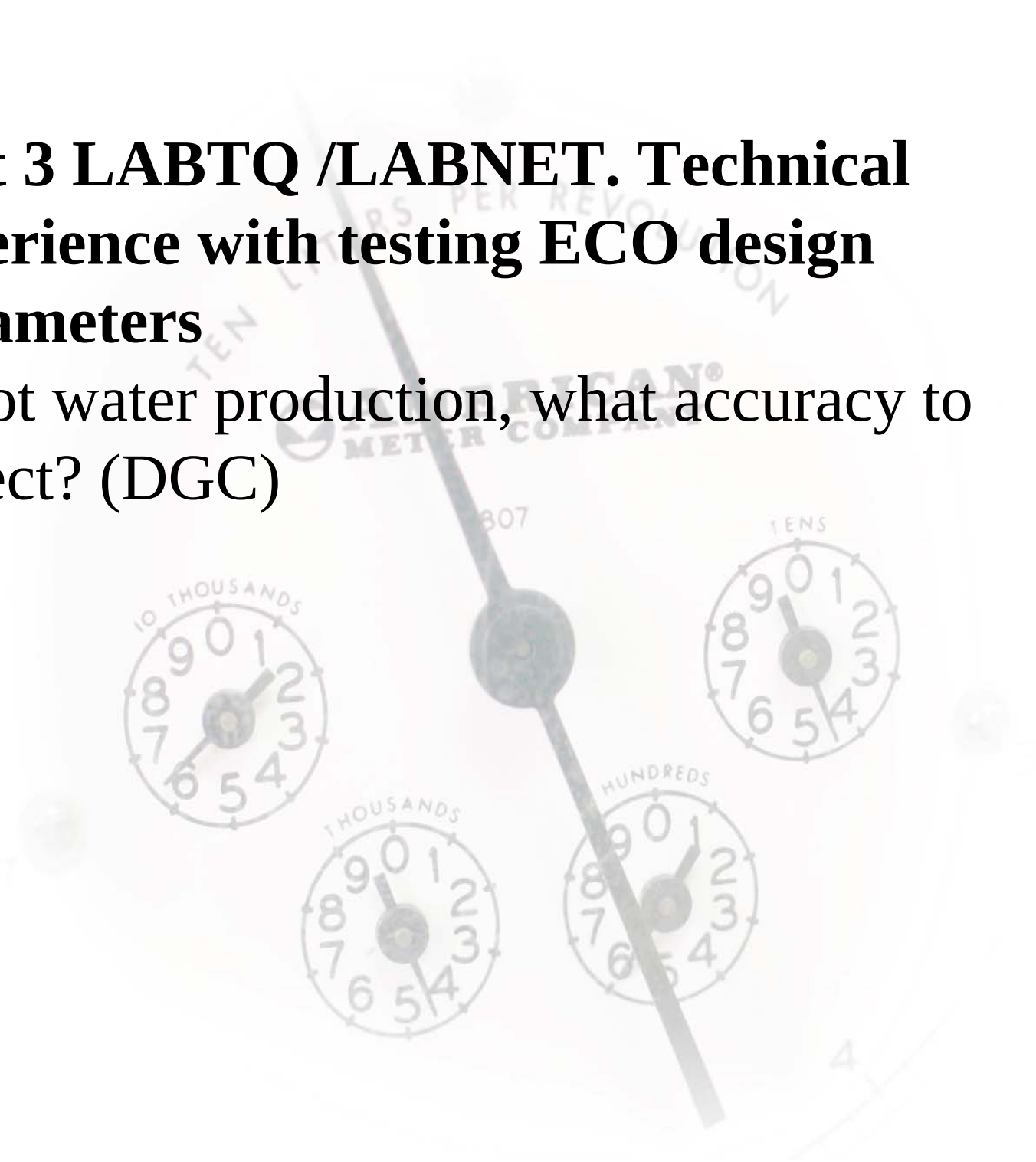
**Part 3 LABTQ /LABNET. Technical experience with testing ECO design parameters**

4)Hot water production, what accuracy to expect? (DGC)

