Intercomparison measurements by pulse transient and stepwise transient methods on Perspex and stainless steel A310

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Abstract. Intercomparison measurements have been made on Perspex (polymethylmethacrylate) and stainless steel A310 by pulse transient and stepwise transient methods. Both methods belong to the transient techniques that give specific heat, thermal diffusivity, and thermal conductivity within a single measurement. Measuring times and time windows for data evaluation are given for both measuring techniques. Criteria for characteristic parameters of the ideal model by pulse transient are given. Experimental results are compared with recommended and published data for thermal conductivity, specific heat, and thermal diffusivity. Deviations from published and recommended data were found. Data uncertainties in thermal conductivity caused by these deviations are up to 6% for Perspex and up to 10% for stainless steel A310.

1 Introduction
Modern technology is looking for measuring methods that give reliable data on thermophysical parameters of different materials in a short time. In practice, materials that possess high inhomogeneity have also started to be used. Many of them are prepared in a markedly nonequilibrium state (glasses, polymers, special types of steels, ceramics, etc). Any heat treatment, even during the measurements, influences the material properties. Measuring methods applied to these materials need to work in a regime of thermal analysis, ie the measurements should be performed in a specific isothermal or nonisothermal regime. A full set of thermophysical data, ie specific heat, thermal diffusivity, and thermal conductivity, is required to characterise the thermophysical properties of materials. To fulfill the above requirements is a challenge for scientists in searching for appropriate measurement methods.

Various methods are used for measurement of specific heat, \( c_p \), thermal diffusivity, \( \alpha \), and thermal conductivity, \( \lambda \). Most of them give one parameter, only. Maglić et al (1992) gave a review of the recommended measuring techniques. A crucial problem exists regarding data consistency (\( \lambda = ac_p \rho \), where \( \rho \) is density) as for every parameter a different method is used. However, a class of methods exists that gives all three parameters, ie specific heat, thermal diffusivity, and thermal conductivity, within a single measurement. Transient methods belong to this class (Kubičár and Boháč 1998). Nevertheless, values of thermophysical parameters might be shifted because of differences between the model and the experiment. A careful theoretical and experimental analysis has to be performed to diminish any deviation of the measured data from the recommended ones.

This study is focused on intercomparison measurements on Perspex and stainless steel A310 by pulse transient (Kubičár 1990) and stepwise transient (Kubičár and Boháč 2000) methods. The intercomparison is based on ideal models of both methods. The methods belong to the transient techniques. Experimental results are compared with recommended and published values. A pulse of heat produced by a plane heat source generates a dynamic temperature field inside a specimen when the pulse transient technique is used. A thermometer placed some distance from the heat source (two probes system) measures the temperature change (temperature response) when the heat pulse
has finished. A plane heat source produces a constant heat in the form of the stepwise function when the stepwise transient technique is used. In contrast to the pulse transient method, a thermometer placed some distance from the heat source measures the temperature response during the heat production. Our main goal was the examination of the measuring regime and the range of the experimental parameters by stepwise and pulse transient techniques, to give data as close to recommended and published values as possible.

2 Experiment

The measuring process can be described as follows: the temperature of the specimen is stabilised and uniform. Then, a small disturbance is applied to the specimen, by production of heat by a heat source. From the temperature response to this small disturbance, the thermophysical parameters can be calculated, according to the model used. The scanning of the temperature response with respect to the production of the heat is different for pulse transient and stepwise transient methods. While the temperature response is scanned as long as the heat is produced for the stepwise transient method, a significantly longer period of temperature scanning in comparison to the time period of the heat production is used in the pulse transient method.

The model of a method is characterised by the temperature function. The temperature function is a solution of the partial differential equation with boundary and initial conditions corresponding to the experimental arrangement. Idealised models were used for both pulse transient and stepwise transient methods. Then, boundary and initial conditions correspond to an infinite body in which an unlimited instantaneous plane heat source for pulse transient (Carslaw and Jaeger 1959, p. 359) or a constant heat flux from the heat source in the form of a stepwise function (Carslaw and Jaeger 1959, p. 75) act. The thermophysical parameters can be found from the temperature function and the temperature response by an appropriate evaluation technique.

