Application Note

RTI Scatter Probe – response Time

This application note describes how the response time of a detector influence the measured result for instruments used for scatter and leakage measurements.
In particular the characteristics of the RTI Scatter Probe is described.

Response Time

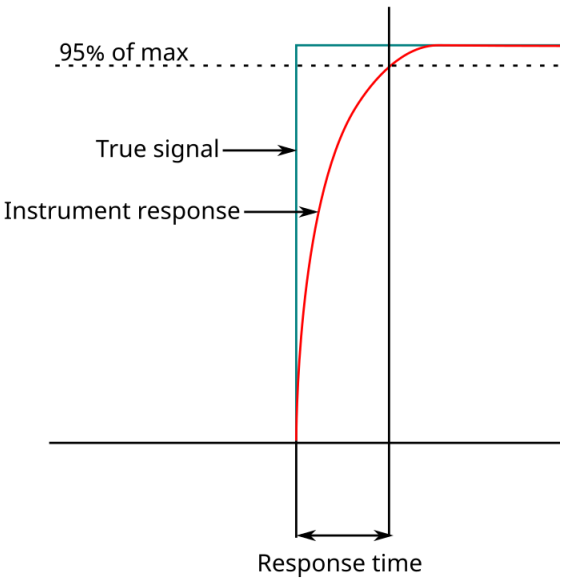
What is meant with Response Time is not unambiguous.

Example of definition:

"The time taken for a circuit or measuring device, when subjected to a change in input signal, to change its state by a specified fraction of its total response to that change."

Hereunder we are using this definition, specifying that the signal shall reach 95% of the change in signal. See figure 1.

Figure 1. Response Time Defintition



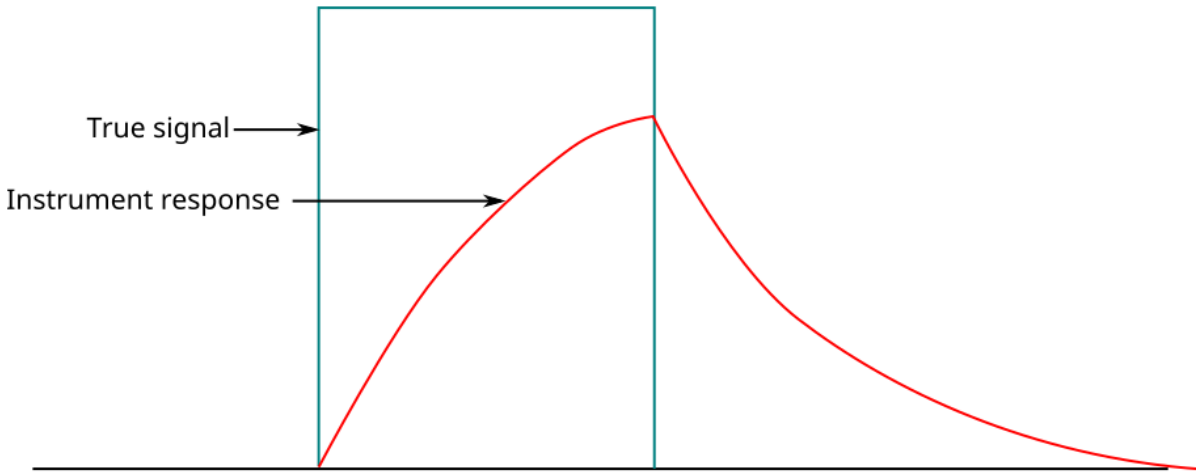
Different brand of meters has different response times. Meters intended for high dose rates, such as measurements directly in the x-ray beam, normally has fast response times to be able to follow fast fluctuations in the radiation. Meters intended for very low dose rates such as leakage and environmental radiation on the other side normally has very long response times, up to several seconds.

Application Note

It follows by this that with a response time longer than the radiation exposure time, implies that the instrument will not be able to find the true dose rate (or peak rate) of the exposure. See figure 2.

Though, the integrated dose reading will be valid if the electronics has a proper integrating capability.

Figure 2. Response Time longer than exposure



Notice: The response time will also have influence on the capability to measure the irradiation time.

Most meters intended for measurement of leakage or scatter radiation measures “peak dose rate”. Independently if measure some kind of average dose rate, or peak dose rate, the same is valid - When response time is longer than exposure time, neither the true dose rate or peak dose rate will be measurable.

