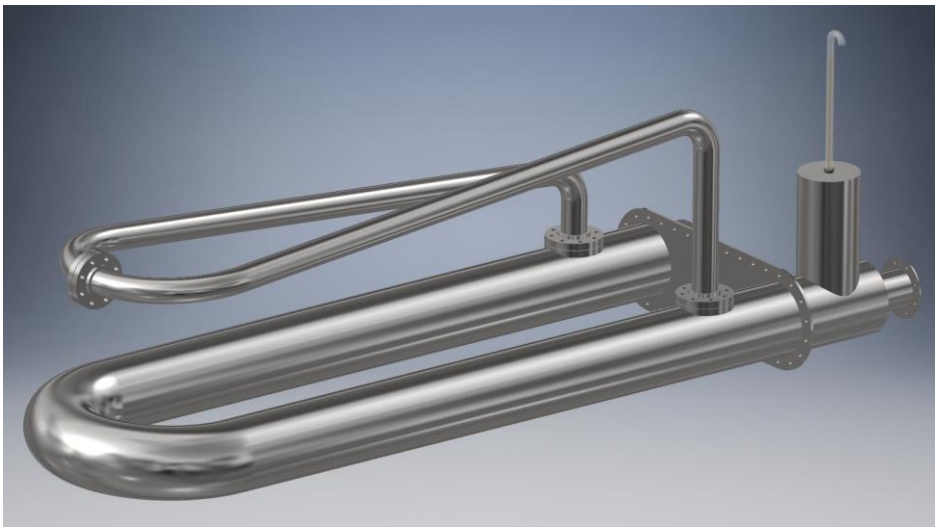
Presenting the EcoTube

The EcoTube is a patent pending new indirect heating system which provides a safer, more reliable and efficient option to heat wellhead fluids.



HOW DOES IT WORK?

Although it looks similar to an old style firetube traditionally used in heavy oil, appearance is where the similarity ends. A traditional direct fired firetube uses a flame to heat the steel surface of the tube which directly heats the process fluid.

By contrast, the EcoTube heats the process fluid indirectly by adding a heat transfer fluid and a second layer of steel. Heat is first transferred through the inner heating surface into the heat transfer fluid. It is then transferred from the heat transfer fluid through the outer heating surface into the process fluid. Refer to Figure 1 below:

