TECHNICAL BULLETIN

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Electric Heating Element Failure Modes on Water Heater

There are four (4) principal failure modes for an immersion element on an electric water heater. Here is a brief description of those and how to recognize them:

1. Dry-Fired Element

A dry-fired element is an element that has been energized without being immersed in water. This happens when the water heater is not completely filled with water. The element overheats and the resistance wire inside the tube as well as the tube itself can melt. It can easily be identified as the copper sheath will soften and be effortlessly bendable by hand.

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2. Scale accumulation on the element

Scale is formed when certain hardness generates constituents in water. The scale quantity that will form in any given system varies with the amount of these constituents in the water, the volume of water used and the temperature to which the water is heated. Because the water is extremely hot in the vicinity of a heating element, there is a tendency for extra scale. The heat transfer to the water is impeded so that the element overheats and fails through melting of the resistance wire, the sheath, or both. This will be recognized exactly as a dry-fired element but with scale build-up on it.

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3. Presence of Carbon Dioxide in Water

In some region, the water has a high CO_2 concentration which has a corrosion effect on the electric element copper sheath. This will lead to an element sheath premature failure which can create a short circuit (explosion) as water enters into it. Copper corrosion sometimes appears as blue-green stains.

4. Defective Element

Many different causes can lead to an electric element premature failure. Amongst the most popular ones are: impurity in the resistance wire, uneven distribution of the insulation powder (magnesium oxide), or welding imperfections between the connecting pin and the resistance wire, etc. In most cases, those will cause the element resistance wire failure.

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