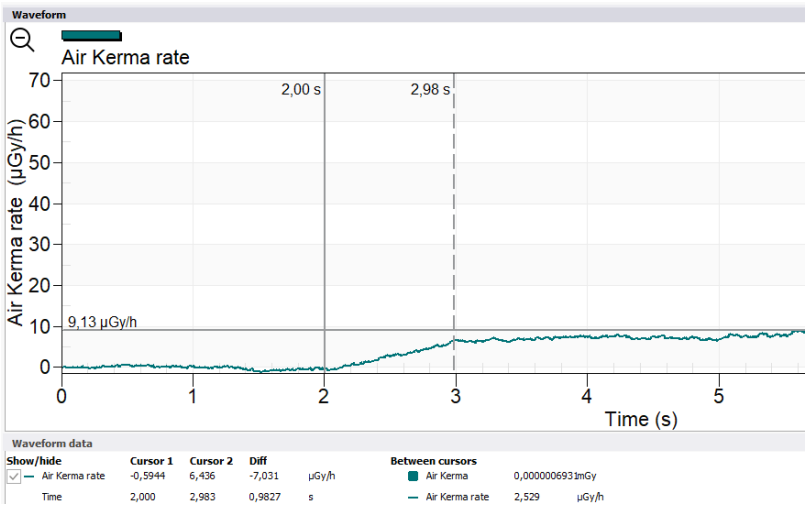
The RTI Scatter probe

The RTI Scatter probe has an adaptive integration time (which is directly proportional to the response time. The integration time starts at 1 sec (1 Hz), to be able to measure and trigger at the very lowest dose rates, with a triggering point at 5 µGy/h for the 100 cm^2 detector area.

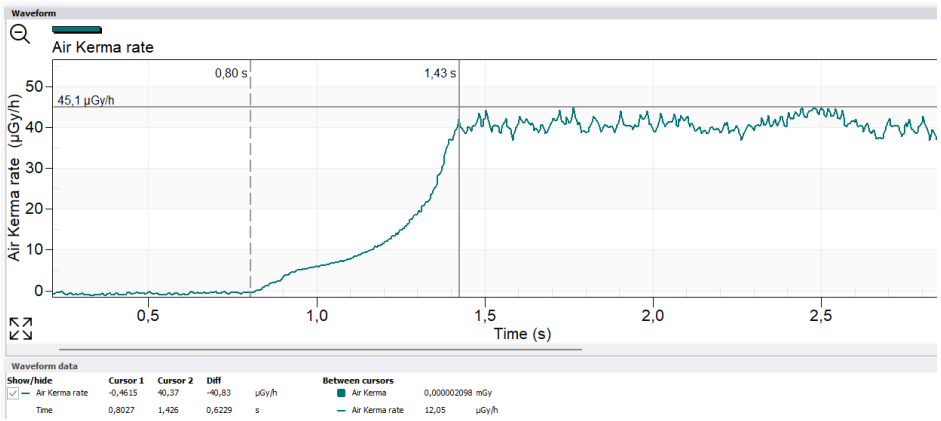
The integration time thereafter adapts to the current dose rate, to become 10 ms (100 Hz) at about 100 µGy/h.

The series of images below illustrate how the RTI Scatter probe adapts to the signal level.

Application Note

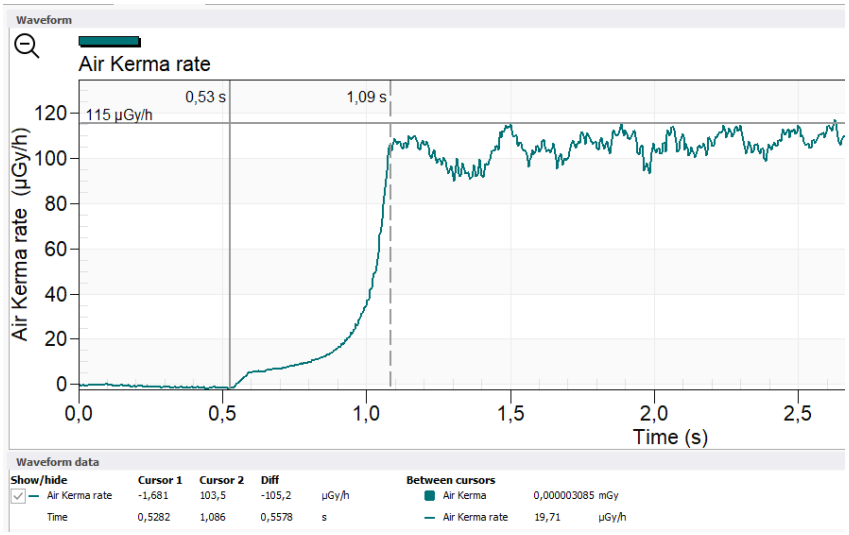


At a rate of about 10 µGy/h it will take one second to adapt to the true dose rate.



At 40 µGy/s it will still take some time to adapt to the signal. But when adapted to the target rate the RTI Scatter Probe will hold the short integration time and will be able to follow also fast change in the true dose rate.

Application Note



This is further illustrated when the signal is doubled, where it follows the variation in the dose rate even better.

Notice: The “exponential ramp-up shape” of the waveform follows from internal mathematical filtering by the RTI Scatter Probe and does not represent the true shape of the irradiation.
The RTI Scatter Probes adaption of response time to the current dose rate is instant, which make the peak rate value reliable at exposure times shorter than 0.1 s when dose rate is above 100 µGy/s.

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