The sensitivity coefficients, defined as

\[ \beta_P = \frac{\partial T(x, t)}{\partial P}, \quad P = a, c_p, \]

(Beck and Arnold 1977) and the correlation, defined as

\[ \gamma(t) = \frac{\beta_a(t)}{\beta_{c_p}(t)}, \]

(Raynaud 1999) give the measuring time (time during which the temperature response is scanned) and the time window in which the evaluation technique can be applied over the temperature response. The sensitivity coefficient is a measure of the change in the temperature response due to the variation of the parameter \( P \) over the range of the observation. The properties of both the sensitivity coefficients and the correlation play important roles during the scanning of the temperature response, which requires high sensitivity coefficients, and during data evaluation (ie fitting), which requires, again, high sensitivity coefficients and low correlation. High correlation means that the sensitivity coefficients are linearly dependent on each other. The fitting procedure does not work properly when there is a high correlation. The experimental arrangement, temperature response, sensitivity coefficients, temperature function, initial and boundary conditions, and evaluation technique are given in figure 1 for both pulse transient and stepwise transient methods. The temperature response is scanned up to the moment when the correlation of the sensitivity coefficients starts to be high: \( \gamma(t) \rightarrow \text{const} \) (Raynaud 1999). This criterion gives the measuring time. The time window used for data evaluation is always shorter than the measuring time as, usually, correlation is high at the beginning of the temperature response. In practice the duration of the heat pulse
is 1/10 of the time corresponding to the temperature response maximum. The measuring time for the pulse transient method is three times longer than the maximum of the temperature response. The measuring time for the stepwise transient method, usually, is the same as for the pulse transient method. A temperature response in the range from 0.5 to 2 K is used. To keep the temperature response within the above range, the energy of the heat pulse and the heat output of the heat source have to be appropriately adjusted by choice of the electrical current. The energy of the heat pulse and the heat outputs of the heat source vary within the range $(3 \times 10^4)\text{J m}^{-2}$ and $(400 \times 800)\text{W m}^{-2}$ for the

Temperature function characterising model and boundary and initial conditions:

$$T(h, t) = \frac{Q}{c_p \rho \pi} \exp\left(-\frac{h^2}{4at}\right)$$

corresponding to the nonlimited body, instantaneous plane heat source of $Q/c_p$ strength at $x = 0$ and $t = 0$.

$$Q = RI_t \cdot t_0$$

where $R$ is the electrical resistance of the heat source.

Method of data evaluation:

thermal diffusivity, $a = \frac{h^2}{2\tau_m}$

specific heat, $c_p = \frac{Q}{(2\pi\varepsilon)^{1/2} \rho h T_m}$

thermal conductivity, $\lambda = ac_p\rho$

Temperature function characterising model and boundary and initial conditions:

$$T(h, t) = \frac{q}{ac_p\rho} \left\{ \left(\frac{at}{\pi}\right)^{1/2} \exp\left(\frac{h^2}{4at}\right) - \frac{h}{2} \text{erfc}\left(\frac{h}{(4at)^{1/2}}\right) \right\}$$

corresponding to the nonlimited body plane heat source $q = \text{const. at } x = 0$ and $t > 0$.

$$q = RI^2$$

Method of data evaluation:

fit of the parameters specific heat and thermal diffusivity;

thermal conductivity, $\lambda = ac_p\rho$

**Figure 1.** (a) Experimental arrangement of the pulse transient method (Kubičár 1990). (b) Temperature response, $T(t)$, sensitivity coefficient of thermal diffusivity, $\beta_a$, and sensitivity coefficient of specific heat, $\beta_c$, for the pulse transient method. (c) Experimental arrangement of the stepwise transient method (Kubičár and Boháč 1999). (d) Temperature response and sensitivity coefficients for the stepwise transient method.
pulse transient and the stepwise transient methods, respectively, when stainless steel A310 was measured. In the case of Perspex, the energy of the heat pulse and the heat outputs of the heat source within \((5 \pm 10) \times 10^4 \text{ J m}^{-2}\) and \(300 \pm 700 \text{ W m}^{-2}\) for the pulse transient and the stepwise transient methods, respectively. It is assumed that the disturbance induced by the heat source does not influence the thermodynamic state of the studied material.

