

IRt/c™

Infrared Temperature Sensor

EXERGEN

C O R P O R A T I O N

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IRt/c Monitors Plastic Injection Mold Clearing version II Tech Note #101

Problem Overview

In high volume plastic injection molding machinery, a molded part that does not clear the mold can cause serious problems, including a long down time to clean up or make repairs. Alternatively a manufacturer can have a full time operator monitoring the process. Both alternatives are highly expensive. The Exergen IRt/c line offers a reliable way to prevent molding the next round until all the parts have been removed. Thus, allowing one operator for dozens of machines and no jamming, ultimately, increasing long-term productivity for a small one-time investment.

IRt/c Overview

Exergen IRt/c™ non-contact temperature sensors measure the actual temperature and thermal signature of an object with unprecedented speed and accuracy. Exergen IRt/c sensors come hermetically sealed in a range of sizes and configurations for every imaginable application. They are designed for years of trouble-free operation in a wide variety of the toughest environments. IRt/c's need no power supply and can be connected to standard thermocouple devices to give an instant boost in start-up speed. More than 300 models of non-contact infrared sensors are offered with FOVs (Field of Views) ranging from 1:2 to 100:1. Exergen offers system solutions and technical application support for any thermal process requiring temperature measurement or control.

IR Sensing Issues

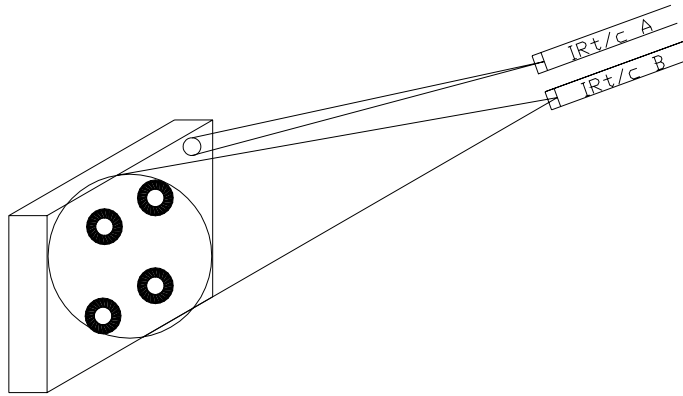
There are two key features of injection modeling which allow the IRt/c to observe when parts are left in the cavities. Most models have a lower emissivity than the plastic parts they are making. Emissivity is a surface property that affects how much radiation is emitted at a given temperature. Secondly, when the part is ejected it is still usually hotter than the mold. These two points mean the amount of radiation emitted from the part will be higher than the mold when at the same temperature. When a part is still in the mold, the radiation will be higher than when all the parts have been cleared from the mold. The IRt/c allows us to detect this difference.

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IRt/c Setup

For this application two IRt/c's are required. One IRt/c will measure the temperature of the mold and parts, while the other will measure just the mold. When using these units differentially, one will be able to detect that a part is still in the mold. The two IRt/c models should be selected based on mounting constraints, so they view the right portions of the mold.



As you can see from the drawing above IRt/c B looks at most of the mold including the parts. Its output will be the Temperature of the Mold + (Temperature of the Parts - Temperature of the Mold). IRt/c A looks only at a corner of the mold, so its output will be the Temperature of the Mold. By connecting the units differentially we will get:

[Temperature of the Mold + (Temperature of the Parts - Temperature of the Mold)] - Temperature of the Mold =

Temperature of the Parts - Temperature of the Mold

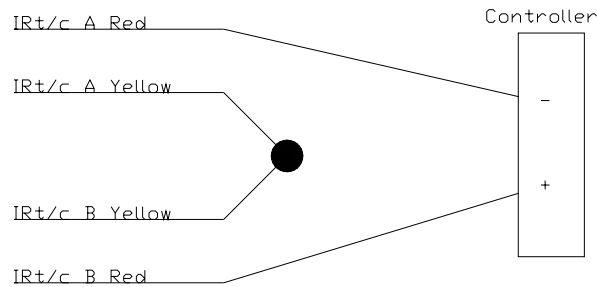
In other words you will see the rise in temperature due to the parts not being ejected from the mold. If all the parts are ejected the above equation will be 0. We are assuming the mold is an even temperature.

Note: It is important to use two IRt/cs to get this value. This will automatically compensate for emissivity of the mold.

A differential set up is when you connect the two RED wires from the IRt/cs into the plus and minus thermocouple inputs on the control. IRt/c B should be connected to the positive input, this will result in a positive signal when the parts are not ejected. Bond the two yellow wires from the IRt/cs together. Care should be taken to make sure all other connections are solid. Insulate the yellow wire junction and leave it located near the controller. See drawing.

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Exergen recommends the Eurotherm 2132 controller as a suitable interface between the IRt/cs and your machinery. These are easy to set up and will let you quickly get into production. There are other controllers that will also work, alternatively you could build your own circuit.

Key Features:

Can turn off cold junction compensation (needed).

Can make an offset adjustment

Can set alarm levels

Accepts K type thermocouples signals

Alarm pin with threshold trigger

To set up the controller one must turn off the Cold Junction compensation and provide it with the differential IRt/c signal. One now must determine what the rise in temperature will be when a part is not properly ejected. This will be determined by how big the parts and mold are. To get an estimation, determine the percentage of the IRt/c detectable area the part occupies.

Let's say your spot size of the IRt/c is 5 inches in diameter. And each part is 1 inch in diameter. The area of the FOV is $\pi * R^2 = \pi * 2.5^2 = 20$ sq. inches, while the part is 3 sq. inches. So the percentage of the area is $3/20 = 15\%$.

Now if you expect your parts to be 15°F hotter than the mold, on average, you will get approximately a 2.3°F rise when a part is not ejected. In no way is the estimation any guarantee. One will have to watch their process to determine the right trigger level. It is more acceptable to have a false trigger than failures to detect, so setting the alarm level lower than expected is a good precaution. One should set the alarm pin to about 80% percent of the estimation, in our example: 1.8°F.

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You need to wire your alarm pin into your existing system or a safety switch that will not start the process again until the operator indicates. The alarm pin will change state as soon as the part is removed.

Now you are ready to mold without jams. GOOD LUCK!!!!

Flow Chart of Process