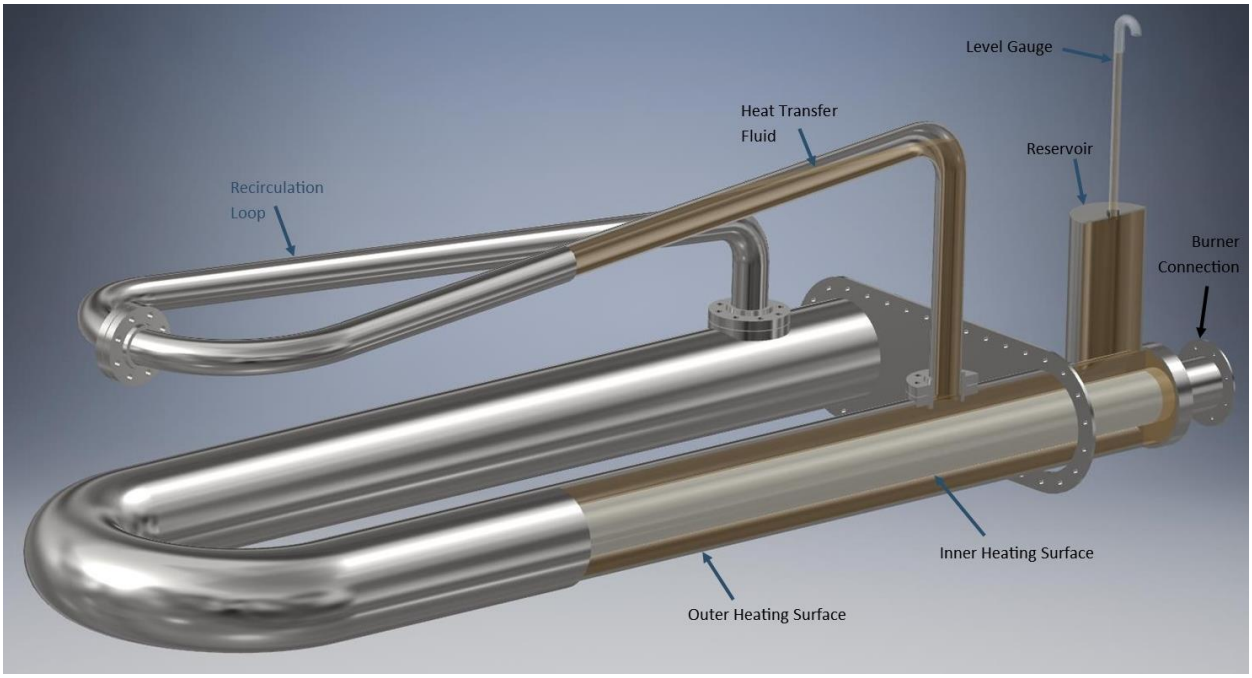


Figure 1 – Section View

In this view, we can see the main parts of the EcoTube. A burner connection, the inner and outer heating surfaces, the heat transfer fluid, a reservoir c/w level gauge and a recirculation loop.

To understand the operation of the recirculation loop, refer to Figure 2 below.

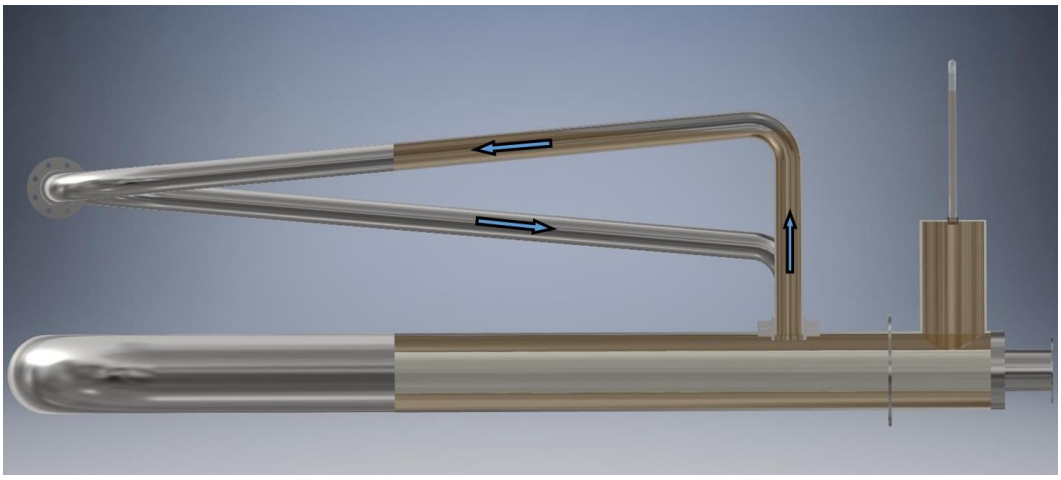
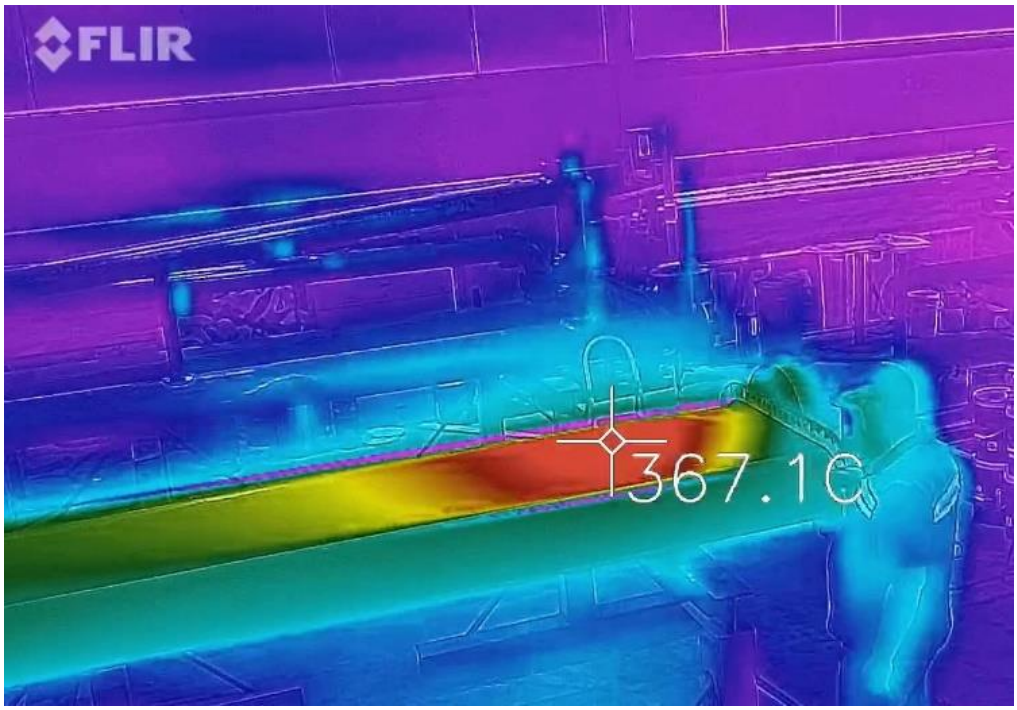