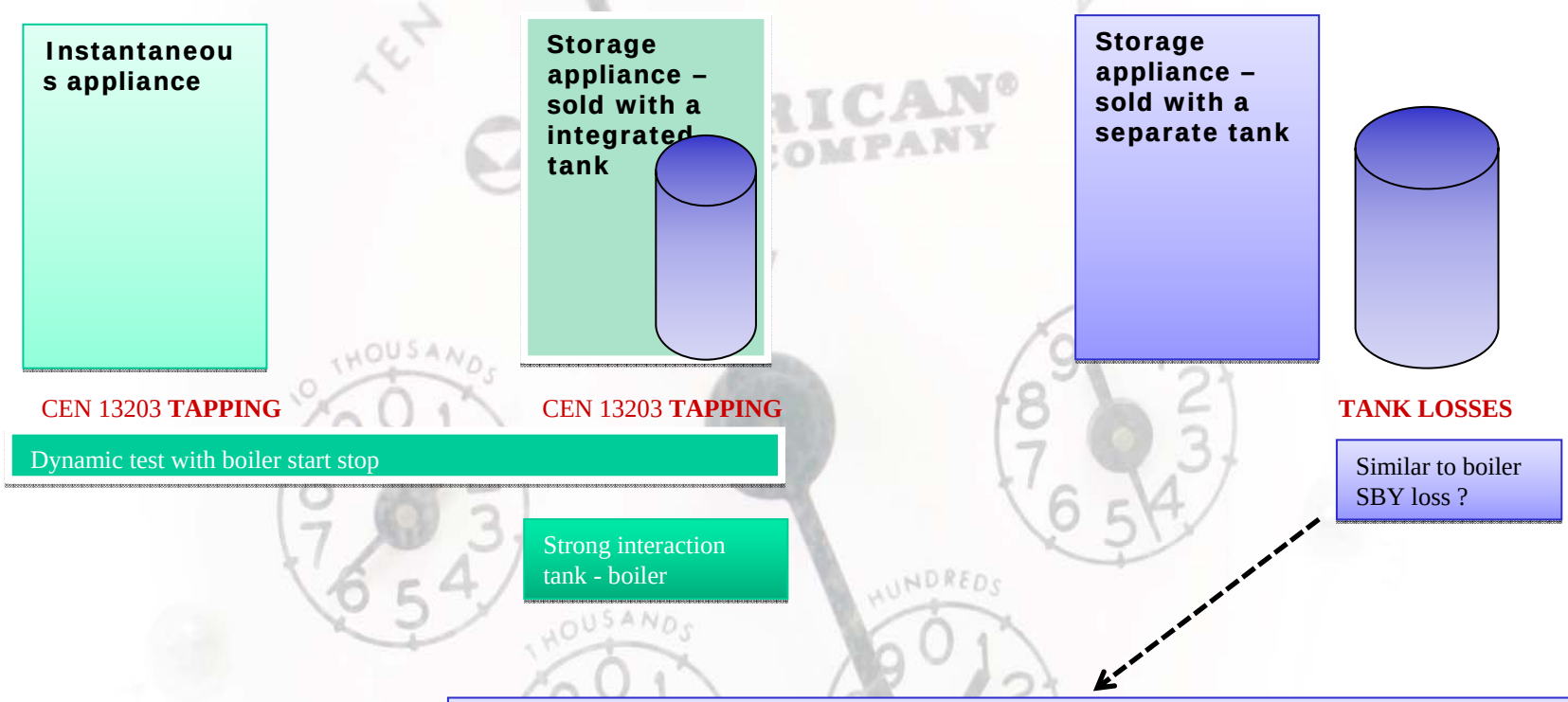


# References:

- HOT WATER PRODUCTION: ESTIMATION OF THE UNCERTAINTIESNote / DGC August 1999
- Uncertainties measurement of the standby loss measurement for boilers. Working document DGC  JSC

***Based on testing experience***

# Three configurations




**Uncertainties measurement of the standby loss measurement for boilers. Working document DGC JSC:**

**Exemple =**

*For 10 W measured U = 2, 25 W (22,5%)*

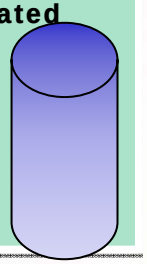
*For 100 W measured U = 4,5 W (4,5%)* → *contradicted by SBY data from RRT (much larger)*