2.1 Specimen material

The choice of material for intercomparison measurements is a critical issue as reference values of thermophysical parameters need to be taken from various sources. Thermophysical parameters are strongly influenced by the technology of material preparation. Usually, there is poor information regarding material preparation. This makes intercomparison more difficult, especially for transient methods where all three thermophysical parameters can be obtained. Usually, the only technological parameter known that can be used is the density when different sources are used. It should be noted that additional parameters like purity, heat treatment, etc, have to be considered, too. Perspex and stainless steel A310 provided by the National Physical Laboratory (NPL), UK, were used for our experiments. The materials are used as standard reference materials for thermal conductivity. While a full set of thermophysical parameters for stainless steel A310 is taken from NPL \([\rho = 7902 \text{ kg m}^{-3}, a = 3.45 \times 10^{-6} \text{ m}^2 \text{ s}^{-1}, \lambda = 12.8 \text{ W m}^{-1} \text{ K}^{-1}, c_p = 471 \text{ J kg}^{-1} \text{ K}^{-1}\) (Corsan et al 1991), the specific heat and thermal diffusivity values of Perspex are taken from literature (Vasiliev and Tanajev 1971). These authors published a detailed study of the thermophysical properties of polymethylmethacrylate of different densities using a variant of the transient method. An agreement in thermal conductivity between the data recommended by NPL \((\lambda = 0.192 \text{ W m}^{-1} \text{ K}^{-1})\) and the data given by Vasiliev and Tanajev (1971) was found, for the same density \((\rho = 1184 \text{ kg m}^{-3})\). Then, values of the specific heat \((c_p = 1460 \text{ kg}^{-1} \text{ K}^{-1})\) and the thermal diffusivity \((a = 0.1105 \times 10^{-6} \text{ m}^2 \text{ s}^{-1})\) that correspond to the density \(\rho = 1184 \text{ kg m}^{-3}\) were taken from the work of Vasiliev and Tanajev (1971).

2.2 Experimental arrangement

The diameter of the specimen is 30 mm for Perspex and 20 mm for stainless steel A310. The specimen is cut into three pieces (figure 2). The heat source is made of nickel foil of thickness 20 µm and diameter 30 mm or 20 mm. The electrical resistance of the heat source was \(\sim 1.5 \Omega\). The heat source is prepared in the form of meander, shown in figure 2. A Chromel–Alumel thermocouple of thickness 50 µm is placed at a distance 6 mm from the heat source for stainless steel A310 and at 5 mm for Perspex. The thermocouple is placed into a groove \((\sim 0.2 \text{ mm})\) that is ground into the third part of the specimen.

![Figure 2. Specimen set (in 3 pieces). A part of the specimen is cut to show the form of the heat source.](image-url)
(see figure 1). A varnish covers the thermocouple and heat source for experiments with stainless steel A310. Both the heat source and the thermocouple are placed between the cut surfaces. A heat sink paste (Midland Silicones, Barry, Glamorgan, UK) is used to improve the thermal contact between the individual parts of the specimen set. The same specimen setup was used for both pulse transient and stepwise transient methods.