Figure 2 – Recirculation Loop

One of the key parts of the EcoTube is the recirculation loop. When the heat transfer fluid begins to heat up, natural convection forces it up into the recirculation loop. The fluid travels through the loop and re-enters the cold end (stack side) of the heater. The purpose of the loop is to provide additional surface area, as well as to normalize temperatures throughout the heater.

HOW IS IT DIFFERENT?

A conventional firetube has an extremely large temperature gradient from the burner to the stack. To illustrate this, a 300,000 BTU/hr industrial burner was placed in a standard firetube and ran for 20 minutes in open air to allow the temperatures to reach steady state. The results are shown in the FLIR photograph below in Figure 3.



Temperature Scale

Red = 360°C
Yellow = 200°C
Green = 100°C
Cyan = 50°C

Figure 3 – Firetube FLIR Photo

Here we can see that, while the temperature at the burner has reached 367°C, most of the tube is less than 100°C, and the entire return leg is closer to 50°C. This variability causes the following problems:

1. The high temperature at the burner can be above the auto-ignition temperature of some fluids. This is why firetubes are not allowed in light oil applications.
2. Tube failures typically occur at the burner because the high temperature weakens the steel. These temperatures can also cause additional process problems. For example, oil, sand and polymer can bake onto the tube creating a layer of insulation. This layer prevents heat transfer, causing the steel temperature to increase further, often leading directly to failure.
3. Differential heating of the hot and cold legs induces stresses in the firetube miters. Combined with thermal cycling, this can also cause failure over time.
4. The process is not heated evenly. In almost all situations it is preferable to provide even heat across a wide area rather than concentrated in a small area.

The same 300,000 BTU/hr burner was then placed into an EcoTube for 20 minutes allowing temperatures to reach steady state. Note that this particular example is a "straight through" version mounted in a horizontal tank, rather than the "U-type" shown in the preceding figures. Both versions operate identically and, except for the 180-degree bend in the middle, are essentially the same. The results are shown below in Figure 4.