*For 1000 W measured U = 27 W (2,7%)*

# Two configurations with tapping test

**Instantaneous appliance**

**Storage appliance – sold with a integrated tank**



CEN 13203 **TAPPING** CEN 13203 **TAPPING**

Dynamic test with boiler start stop

Strong interaction tank - boiler

**Exemple Table – Tapping cycle n° 2**

| | Start (h.min) | Energy (kWh) | Type of delivery | ΔT desired (K), to be achieved during tapping | Min. ΔT (K), = start of counting useful energy |
|---|---|---|---|---|---|
| 1 | 07.00 | 0,105 | Small | | 15 |
| 2 | 07.15 | 1,400 | Shower | | 30 |
| 3 | 07.30 | 0,105 | Small | | 15 |
| 4 | 08.01 | 0,105 | Small | | 15 |
| 5 | 08.15 | 0,105 | Small | | 15 |
| 6 | 08.30 | 0,105 | Small | | 15 |
| 7 | 08.45 | 0,105 | Small | | 15 |
| 8 | 09.00 | 0,105 | Small | | 15 |
| 9 | 09.30 | 0,105 | Small | | 15 |
| 10 | 10.30 | 0,105 | Floor cleaning ? | 30 | 0 |
| 11 | 11.30 | 0,105 | Small | | 15 |
| 12 | 11.45 | 0,105 | Small | | 15 |
| 13 | 12.45 | 0,315 | Dish washing | 45 | 0 |
| 14 | 14.30 | 0,105 | Small | | 15 |
| 15 | 15.30 | 0,105 | Small | | 15 |
| 16 | 16.30 | 0,105 | Small | | 15 |
| 17 | 18.00 | 0,105 | Small | | 15 |
| 18 | 18.15 | 0,105 | Household Ccleaning | | 30 |
| 19 | 18.30 | 0,105 | Household Ccleaning | | 30 |
| 20 | 19.00 | 0,105 | Small | | 15 |
| 21 | 20.30 | 0,735 | Dish washing | 45 | 0 |
| 22 | 21.15 | 0,105 | Small | | 15 |
| 23 | 21.30 | 1,400 | Shower | | 30 |
| Total | | 5,845 | | | |

# 1.1 Repeatability: ability of the system to repeatability

- The repeatability might very much depend on the system tested. (Thermostat position, interaction tank, boiler, etc.). The influence of the ambient conditions is also a factor to take into account

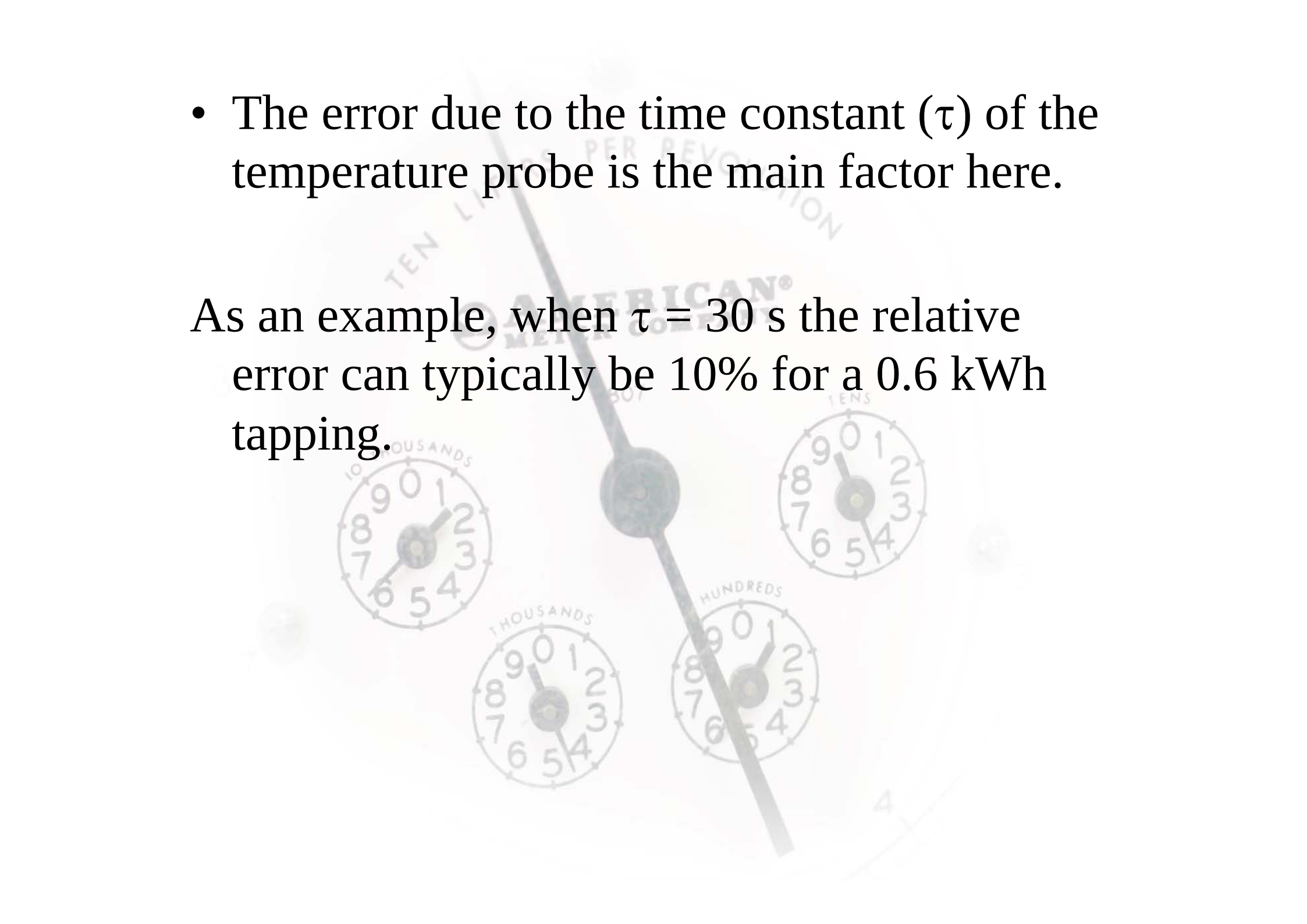
- 1.2 Repeatability of measurement
- 1.3 Ability to retrieve the initial heat content in the system to be tested.
- 1.4 Problems related to the water temperature measurement