2.3 Measurement

A Thermophysical Transient Tester Model RT 1.02 (Institute of Physics, SAS) was used for measurement of the thermophysical parameters. The instrument was originally designed for the pulse transient measuring technique. Software was implemented to add measurements by the stepwise transient method. The measuring cycle consists of the following operation: measurement of the specimen temperature at isothermal conditions followed by generation of the dynamic temperature field and scanning of the temperature response, and finally the stabilisation of the specimen temperature. The measuring time (time period during which the temperature field is generated and the temperature response is scanned) and the length of the measuring cycle (time period between two consecutive measurements that includes measuring time and stabilisation) are important experimental parameters. The measuring time was 30 s for stainless steel A310 and 300 s for Perspex. The length of the measuring cycle was 20 min for stainless steel A310 and 30 min for Perspex. This was the time needed to restore isothermal conditions after the transient heating. Variations in the energies and in the lengths of the heat pulse for the pulse transient as well as in the heat output of the heat source for stepwise transient methods were used. Typical heat pulse lengths of 1 s and 10 s were used for stainless steel A310 and Perspex, respectively. Formulas given in figure 1 were used for calculation of the thermal diffusivity, specific heat, and thermal conductivity by the pulse transient method. A fitting procedure in the time window 10–22 s for stainless steel A310 and 75–225 s for Perspex was used to estimate the thermal diffusivity and specific heat for the stepwise transient method. A sequence of data was obtained for every combination of heat pulse energy and the surrounding atmosphere for the pulse transient technique and heat output of the heat source and surrounding atmosphere for the stepwise transient technique. Different surrounding conditions were used to check the influence of the specimen surfaces on the measuring process. The measurements were performed in the isothermal regime at temperature 25°C. Reassembling was used to test the reproducibility of the specimen setup.

2.4 Measurement error

Two groups of error components exist, namely components that shift data systematically and components that cause data scattering. The former group plays a predominant role. This group is responsible for data differences found in intercomparison by different methods and various laboratories. In practice, even when data scattering is low, the data shift might be considerable. The data consistency relationship \( (\lambda = ac_p\rho) \) might be not fulfilled because of data shift when methods that give only one parameter are used.

An intercomparison is a key strategy to improve data reliability. The use of an ideal experimental arrangement corresponding to the ideal model is a prerequisite of the intercomparison. Carrying out the measurements according to the ideal model gives data with zero error. Deviations exist from the ideal model due to the actual experimental arrangement. Any deviation from the ideal model causes a shift of the experimental data. Table 1 gives a comparison of the ideal model and the actual experimental setup for both pulse transient and stepwise transient methods. The analysis of the temperature functions corresponding to the real experimental arrangement gives the criteria which determine when ideal model is achieved (Kubičár and Bohač 1996). The criteria for the pulse transient method are given in figure 3. Actual values of characteristic parameters for Perspex and stainless steel A310 are given in table 2. When the criteria valid
for the length of the heat pulse are not fulfilled, then measured data need to be corrected by the use of $a = a_{\exp}/f_a$ and $c = c_{\exp}/f_c$, where $a_{\exp}$ and $c_{\exp}$ are measured data of thermal diffusivity and specific heat. The correction factors $f_a$ and $f_c$ depend on $t_{m}/t_0$ (where $t_m$ and $t_0$ are the times of maximum of the temperature response and the width of the heat pulse, respectively) and their values can be calculated according to relationships given elsewhere (Kubicár 1990).

Criteria for the ideal model for the stepwise transient method are not yet known. It is reasonable to assume that criteria regarding specimen size and the heat source parameters could be similar to those specified in figure 3. However, a set of solutions of the partial differential equation with various boundary and initial conditions that corresponds to the real experimental arrangement has to be found to obtain a precise picture of the stepwise transient measuring process.

![Figure 3. Criteria of the ideal model for the pulse transient method.](image)

**Table 1.** Comparison of the ideal model and the experimental setup for the pulse transient and stepwise transient methods.

