations can be abbreviated as follows:
  - i. FRONT WALL as FW
  - ii. REAR WALL as RRW
  - iii. LEFT WALL as LW
  - iv. RIGHT WALL as RW

## NUMBERING

- d. All tubes shall be numbered as follows:
  - i. **in the direction from the FRONT wall towards the REAR wall or from the LEFT wall towards the RIGHT wall.**
  - ii. Corner tubes shall be properly assigned to the correct wall based on the connection to the lower headers and thus based on water circulation.
    - 1. If the corner tubes are not oriented in a perpendicular manner, or if the first/last tube for a furnace wall is not easy to identify (especially at higher furnace elevations), one has to investigate which tube is the first/last. Front wall tubes usually turn into a roof or a floor or both and these locations may serve as guidelines.
- e. Wall designation and tube numbers shall be unambiguous whether they are identified from the cold side or the fire side of the furnace.

## ELEVATIONS

- f. If boiler drawings are available and elevations (location in the vertical direction) are referenced, the elevations shall be used as per the drawing.  
**For example:** LW T#56, El. 34 meters. This refers to the left wall, tube #56, at an elevation of 34 meters, referring to the original drawing. Zero meter elevation can be found in the drawing.

- g. If no standard exists as per the previous paragraph, a 0 elevation shall be designated:
  - i. Designation of 0 elevation shall be made as practical as possible, so as to easily measure and reference it in the field.
  - ii. Examples of 0 elevation may be as follows: ground floor, furnace floor, bottom of air port openings, etc.
  - iii. Consideration to zero elevation shall be made to a component that is unlikely to change or move even during retrofits and major rebuilds.

#### NON-STANDARD SITUATIONS

- h. If a tube number or elevation of a wall section cannot be identified (for example, a section of insulation is removed from the wall but it is not possible to identify a tube number with certainty), then the following identification shall be made:
  - i. a reference point shall be identified.  
**Example:** centerline of sootblower #36
  - ii. elevation from the reference point shall be measured.  
**Example:** -550 mm, or -18 inches from centerline of sootblower #36  
(This implies the location in question is below the reference point)
  - iii. tube number from the reference point shall be documented. Directions of numbering shall be maintained.  
**Example:** Tube #-3, -550 mm from centerline of sootblower #36. This implies that this the 3<sup>rd</sup> tube towards the front wall. (Sootblowers are usually on the left and right walls only, as such the numbering on both walls is in the direction from the front wall towards the rear wall)





## FURNACE WALL PORT OPENINGS

- i. Port openings shall be numbered in the direction specified in paragraph 5.c.
- j. Port openings can be labeled based on their operational use (e.g. primary air port opening, start-up burner port opening, camera port opening) as long as their labels are clear and unambiguous to all personnel, including the unskilled ones in recognizing their operational use.
- k. If, in one elevation, there is a mix of different port openings (e.g. camera port opening next to an air port opening), the labels shall lump these together under a generic name, such as 1<sup>st</sup> level port openings.  
**Example:** 3<sup>rd</sup> level port opening #4. This refers to the 3<sup>rd</sup> elevation of port openings (counted from the bottom) and port opening #4 (counted from the left wall).

## 7. ROOF / FLOOR

- a. Roof is usually formed from the front wall tubes. As such, the roof tubes shall be numbered the same way as the front wall tubes. As such, tube #5 in the front wall, is the same water circuit tube as roof tube #5.
- b. Floor tubes (if applicable) are usually formed from the front wall, although sometimes rear wall and other times both walls. In either case, the floor tubes shall be numbered the same way as the wall they are connected to. As such, floor tube #17 will be the same water circuit tube as a front wall #17.
- c. If the roof / floor tubes are not part of the water circuit with any of the furnace walls, these should be numbered from the left-side wall towards the right-side wall.

## 8. SUPERHEATERS

- a. Superheaters shall be labeled as first, second, or third superheater, as counted from the front wall.

**Example:** 3<sup>rd</sup> SH. This is the third superheater from the front wall.

- b. Superheaters can also be labeled per their operational design based on steam flow sequence, such as primary superheater or secondary superheater. This however requires the knowledge of the position of these superheaters as primary superheater is rarely the 1<sup>st</sup> superheater from the front side.

- i. Primary Superheater (PSH)
- ii. Secondary Superheater (SSH)
- iii. Tertiary Superheater (TSH)
- iv. Reheater (RH)

**Example:** Tertiary SH or TSH. This is the superheater that is 3<sup>rd</sup> in the direction of steam flow, and not necessarily 3<sup>rd</sup> superheater in the boiler. Personnel will need to know which physical superheater this component is.

- c. Superheater pendants (assemblies) shall be labeled from the left wall towards the right wall.

**Example:** 2<sup>nd</sup> SH P#5. This is 5<sup>th</sup> pendant (counted from the left wall) on the second superheater counted from the front wall.

- d. Superheater tubes shall be numbered from the front wall towards the rear wall. Superheater usually has tubes that are looped around at the bottom or the top. As such e.g. tube #3 may be the same tube as #7 (steam circuit wise), looped around at the bottom. Even though this is the same tube, tubes are numbered as if they were all separate tubes.