Response time

- 1. The probe response time
- 2. The heating of the part of the pipe where $T_{out}$ is measured
- 3. The measured dead volume of water (between the real outlet of the tank and the probe).

- The error due to the time constant ($\tau$) of the temperature probe is the main factor here.

As an example, when $\tau = 30$ s the relative error can typically be 10% for a 0.6 kWh tapping.



- **1.5 Uncertainty of meters**

The normal uncertainty on temperature has a very little effect as the delta T to be measured are generally large (>20 k).

The heat input is in any normal case lower than 2%.

# 1.6 Influence factors

•Among the influence factors, which are not depending on the boiler/tank technology, the ambient conditions are probably the most important ones.

•The ambient temperature will change the energy losses of the water tank and therefore influence the standby losses.

•For a typical situation, where the water temperature is about 65°C and the ambient temperature 20°C, the error due to a variation in ambient temperature of $\Delta T_{amb} =$ 5 C will lead to an error on standby losses of 13%

- **1.7 Errors due to the testing procedures**
- **1.7.1. Tolerance on the energy really taken from the tank**
- **1.7.2 Setting of the boiler (eg thermostat)**
- **1.7.3 Starting point of the tapping**
- The procedure says that the tapping shall start at the latest one hour after the burner has stopped for reheating. The influence of the one-hour tolerance is not known.
- 1.7.4 **Calculation**
- **1.7.5 Sampling time (**The sampling time is an important factor especially for small tapping.
- **1.7.6 Peaks of flow**

# EXAMPLE OF U CALCULATION DK TAP

| UNCERTAINTY/ERROR: | TYPE | VALUE estimation | | VALUE % of eff. Random | Syst. (*) |
|---|---|---|---|---|---|
| Repeatability of the system | Random | 5 % | ? | 5 0 | |
| Repeatability of measurements | Random | 2 % | | 2.0 | |
| Influence of heat content balance | Random | 0 12 kWh | | 0 8 | |
| Water temperature influence | Systematic | -7.70 % on eff Tap | | | -6.3 |
| Uncertainty meters | Random | 2 2 % on eff | | 2 2 | |
| Influence of ambient temperature | Systematic | 12.88 % on SEY | | | 2.4 |
| Influence of tank real temperature | Random | 5 % on eff | ? | 5 0 | |
| Non identified influences/errors | Random | 5 % on eff | ? | 5.0 | |
| Tolerance on ennergy tapped | Random | 0 1 kWh | | 0 8 | |
| Tolerance on tapping starting point | Random | 5 % | ? | 5 0 | |
| TOTAL | | | | 10.5 | 3.8 |
| | | Option 1 NO CORRECTION | U= | 14.3 % rel. | |
| | | Option 2 CORRECTION | U= | 10.7 % rel. | |

(*) A negative error will have the effect of decreasing the efficiency given

# Lessons for CEN 13203 testing

For instantaneous appliances some of the U factor will not apply → better accuracy, but experiments also shows that worse case are obtained with small tapping.