<table>
<thead>
<tr>
<th>Ideal arrangement</th>
<th>Real arrangement</th>
<th>Criteria of reliable data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonlimited specimen</td>
<td>Limited specimen</td>
<td>Influence of the heat loss from the specimen surface should be limited</td>
</tr>
<tr>
<td>Negligible thickness of the heat source. Material of the heat source and the specimen are the same.</td>
<td>Thickness of the heat source is relevant. Heat source is made of metal that usually has different thermophysical parameters from the specimen.</td>
<td>Heat capacity of the heat source should be negligible in comparison to the specimen</td>
</tr>
<tr>
<td>Ideal thermal contact between the heat source and the specimen exists</td>
<td>Non-ideal thermal contact exists between the heat source and the specimen</td>
<td>Thermal contact resistance should be negligible in comparison to the thermal resistance of the specimen</td>
</tr>
<tr>
<td>Negligible mass of the thermometer made of the same material as the specimen</td>
<td>Thermometer has mass and is made of different material from the specimen</td>
<td>Heat capacity of the thermometer should be negligible</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Setup</th>
<th>Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specimen size</td>
<td>$h &lt; 0.4R$, $hH/\lambda &lt; 0.1$, $h_{111} &gt; 1.4h$</td>
</tr>
<tr>
<td>Heat source</td>
<td>$\frac{h{c_p}\rho}{2b\kappa_{sp}f_0} &gt; 500$, $h\kappa/\lambda &gt; 1$</td>
</tr>
<tr>
<td>Heat pulse width</td>
<td>$t_0 &lt; 0.1t_m$</td>
</tr>
</tbody>
</table>
The criteria listed in table 2 follow from the theory (Kubicár 1990). Our experiment represents a system with many parameters. Clearly, reliable data can be obtained only within some range of these parameters. A critical comparison of the theoretical analysis with the experimental data gives the desired range of the experimental parameters.

### 3 Results and discussion

#### 3.1 Perspex

Typical data for different data sequences are shown in figure 4. The energies of the heat pulse are plotted in the upper part, the thermal diffusivity in the middle, and the specific heat at the bottom as a function of the time. Figure 4 includes all data that were obtained as a result of variations of the heat pulse energy, reassembling, and the surrounding atmosphere (air, vacuum). Low data scattering was found for higher energies of the heat pulse. A high ratio of the signal (temperature response) to temperature drift can be achieved for higher energies of the heat pulse. Instabilities of the first points just after the change of the energy of the heat pulse can be found. This is connected with the length of the measuring cycle. The longer the measuring cycle, the smaller the instabilities that can be achieved. Variations of data due to reassembling of the specimen set are shown. Averaged values and standard deviations are plotted in figure 5 as a function of the sequence number: in the upper part for the thermal diffusivity, in the middle for the specific heat, and at the bottom for the thermal conductivity. The data shown in figure 5 are corrected with regard to heat pulse length (Kubicár 1990), whereas the data in figure 4 are shown without any correction. Averaging was carried out upon data that were obtained at the same heat pulse energy. Variations of experimental conditions are marked in figure 5. Small variations of the averaged values, especially for specific heat, exist because of the increase of the energy of the heat pulse. The data show a negligible variation due to environment (air, vacuum). This means that specimen surface does not influence the measuring process. The error bar for the thermal diffusivity represents 4%, for the specific heat 3%, and for the thermal diffusivity 5%, indicating the precision

### Table 2. Values of characteristic parameters for Perspex and stainless steel A310.

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Stainless steel A310</th>
<th>Perspex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specimen size</td>
<td>( h = 6, R = 10, h = 0.6R )</td>
<td>( h = 5, R = 15, h = 0.33R )</td>
</tr>
<tr>
<td>Heat source</td>
<td>( \frac{h c_r \rho}{2b c_{p0} \rho_0} = 135 )</td>
<td>( \frac{h c_r \rho}{2b c_{p0} \rho_0} = 61 )</td>
</tr>
<tr>
<td>Heat pulse width</td>
<td>( \frac{h \alpha}{\lambda} = 160 )</td>
<td>* ( h \alpha/\lambda = 1200 )</td>
</tr>
</tbody>
</table>