**Example:** TSH, P#6, T#8. Tertiary superheater (one needs to know which physical superheater this is), pendant #6 (counted from the left wall), tube #8 (counted from the front wall).

- e. Tube sides. Side of a tube facing the left wall is left hand side (LHS) of the tube and the one facing the right wall is right hand side (RHS) of the tube.  
**Example:** Install a superheater tie between PSH, P#4, T#5-6, LHS at elevation of sootblower 26. This refers to a location on the primary superheater (one needs to know which physical superheater this is), pendant #4 (counted from the left wall), between tubes #5 and #6 (counted from the front wall) on the side that is facing the left wall at the same elevation where sootblower #26 is located.
  
- f. Elevations shall be designated as follows:
  - i. Elevation shall be referenced to a known fixed point, such as a superheater opening  
**Example:** Elevation of sootblower #67. Personnel needs to know where sootblower #67 is.
  
  - ii. Elevation shall be referenced from the bottom of the superheater.  
**Example:** Elevation of +5 m (+12 feet) above the lower loops.
  
  - iii. Elevation shall be referenced as number of components from the bottom towards the top.  
**Example:** 3<sup>rd</sup> elevation of ties on PSH, P#6, T#7-9, RHS. This refers to primary superheater (one needs to know which physical superheater this is) 3<sup>rd</sup> elevation of ties (counted from the bottom) on the 7<sup>th</sup> pendant (counted from the left wall) between tubes 7 and 8, and 8 and 9 (counted from the front wall) and on the side facing the right wall.

## 9. GENERATING BANK / ECONOMIZER / ANY 2D GRID OF TUBES

- a. There are different designs of generating banks and economizers.
  - i. Single drum units have generating bank sections consisting of 2-dimensional grid of tubes.

- ii. Two drum units have generating bank sections also consisting of 2-dimensional grid of tubes, however side walls are part of this grid.
  - iii. Some economizers have tubes running vertically.
  - iv. Some economizers have tubes running horizontally.
- b. The 2-dimensional grid of tubes shall be designated as rows, and columns, as follows
- i. For vertically oriented tubes in any 2D grid of tubes:
    - 1. Rows run across the boiler from the left side wall towards the right side wall and are also counted as such. Rows run perpendicular to the flow of flue gas.
    - 2. Columns run along (parallel) the flue gas path, in the front to rear direction and are also counted as such.  
**Example:** Plug the GB tube @ R#7, C#18. This refers to a generating bank tubes located at the 7<sup>th</sup> row (counted from the front wall) column number 18 (counted from the left wall).
  - ii. For horizontally oriented tubes in any 2D grid of tubes:
    - 1. Rows run from the bottom towards the top of the component and should be counted as such.
    - 2. Columns run from the front towards the rear side or from the left side towards the right side and should be counted as such.
- c. In the 2-drum unit design, usually the 1<sup>st</sup> and last columns are forming the sidewall of the boiler. As such, the column counting shall start and also include the side walls.

- d. Tube sides. Side of a tube facing the left wall is left hand side (LHS) of the tube and the one facing the right wall is right hand side (RHS) of the tube.  
**Example:** Reattached the broken vibration bar @ GB, R#7, C#5, LHS at the 2<sup>nd</sup> elevation. This refers to the generating bank second elevation of vibration bars (counted from the bottom) at row #7 (counted from the front side) At the left side of the column #5 (counted from the left side wall)
  
- e. Elevations shall be designated as follows:
  - i. Elevation shall be referenced to a known fixed point, such as a superheater opening  
**Example:** Elevation of sootblower #67. Personnel needs to know where sootblower #67 is.
  
  - ii. Elevation shall be referenced from the bottom of the generating bank.  
**Example:** Elevation of +5 m (+12 feet) above the bottom of the boiler bank.
  
  - iii. Elevation shall be referenced as a number of components from the bottom towards the top.  
**Example:** 3<sup>rd</sup> elevation of handcuff ties on GB, C#5, R#1-3. This refers to generating bank 3<sup>rd</sup> elevation of handcuff ties (counted from the bottom) on the 5<sup>th</sup> column (counted from the left wall) between rows 1 and 3 (counted from the front wall).

## 10. SOOTBLOWERS

- a. Sootblowers usually have numbers. These should be used as a reference, although drawings should be available to any personnel that needs to know these references.

- b. It is very difficult to find a sootblower number from the inside of a boiler without a drawing. And even with a drawing, this requires a skill that may not be possessed by many contractors.
  
- c. Sootblowers are usually (although not always) numbered in such a way that odd numbered sootblowers are on one wall and even numbered sootblowers are on another wall. If this is the case, this should be communicated to all personnel.

## 11. MISCELLANEOUS COMPONENTS

- a. All components shall be numbered (if applicable) in the direction as specified in paragraph 5.c.

**Example:** Open the LW lower header #2 handhole cap #1. This refers to lower left side wall header #2 (counted from the front wall side) and handhole cap #1 (counted from the front wall side). There might be 2 handhole caps per header and thus this is handhole cap #3 which would also be a correct designation.

- b. Sides of components that are outside of the furnace shall also be referenced in the same orientational direction.

**Example:** Repair the crack at the front side of the primary air fan casing. This refers to casing of a primary fan that is oriented in the same direction as the front wall of the furnace.