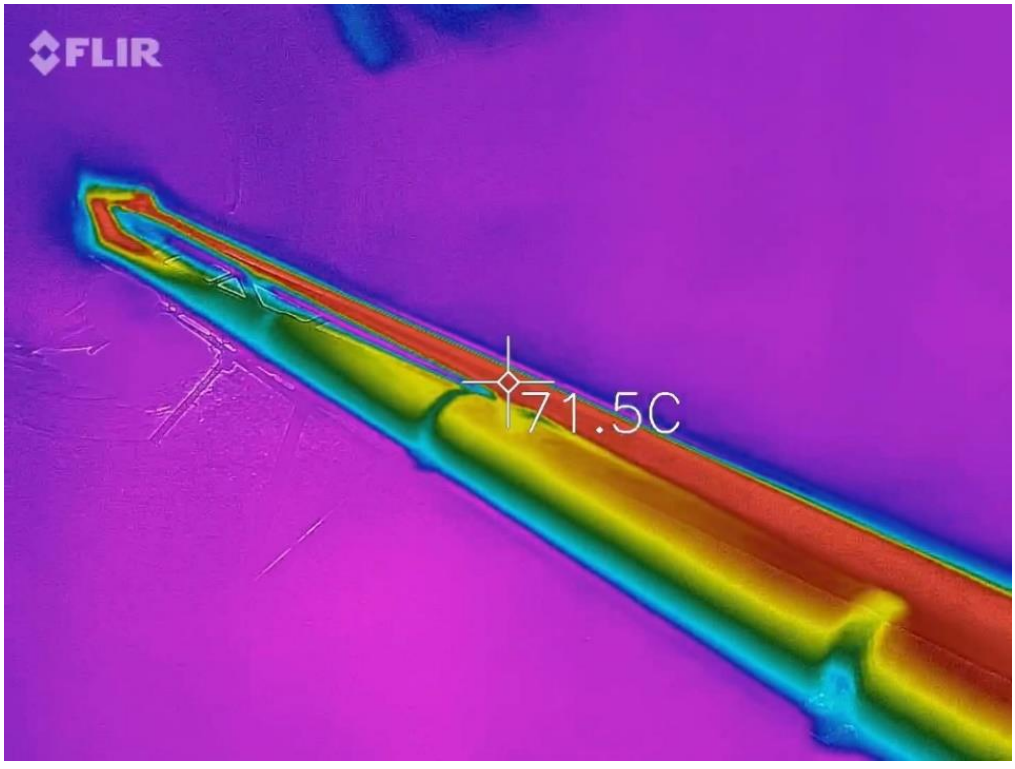


Figure 4 – EcoTube Flir Photo

Note that the red pipe on top is the recirculation loop. When compared to the firetube, we can see that the skin temperatures are drastically lower (71°C vs 367°C) and far more consistent. Also note that most of the heat is being provided by the recirculation loop.

WHY IS IT BETTER?

The low skin temperatures and even heat distribution of the EcoTube provide a number of advantages vs conventional firetubes.

1. **Safety**

The low skin temperatures allow the system to be used safely in more volatile fluids. Skin temperatures can also be adjusted using the temperature controller in the heat transfer fluid. In addition, every EcoTube system includes the following:

- CSA B149.3 compliant burner piping c/w Field Approval
- Class 1, Zone 2 compliant Burner Management System
- Inlet mounted aluminum cell Flame Arrestor
- High Temperature Shut-Down (Bath)
- High Temperature Shut-Down (Heat Transfer Fluid)
- Low Level Shut-Down (Bath)
- Low Level Shut-Down (Heat Transfer Fluid)

2. **Reliability**

Because of the low skin temperatures, the risk of baking on production solids, asphaltenes or polymer is eliminated or greatly reduced, as is the possibility of tube failure. This also improves the effectiveness of cleaning systems such as spray nozzles etc.

3. **Efficiency**

During development, a 1200 bbl tank fitted with the EcoTube was filled with water and the heater was turned on. Over the length of the test it was determined that **91%** of the available heat was transferred to the water. This is much higher than the 50%-60% commonly associated with firetubes.

4. **Environment**

Most leaks through a firetube occur when it fails. Because the EcoTube is so much more reliable, these leaks are virtually eliminated. Also, because it is an indirect system, there are two barriers between the process fluid and the environment providing an additional level of safety. In addition, the heat transfer fluid used in the EcoTube is environmentally friendly and biodegradable.