*estimated value

The criteria listed in table 2 follow from the theory (Kubicár 1990). Our experiment represents a system with many parameters. Clearly, reliable data can be obtained only within some range of these parameters. A critical comparison of the theoretical analysis with the experimental data gives the desired range of the experimental parameters.
of the experimental setup. The error bar represents the imperfection of the instrument used in measurements of the energy of the heat pulse and the maximum of the temperature response ($t_m$ and $T_m$—see figure 1) and the uncertainty in the estimation of the specimen thickness. The predominant part of this error is caused by the uncertainty due to the groove in which the thermocouple is placed (Kubicár 1990). While data variation due to change of the surrounding atmosphere is within the indicated error bar, reassembling causes data shifts that are slightly outside the error bar, especially for the

![Graph showing heat pulse energy, thermal diffusivity, and specific heat of Perspex as a function of time. Specimen temperature $T = 25^\circ$C.](image)

**Figure 4.** Heat pulse energy, thermal diffusivity, and specific heat of Perspex as a function of time. Specimen temperature $T = 25^\circ$C.

![Graph showing thermal diffusivity, specific heat, and thermal conductivity of Perspex as a function of the measurement sequence. Specimen temperature $T = 25^\circ$C.](image)

**Figure 5.** Thermal diffusivity, specific heat, and thermal conductivity of Perspex as a function of the measurement sequence. Specimen temperature $T = 25^\circ$C.
specific heat and the thermal conductivity. This stressed the importance of the thermal contacts between the individual parts of the specimen set. Usually, the quality of the thermal contact is changed as a consequence of reassembling.

A similar procedure was chosen for the stepwise transient. We (Kubičár and Boháč 2000) have published details of this measuring technique. Analysis of the data set that was obtained for different heat outputs of the heat source, reassembling, and a change of the surrounding atmosphere (air, vacuum) in a similar way as in figure 4 gives variations caused by the different experimental conditions. Data shifts due to a change of the surrounding atmosphere are higher than for the pulse transient technique. The heat loss from the specimen surface influences the measuring process.

Finally, the mean values and standard deviation of the thermal diffusivity, specific heat, and thermal conductivity were obtained by averaging all data, excluding values that showed large shifts for both the pulse transient and stepwise transient. Data given in figure 6 represent values of thermophysical parameters given by the pulse transient and the stepwise transient together with the recommended and published values. The error bars characterising the precision of the experimental setup are shown again. Bars connected with the experimental data represent statistics caused by the temperature instability during the measuring process, the change of the surrounding atmosphere (vacuum, air), and the reassembling. However, shifts of experimental data for both the pulse transient and the stepwise transient methods can be found. This indicates that discrepancies still existence between the model and the experimental setup. Error bars characterising statistics are larger for the stepwise method than for the pulse transient one. Clearly, the evaluation procedure still needs to be improved for the stepwise transient method in order to decrease the data scattering.

Figure 6. Intercomparison of data on Perspex given by the pulse transient, the stepwise transient method, NPL (Salmon 1999), and the literature (Vasiliev and Tanajev 1971). Specimen temperature $T = 25 \, ^\circ\text{C}$.

3.2 Stainless steel A310

The analysis was performed in a similar way as in the previous case. Similar types of figures to figures 4 and 5 were constructed to find the influence of the heat pulse energy and the surrounding atmosphere (air, vacuum) on experimental data for the pulse transient method and the heat output of the heat source and different surrounding
atmospheres for the stepwise transient method. The reproducibility of the experimental setup was tested on reassembling. Again, mean values and standard deviations of the thermophysical parameters were calculated excluding data that showed large shifts. Data obtained by the pulse transient and the stepwise transient methods are intercompared with recommended values given by NPL (Corsan et al 1991) in figure 7. Error bars characterising the precision of the experimental setup in this case are smaller than for Perspex because of the different specimen thickness. The thickness of Perspex is 5 mm and for stainless steel A310 6 mm. However, data shifts for stainless steel A310 are higher than for Perspex. Discrepancies between the model and the experimental setup are larger. Differences in data shifts for Perspex and for stainless steel A310 can be found. While transport parameters (thermal diffusivity and thermal conductivity) for Perspex are distributed around the recommended and published values, data for stainless steel A310 are clearly shifted to lower values. Data on the specific heat show the opposite tendency, i.e., data are distributed around recommended values for stainless steel A310 while data for Perspex are clearly shifted to lower values. Differences in data shifts of the transport parameters are caused by the thermal contacts (Kubičár 1990). Additional experiments are required to find arguments for the differences in data shifts of the specific heat.

Figure 7. Intercomparison of data on stainless steel A310 given by pulse transient, stepwise transient, and NPL (Corsan et al 1991). Specimen temperature $T = 25^\circ C$.

4 Conclusions

Data on the thermophysical parameters of Perspex and stainless steel A310, namely the specific heat, thermal diffusivity, and thermal conductivity, measured by the pulse transient and the stepwise transient methods, were intercompared with published and recommended values. Variation of the experimental parameters such as the surrounding atmosphere (air, vacuum), different heat pulse energies and reassembling was carried out. The output of heat from the heat source, reassembling, and the surrounding atmosphere were varied when the stepwise transient method was used. Different shifts from the recommended and published data and various scatters of data were found (figures 6 and 7).
Data shifts were significantly lowered by improvements in the experimental technique and in the evaluation procedure, when one compares our previous work (Kubičář and Boháč 1999). The analysis of the sensitivity coefficients and correlation in combination with the difference analysis improved the evaluation strategy (Kubičář and Boháč 2000). However, deviations from the recommended and published data still exist. The following reasons for these deviations can be identified:

A clear indication exists that the thermophysical data depend on specimen thickness $h$ for Perspex. This fact was experimentally tested with two specimen sets with diameter 30 mm and thickness in the range 2 – 10 mm and one specimen set with diameter 20 mm and thickness in the range 2 – 8 mm. In addition, previously published data by Kubičář (1990) showed, again, thickness dependence. Similar thickness dependence of Perspex was found by Koniorczyk and Zmywaczyk (1996) using the guarded hot-plate technique. A radiation mechanism was active during the measuring process, according to them. Thus, two different measuring techniques (pulse transient and guarded hot-plate techniques) and three different material sources of Perspex indicate that a thickness dependence of the thermophysical data exists. The present data on Perspex correspond to specimen thickness $h = 5$ mm. A detailed study of this effect that will include the stepwise transient method is in preparation.

Transport parameters (thermal diffusivity and thermal conductivity) of stainless steel A310 are shifted to lower values than the recommended data. Thermal contacts are responsible for the data shift when materials with high thermal conductivity are measured (Kubičář 1990). However, a detailed study of the influence of the thermal contact on transport parameters should be performed when the pulse transient and stepwise transient techniques are used. The results of this study should indicate a strategy for the elimination of the data shift as well as a limit of the thermal conductivity range of materials that can be investigated by the transient pulse and stepwise transient techniques.

Data reliability depends on intercomparison measurements with a combination of steady state (ie guarded hot-plate method), equilibrium (ie adiabatic calorimetry), and dynamic measurement techniques (ie flash, stepwise, transient methods, etc). Then, the data consistency relationship $\lambda = \alpha c_p \rho$, where $\rho$ is density, has to be fulfilled. This is a critical point when one looks for data to perform intercomparison measurements. Data consistency relationship is valid for heat transport that obeys the Fourier law. Otherwise, data discrepancies can be found.

The data given in figures 6 and 7 indicate a difference between the model and the experiment. A set of possible corrections can be used to improve the agreement between the measured data and published and recommended values (Kubičář 1990). However, any correction includes additional parameters that cannot be intercompared (ie thermal contact conductance, heat loss coefficient, heat capacity of the heat source, etc). A strategy of intercomparison was chosen in which the ideal model of the method is considered, to obtain as close agreement as possible. It is clear that, in the final stage, more complicated temperature functions should be used, which include suitable corrections.

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